PATIENT SAFETY

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LETTER
From the Editor

Regina Hoffman,
Editor-in-Chief
Patient Safety

Hello, 2026!

As we enter the new year, let's talk about newness, specifically as it relates to academic writing. Novelty is one of the most important criteria when deciding whether a manuscript is worthy of publication. After all, if someone is going to spend time reading a paper, they want to discover something they didn't already know.

But uncovering new insights, particularly on long-standing issues, is no easy task. With millions of academic papers published *every single year*, how do you tell new stories about old problems?

Two Patient Safety Authority (PSA) researchers did exactly that. Their study, the first of its kind, uncovered that one of the riskiest times for a patient to fall is during discharge. In fact, they found that patients were 2.5 times more likely to be injured due to a fall during the discharge process than at any other time during their hospital stay—opening an opportunity to rethink prevention strategies.

Similarly, PSA researchers took a fresh look at wrong drug events, errors that continue to happen every year despite significant collective effort to prevent them. The team drilled down using previously unpublished granularity, bringing us one step closer to stopping these events for good.

Other researchers focused on emerging topics. One PSA researcher investigated the impact of artificial intelligence on patient safety events: not only what we are seeing today but what we might expect to see in the future.

I invite you to explore these articles and many more as you plan for the year ahead. Let's make 2026 a year of innovation, discovery, and meaningful progress in patient safety.

Cheers!

ABOUT *PATIENT SAFETY*

As the journal of the Patient Safety Authority, committed to the vision of "safe healthcare for all patients," *Patient Safety* (ISSN 2689-0143) is fully open access and highlights original research, advanced analytics, and hot topics in healthcare.

The mission of this publication is to inform and advise clinicians, administrators, and patients on preventing harm and improving safety, by providing evidence-based, original research; editorials addressing current and sometimes controversial topics; and analyses from one of the world's largest adverse event reporting databases.

We invite you to submit manuscripts that align with our mission. We're particularly looking for well-written original research articles, reviews, commentaries, case studies, data analyses, quality improvement studies, or other manuscripts that will advance patient safety.

 The current issue is available at patientsafetyj.com.

The patient is central to everything we do. *Patient Safety* complies with the Patients Included™ journal charter, which requires at least two patient members on the editorial board; regular publication of editorials, reviews, or research articles authored by patients; and peer review by patients.

Articles are published online on a rolling basis throughout the year. Selected articles are published in a special print issue and online each January.

Articles accepted for publication do not necessarily reflect practices or opinions endorsed by the Patient Safety Authority.

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Long-Term Care Healthcare-Associated Infections in 2024:

An Analysis of 26,501 Reports

By **Shawn Kepner**, MS*[1], **JoAnn Adkins**, BSN, RN[1] & **Rebecca Jones**, MBA, RN[1]

Keywords: long-term care, nursing homes, annual report, healthcare-associated infections, HAI, Infection rates, resident days

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Abstract

Background: The Pennsylvania Patient Safety Reporting System (PA-PSRS) is the largest repository of patient safety data of its kind in the United States. The PA-PSRS database contains over 5 million reports, including more than 448,000 long-term care (LTC) healthcare-associated infection (HAI) reports.

Methods: LTC HAI data from PA-PSRS were extracted on March 1, 2025. Infection counts were calculated based on report submission date, and rates were calculated based on infection confirmation date. Reports from LTC facilities and specific care areas were included in rate calculations if resident and device days were also entered in PA-PSRS for the corresponding month.

Results: In 2024, Pennsylvania's LTC facilities submitted 26,501 infection reports to PA-PSRS, which is a 10.6% increase over the prior year and the third consecutive annual increase. The overall infection rate was 1.08 infections per 1,000 resident days, representing a 9.1% increase from 2023. The 2024 rate also established a significant three-year upward trend since the low point of 0.77 in 2021 (R^2=0.998, p=0.0011). All six regions of the state had an increase in infection rate. The overall infection rate increased due to rising rates across all infection types, except for device-related bloodstream infections.

Conclusion: In 2024, there was a rise in both the number of infection reports submitted to PA-PSRS and the overall infection rate. This third consecutive annual increase may be associated with enhanced surveillance and reporting in Pennsylvania's LTC facilities stemming from the Patient Safety Authority's intensive outreach and educational efforts.

Introduction

The Pennsylvania Patient Safety Reporting System (PA-PSRS)[a] is the largest repository of patient safety data of its kind in the United States. In addition to over 5 million patient safety event reports from hospitals, ambulatory surgical facilities, abortion facilities, and birthing centers, the PA-PSRS database contains more than 448,000 long-term care (LTC) healthcare-associated infection (HAI) reports submitted since 2009.

Methods

The LTC data from PA-PSRS were extracted on March 1, 2025, to allow extra time for calculating rates based on resident and device utilization days. Report counts for infections are based on the report submission date, while overall infection rates are calculated per 1,000 resident days using the infection confirmation date. Rates for infections associated with urinary catheters and central lines are calculated per 1,000 urinary catheter days or 1,000 central line days, respectively. Reports from LTC facilities and specific care areas were included in rate calculations if resident and device days were entered in PA-PSRS for the corresponding month. Unless otherwise stated, statistical results are presented at a 0.05 significance level.

Results

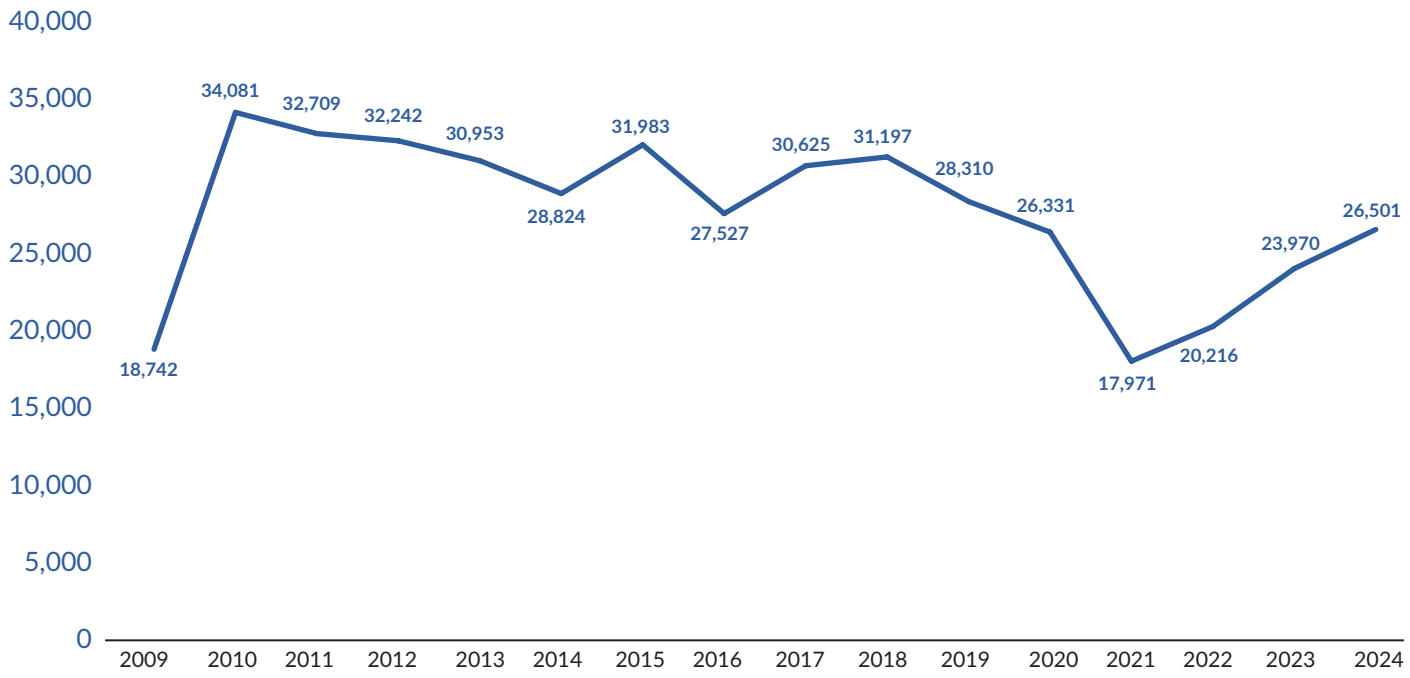
Pennsylvania's LTC facilities submitted 26,501 infection reports to PA-PSRS in 2024, which is a 10.6% increase over the prior year and the third consecutive annual increase (see **Figure 1**). As shown in **Figure 2**, the overall infection rate in 2024 was 1.08 infections per 1,000 resident days, representing a 9.1% increase from 2023. The 2024 rate also established a significant three-year upward trend since the low point of 0.77 in 2021 (R^2=0.998, p=0.0011).

Figure 3, which displays infection rates by region, shows that all six regions of the state had an increase in infection rate from 2023 to 2024. The Northeast region had the highest infection rate in 2024, with 1.53 reports per 1,000 resident days, and the Southeast region had the lowest rate, at 0.79. The distribution of LTC infection reports and infection rates by region are shown in **Table 1**.

LTC Healthcare-Associated Infections

LTC facility reports submitted to PA-PSRS are classified into five main infection types (see **Figure 4**). For the last four years, skin and soft tissue infections (SSTIs) were the most frequently reported, followed by urinary tract infections (UTIs) and respiratory tract infections (RTIs). These three infection types have increased each year since 2021. The largest annual percentage increase in 2024 occurred with the respiratory tract infection type.

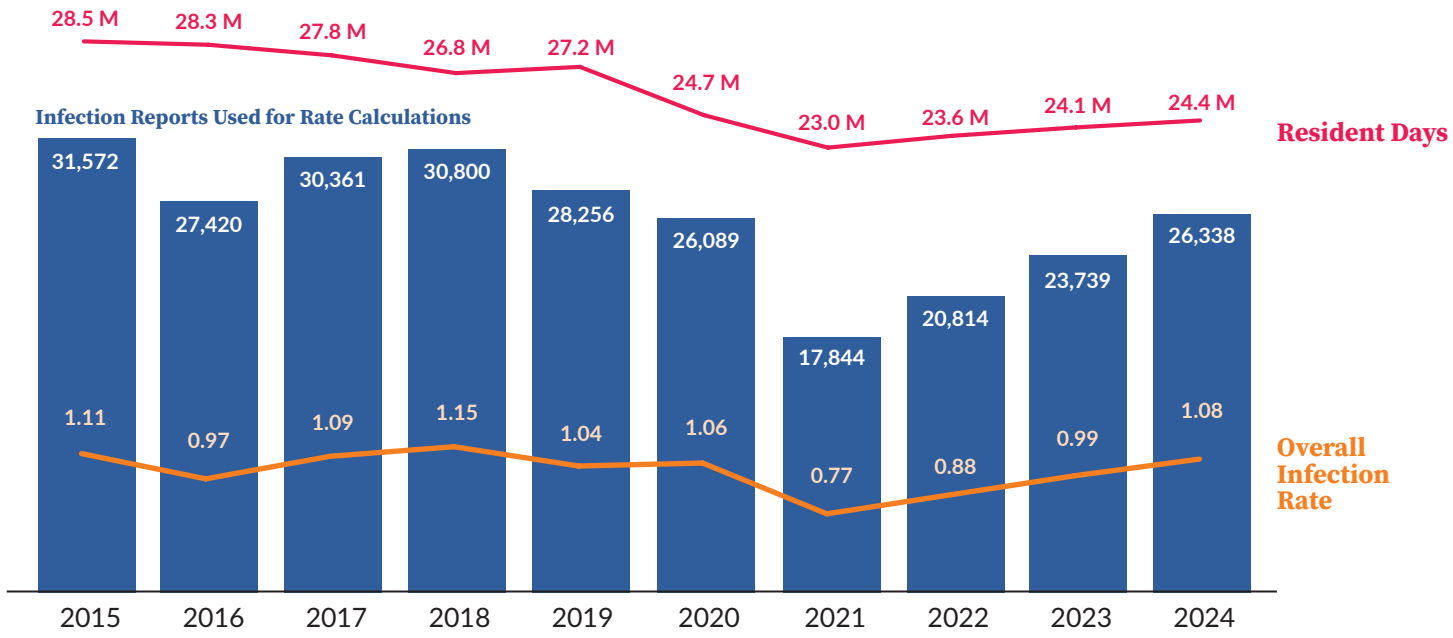
Figure 1. LTC Infection Reports Submitted to PA-PSRS by Year



Note: Numbers shown for previous years may differ from past publications due to newly received data or revisions made by reporting facilities after the prior data cutoff date.

[a]PA-PSRS is a secure, web-based system through which Pennsylvania long-term care facilities submit reports of healthcare-associated infections in accordance with mandatory reporting laws outlined in the Medical Care Availability and Reduction of Error (MCARE) Act (Act 52 of 2007).[1] All reports submitted through PA-PSRS are confidential and no information about individual facilities or providers is made public.

Figure 2. PA-PSRS LTC Infection Reports, Resident Days, and Overall Infection Rates per 1,000 Resident Days by Year



Note: The number of infection reports shown for each year is based on the infection confirmation date, rather than the report submission date, ensuring alignment with the time frame in which resident days occurred. Reports were excluded from the rate calculations if a facility did not report resident days for the corresponding month. Numbers and rates shown for previous years may differ from past publications due to newly received data or revisions made by reporting facilities after the prior data cutoff date.

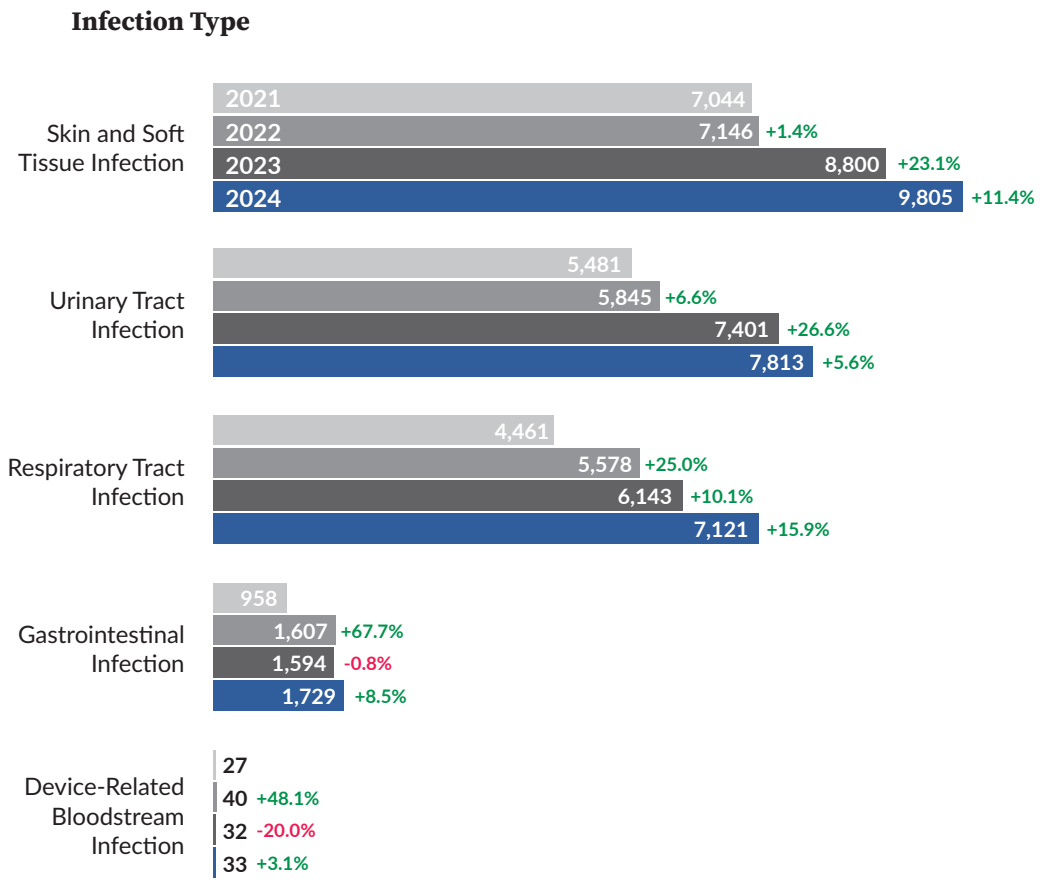
Figure 3. PA-PSRS LTC Infection Rates per 1,000 Resident Days by Region—2023 Versus 2024

Table 1. PA-PSRS LTC Infection Reports and Infection Rates per 1,000 Resident Days by Region

Region	2023 Infection Reports	2023 Rate per 1,000 Resident Days	2024 Infection Reports	2024 Rate per 1,000 Resident Days
North Central	1,866	1.24	2,244	1.50
Northeast	4,112	1.31	4,929	1.53
Northwest	2,281	1.09	2,395	1.13
South Central	3,493	1.10	3,774	1.15
Southeast	6,875	0.72	7,614	0.79
Southwest	5,112	1.10	5,382	1.16
Total	**23,739**	**0.99**	**26,338**	**1.08**

Note: The number of infection reports shown for each year is based on the infection confirmation date, rather than the report submission date, ensuring alignment with the time frame in which the resident days occurred. Reports were excluded from the rate calculation if a facility did not report resident days for the corresponding month. Numbers and rates shown for previous years may differ from past publications due to newly received data or revisions made by reporting facilities after the prior data cutoff date.

Figure 4. LTC Infection Reports Submitted to PA-PSRS by Infection Type and Year



Note: Numbers shown for previous years may differ from past publications due to newly received data or revisions made by reporting facilities after the prior data cutoff date.

LTC Healthcare-Associated Infection Subtypes

Table 2 shows the number of reports submitted for all infection subtypes for the past four years. In 2024, the most frequently reported subtype was cellulitis, soft tissue, or wound infection, followed by symptomatic urinary tract infection (SUTI) and pneumonia. This ranking has remained consistent for the past three years. Among the 14 infection subtypes, 13 had an increase in the number of reports submitted in 2024 compared to 2023. Influenza showed the largest increase, with 795 more reports (+130.5%). The only subtype that declined was influenza-like illness, but the decrease was minimal, with just five fewer reports.

Care Area

Table 3 shows the distribution of reports submitted in 2024 by infection type and care area. Skilled nursing/short-term rehabilitation units accounted for the largest proportion of infections (34.6%; 9,158 of 26,501). SSTIs were the most commonly reported infection type across all care areas, except in ventilator-dependent units, where RTIs were the most frequent. **Table 4** shows the distribution of infection reports submitted in 2024 by infection subtype and care area. The largest concentration of reports was seen with cellulitis, soft tissue, or wound infection in skilled nursing/short-term rehabilitation units.

LTC Healthcare-Associated Infection Rates

Figure 5 shows rates per 1,000 resident days for the five main infection types for 2021 through 2024. In 2024, the overall infection rate increased due to rising rates across all infection types, except for device-related bloodstream infections.

Figure 6 and **Table 5** display rates for each infection subtype for 2021 through 2024. The influenza infection subtype saw the largest increase from 2023 to 2024 in both number and percentage, rising from 0.023 to 0.056 reports per 1,000 resident days, representing a 143.5% increase. The only decrease was with CLABSI, for which the rate dropped by 0.015 points or 15.8%.

Table 6 displays infection rates by year based on care area and infection subtype. From 2023 to 2024, the largest percentage increases in rates were seen in bacteriologic gastroenteritis within dementia units (+320%) and mixed units (+250%), as well as influenza in skilled nursing/short term rehabilitation units (+176.6%).

Figure 7 and **Table 7** display infection rates for seasonal infection subtypes (i.e., influenza, influenza-like illness, pneumonia, lower respiratory tract infection [LRTI], and norovirus) by quarter from 2021 through 2024. These rates are calculated as the number of infections by quarter per 1,000 resident days. The rates for influenza, influenza-like illness, and pneumonia were highest in Q1 2024, while this quarter showed a lower rate for norovirus compared to Q1 in the prior two years.

Table 2. LTC Infection Reports Submitted to PA-PSRS and Percentage Distribution by Infection Subtype and Year

Infection Type	Infection Subtype	Number of Reports				% of Total				Change in Reports 2023 to 2024	
		2021	2022	2023	2024	2021	2022	2023	2024	Number	Percent
Skin and Soft Tissue Infection	Cellulitis, Soft Tissue, or Wound Infection	4,951	5,081	**6,212**	6,797	27.5%	25.1%	**25.9%**	25.6%	585	9.4%
	Conjunctivitis	1,957	1,937	**2,483**	2,894	10.9%	9.6%	**10.4%**	10.9%	411	16.6%
	Scabies	136	128	**105**	114	0.8%	0.6%	**0.4%**	0.4%	9	8.6%
Urinary Tract Infection	SUTI	4,288	4,589	**5,817**	6,144	23.9%	22.7%	**24.3%**	23.2%	327	5.6%
	CAUTI	1,052	1,087	**1,363**	1,411	5.9%	5.4%	**5.7%**	5.3%	48	3.5%
	ABUTI	141	169	**221**	258	0.8%	0.8%	**0.9%**	1.0%	37	16.7%
Respiratory Tract Infection	Pneumonia	3,004	3,005	**3,747**	3,917	16.7%	14.9%	**15.6%**	14.8%	170	4.5%
	LRTI	1,216	1,451	**1,608**	1,626	6.8%	7.2%	**6.7%**	6.1%	18	1.1%
	Influenza	201	1,058	**609**	1,404	1.1%	5.2%	**2.5%**	5.3%	795	130.5%
	Influenza-Like Illness	40	64	**179**	174	0.2%	0.3%	**0.7%**	0.7%	-5	-2.8%
Gastro-intestinal Infection	*C. diff*	883	854	**872**	941	4.9%	4.2%	**3.6%**	3.6%	69	7.9%
	Norovirus	70	730	**707**	754	0.4%	3.6%	**2.9%**	2.8%	47	6.6%
	Bacteriologic Gastroenteritis	5	23	**15**	34	0.0%	0.1%	**0.1%**	0.1%	19	126.7%
Device-Related Bloodstream Infection	CLABSI	27	40	**32**	33	0.2%	0.2%	**0.1%**	0.1%	1	3.1%
Totals		**17,971**	**20,216**	**23,970**	26,501	**100.0%**	**100.0%**	**100.0%**	100.0%	**2,531**	**10.6%**

Note: Numbers shown for previous years may differ from past publications due to newly received data or revisions made by reporting facilities after the prior data cutoff date.

SUTI = Symptomatic Urinary Tract Infection
CAUTI = Catheter-Associated Urinary Tract Infection
ABUTI = Asymptomatic Bacteremic Urinary Tract Infection
LRTI = Lower Respiratory Tract Infection
CLABSI = Central Line–Associated Blood Stream Infection

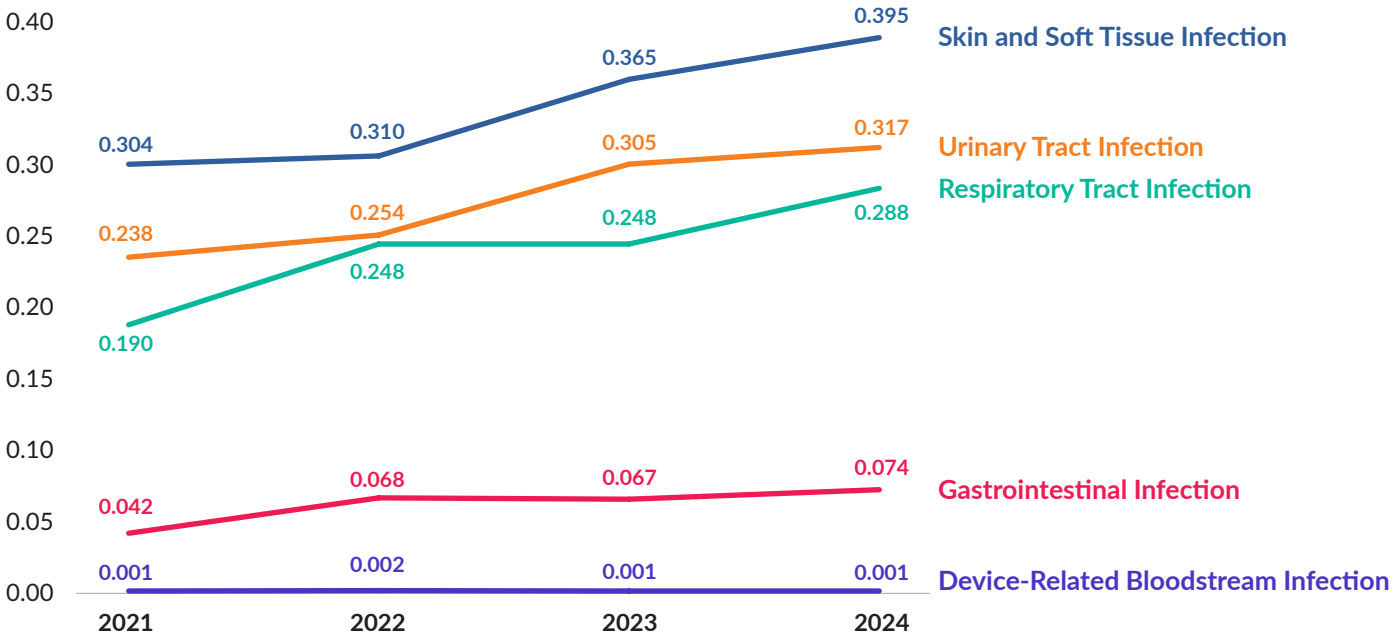
Table 3. LTC Infection Reports Submitted to PA-PSRS in 2024 by Infection Type and Care Area

Infection Type	Skilled Nursing/ Short-Term Rehabilitation Unit	Nursing Unit	Mixed Unit	Dementia Unit	Ventilator-Dependent Unit	Total
Skin and Soft Tissue Infection	3,281	3,074	2,727	637	86	**9,805**
Urinary Tract Infection	2,797	2,432	2,255	316	13	**7,813**
Respiratory Tract Infection	2,458	2,048	1,988	401	226	**7,121**
Gastrointestinal Infection	610	457	501	150	11	**1,729**
Device-Related Bloodstream Infection	12	13	8	0	0	**33**
Total	**9,158**	**8,024**	**7,479**	**1,504**	**336**	**26,501**

Table 4. LTC Infection Reports Submitted to PA-PSRS in 2024 by Infection Subtype and Care Area

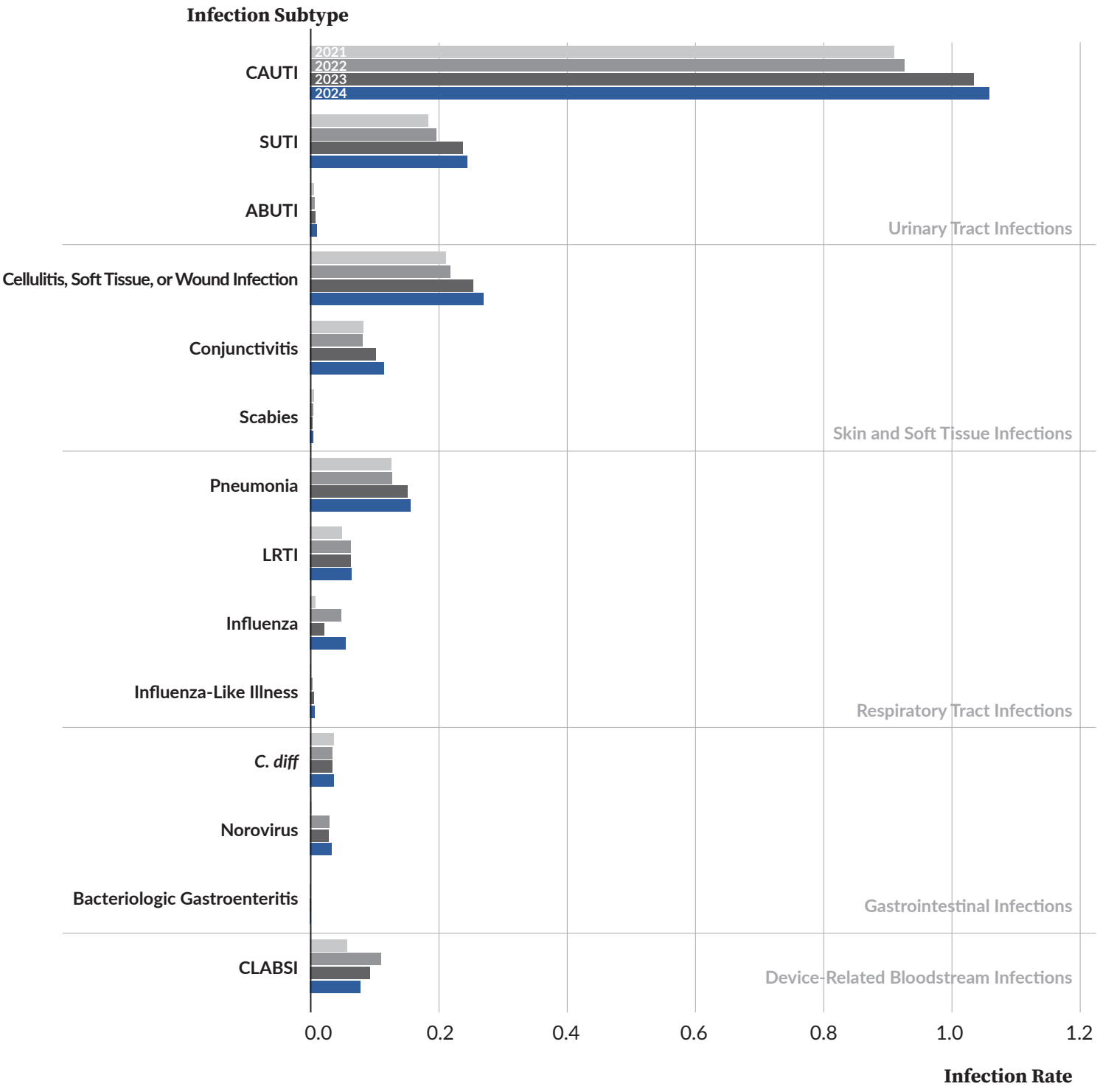
Infection Subtype	Skilled Nursing/ Short-Term Rehabilitation Unit	Nursing Unit	Mixed Unit	Dementia Unit	Ventilator-Dependent Unit	Total
Cellulitis, Soft Tissue, or Wound Infection	2,257	2,202	1,944	339	55	**6,797**
SUTI	2,202	1,920	1,754	263	5	**6,144**
Pneumonia	1,261	1,180	1,107	184	185	**3,917**
Conjunctivitis	983	832	760	288	31	**2,894**
LRTI	555	441	474	116	40	**1,626**
CAUTI	513	419	437	34	8	**1,411**
Influenza	560	404	372	68	0	**1,404**
C. diff	400	243	261	26	11	**941**
Norovirus	199	207	228	120	0	**754**
ABUTI	82	93	64	19	0	**258**
Influenza-Like Illness	82	23	35	33	1	**174**
Scabies	41	40	23	10	0	**114**
Bacteriologic Gastroenteritis	11	7	12	4	0	**34**
CLABSI	12	13	8	0	0	**33**
Total	**9,158**	**8,024**	**7,479**	**1,504**	**336**	**26,501**

Figure 5. PA-PSRS LTC Infection Rates per 1,000 Resident Days by Infection Type



Note: Rates shown for previous years may differ from past publications due to newly received data or revisions made by reporting facilities after the prior data cutoff date.

Figure 6. PA-PSRS LTC Infection Rates per 1,000 Resident or Device Days by Infection Subtype and Year



Note: Rates shown for previous years may differ from past publications due to newly received data or revisions made by reporting facilities after the prior data cutoff date.

Table 5. PA-PSRS LTC Infection Rates per 1,000 Resident or Device Days by Infection Subtype and Year in Descending Order by 2024 Rates

	Rates			
Infection Subtype	**2021**	**2022**	**2023**	**2024**
CAUTI	0.921	0.938	1.047	**1.071**
Cellulitis, Soft Tissue, or Wound Infection	0.215	0.221	0.257	**0.274**
SUTI	0.186	0.199	0.241	**0.248**
Pneumonia	0.128	0.130	0.154	**0.159**
Conjunctivitis	0.084	0.083	0.104	**0.117**
CLABSI	0.059	0.112	0.095	**0.080**
LRTI	0.051	0.064	0.065	**0.066**
Influenza	0.009	0.049	0.023	**0.056**
C. diff	0.038	0.036	0.036	**0.038**
Norovirus	0.003	0.031	0.030	**0.034**
ABUTI	0.006	0.007	0.009	**0.011**
Influenza-Like Illness	0.002	0.004	0.006	**0.007**
Scabies	0.006	0.005	0.004	**0.005**
Bacteriologic Gastroenteritis	0.000	0.001	0.001	**0.001**

Note: Rates shown for previous years may differ from past publications due to newly received data or revisions made by reporting facilities after the prior data cutoff date.

Table 6. PA-PSRS LTC Infection Rates per 1,000 Resident or Device Days by Care Area, Infection Subtype, and Year in Descending Order by Percentage Increase From 2023 to 2024 Within Each Care Area

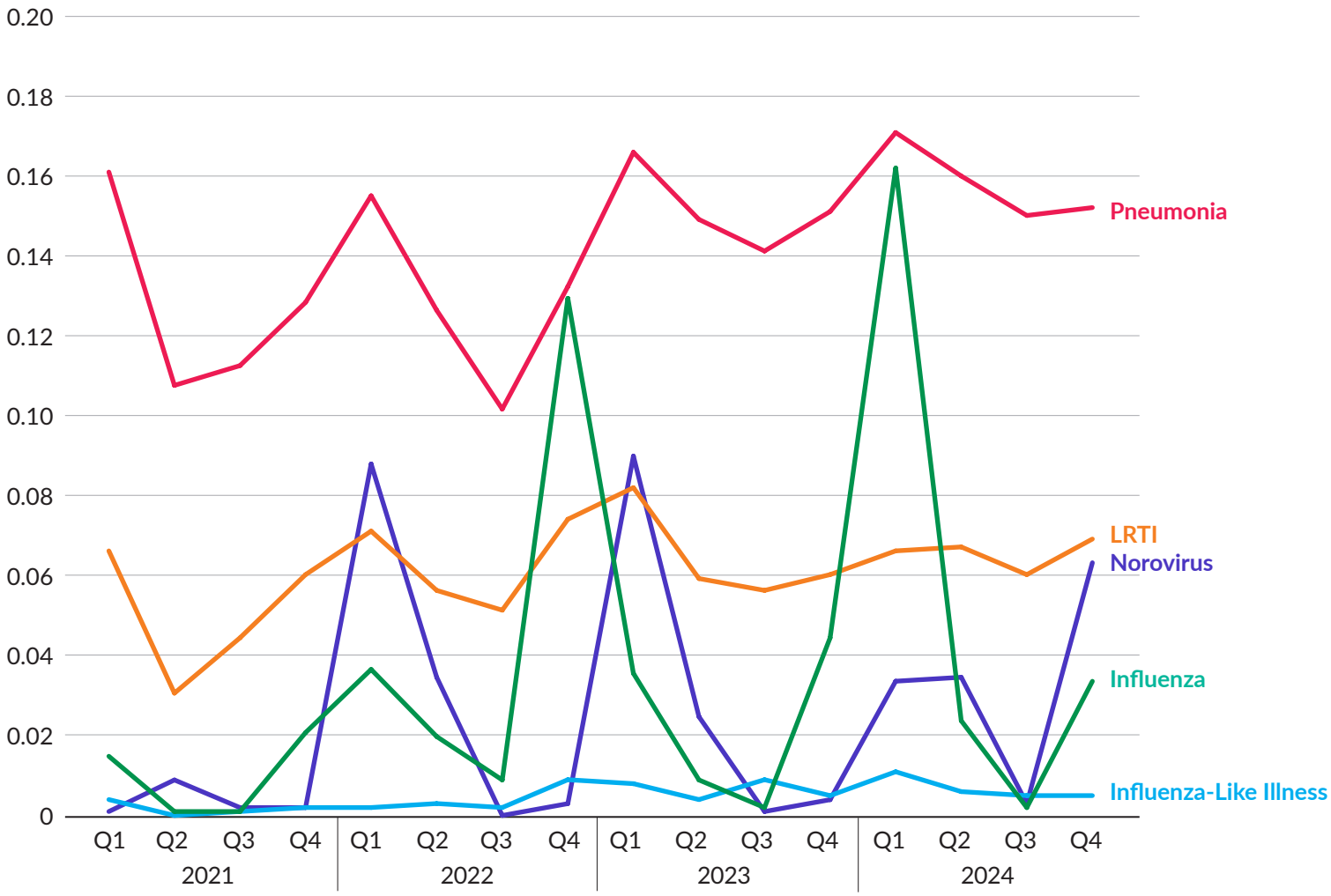
						% Change in Rate		
Care Area	**Infection Subtype**	**2021**	**2022**	**2023**	**2024**	**'21 to '22**	**'22 to '23**	**'23 to '24**
Dementia Unit	Bacteriologic Gastroenteritis	-	-	0.001	0.002	-	-	320.0%
	ABUTI	0.004	0.002	0.005	0.010	-51.2%	123.8%	112.8%
	Influenza	0.002	0.023	0.018	0.035	1004.8%	-22.8%	93.9%
	Norovirus	-	0.066	0.039	0.063	-	-41.6%	64.2%
	Influenza-Like Illness	0.001	0.002	0.013	0.017	90.9%	528.6%	31.8%
	Conjunctivitis	0.090	0.084	0.140	0.153	-6.6%	66.3%	8.8%
	Cellulitis, Soft Tissue, or Wound Infection	0.151	0.156	0.166	0.175	3.2%	6.4%	5.6%
	SUTI	0.107	0.130	0.132	0.137	20.7%	1.6%	4.3%
	Pneumonia	0.085	0.088	0.102	0.098	3.5%	16.1%	-3.7%
	LRTI	0.027	0.061	0.066	0.059	124.6%	8.7%	-11.3%
	Scabies	0.014	0.005	0.006	0.005	-66.2%	23.4%	-19.0%
	C. diff	0.012	0.012	0.018	0.014	-1.6%	52.1%	-22.8%
	CAUTI	0.451	0.975	0.991	0.712	116.1%	1.7%	-28.1%
	CLABSI	-	-	-	-	-	-	-
Mixed Unit	Bacteriologic Gastroenteritis	<0.0005	0.001	0.001	0.002	450.0%	-45.5%	250.0%
	Influenza	0.011	0.053	0.026	0.055	373.9%	-51.0%	112.0%
	Norovirus	0.003	0.014	0.029	0.044	400.0%	117.8%	49.0%
	LRTI	0.040	0.054	0.063	0.070	35.7%	17.4%	10.1%
	Conjunctivitis	0.088	0.087	0.110	0.112	-1.6%	26.2%	2.3%
	Cellulitis, Soft Tissue, or Wound Infection	0.228	0.231	0.281	0.284	1.7%	21.3%	1.1%
	SUTI	0.209	0.205	0.258	0.254	-2.0%	26.0%	-1.4%
	Pneumonia	0.123	0.136	0.162	0.160	10.6%	19.3%	-1.6%
	CAUTI	0.954	0.955	1.217	1.169	0.1%	27.5%	-3.9%
	C. diff	0.040	0.042	0.040	0.037	6.8%	-5.9%	-5.8%
	Scabies	0.006	0.003	0.004	0.003	-58.7%	42.3%	-8.1%
	ABUTI	0.006	0.008	0.014	0.010	35.1%	85.7%	-32.2%
	Influenza-Like Illness	<0.0005	0.004	0.007	0.004	1266.7%	70.7%	-38.6%
	CLABSI	0.052	0.100	0.162	0.073	94.8%	61.0%	-54.9%
Nursing Unit	Scabies	0.005	0.004	0.002	0.005	-27.1%	-40.0%	147.6%
	Influenza	0.005	0.051	0.021	0.050	837.0%	-59.3%	142.2%
	ABUTI	0.007	0.007	0.007	0.013	0.0%	1.4%	82.9%
	CLABSI	0.014	0.081	0.080	0.128	494.2%	-1.8%	60.7%
	Bacteriologic Gastroenteritis	-	0.001	0.001	0.001	-	-14.3%	50.0%
	Influenza-Like Illness	0.002	0.004	0.002	0.003	45.8%	-37.1%	40.9%
	CAUTI	0.855	0.959	0.858	1.064	12.2%	-10.5%	24.0%
	C. diff	0.028	0.025	0.025	0.031	-10.4%	0.8%	22.6%
	Conjunctivitis	0.071	0.072	0.087	0.104	0.8%	21.0%	19.4%
	Norovirus	0.006	0.035	0.024	0.029	494.9%	-31.9%	19.2%
	SUTI	0.162	0.187	0.207	0.245	15.4%	10.7%	18.6%
	Pneumonia	0.109	0.107	0.137	0.152	-2.0%	28.9%	10.5%
	Cellulitis, Soft Tissue, or Wound Infection	0.198	0.221	0.255	0.278	11.7%	15.3%	9.1%
	LRTI	0.042	0.055	0.056	0.057	30.3%	2.4%	1.1%

Table 6. (continued.)

Care Area	Infection Subtype	2021	2022	2023	2024	% Change in Rate '21 to '22	% Change in Rate '22 to '23	% Change in Rate '23 to '24
Skilled Nursing/ Short-Term Rehabilitation Unit	Influenza	0.014	0.053	0.025	0.070	280.6%	-52.4%	176.6%
	Bacteriologic Gastroenteritis	0.001	0.002	0.001	0.001	200.0%	-46.7%	75.0%
	ABUTI	0.006	0.008	0.009	0.011	43.9%	4.9%	24.4%
	Influenza-Like Illness	0.002	0.005	0.008	0.010	113.0%	69.4%	22.9%
	Conjunctivitis	0.083	0.084	0.104	0.124	0.4%	24.8%	18.9%
	Cellulitis, Soft Tissue, or Wound Infection	0.233	0.226	0.259	0.282	-2.9%	14.5%	8.8%
	C. diff	0.052	0.047	0.048	0.050	-9.5%	2.4%	4.4%
	Pneumonia	0.145	0.143	0.157	0.159	-1.4%	10.3%	1.0%
	LRTI	0.061	0.074	0.071	0.070	22.0%	-3.3%	-2.0%
	CAUTI	0.950	0.910	1.124	1.082	-4.2%	23.6%	-3.8%
	SUTI	0.214	0.225	0.290	0.277	5.1%	29.4%	-4.6%
	CLABSI	0.091	0.136	0.068	0.064	49.5%	-50.2%	-5.9%
	Scabies	0.005	0.010	0.007	0.005	119.6%	-29.7%	-23.9%
	Norovirus	0.002	0.034	0.034	0.026	1684.2%	0.6%	-25.2%
Ventilator-Dependent Unit	Pneumonia	1.037	1.062	1.105	1.302	2.4%	4.1%	17.8%
	Cellulitis, Soft Tissue, or Wound Infection	0.361	0.363	0.354	0.379	0.6%	-2.5%	7.1%
	Conjunctivitis	0.407	0.452	0.220	0.222	11.1%	-51.4%	1.0%
	CAUTI	1.440	0.828	0.276	0.276	-42.5%	-66.7%	0.1%
	LRTI	0.774	0.507	0.319	0.286	-34.5%	-37.1%	-10.2%
	C. diff	0.190	0.151	0.113	0.079	-20.8%	-24.8%	-30.5%
	SUTI	0.105	0.164	0.071	0.036	56.6%	-56.9%	-49.4%
	ABUTI	0.026	-	0.014	-	-100.0%	-	-100.0%
	Bacteriologic Gastroenteritis	-	-	-	-	-	-	-
	CLABSI	-	0.165	-	-	-	-100.0%	-
	Influenza	-	0.007	-	-	-	-100.0%	-
	Influenza-Like Illness	-	-	-	-	-	-	-
	Norovirus	-	-	-	-	-	-	-
	Scabies	-	-	-	-	-	-	-

Note: When a dash "-" appears in a cell within the table, it means that the rate is zero. If "<0.0005" appears in a cell, it means that the rate is greater than zero but would otherwise be shown as "0.000" due to rounding to three decimal places. When "-100.0%" appears in a cell, it means that the year to which that percentage reduction applies had a zero rate and the prior year had a nonzero rate. Rates shown for previous years may differ from past publications due to newly received data or revisions made by reporting facilities after the prior data cutoff date. Also, percentage increases and decreases were calculated using cell values with greater decimal expansions than what is displayed in the table to provide greater accuracy.

Figure 7. PA-PSRS LTC Infection Rates per 1,000 Resident Days Trending for Seasonal Infection Subtypes by Quarter



Note: Rates shown for previous years may differ from past publications due to newly received data or revisions made by reporting facilities after the prior data cutoff date.

Table 7. PA-PSRS LTC Infection Rates per 1,000 Resident Days for Seasonal Infection Subtypes by Quarter

	Influenza	Influenza-like Illness	LRTI	Norovirus	Pneumonia
2021 Q1	0.015	0.004	0.067	0.001	0.163
Q2	0.001	0.000	0.031	0.009	0.109
Q3	0.001	0.001	0.045	0.002	0.114
Q4	0.021	0.002	0.061	0.002	0.130
2022 Q1	0.037	0.002	0.072	0.089	0.157
Q2	0.020	0.003	0.057	0.035	0.128
Q3	0.009	0.002	0.052	0.000	0.103
Q4	0.131	0.009	0.075	0.003	0.134
2023 Q1	0.036	0.008	0.083	0.091	0.168
Q2	0.009	0.004	0.060	0.025	0.151
Q3	0.002	0.009	0.057	0.001	0.143
Q4	0.045	0.005	0.061	0.004	0.153
2024 Q1	**0.164**	**0.011**	**0.067**	**0.034**	**0.173**
Q2	**0.024**	**0.006**	**0.068**	**0.035**	**0.162**
Q3	**0.002**	**0.005**	**0.061**	**0.003**	**0.152**
Q4	**0.034**	**0.005**	**0.070**	**0.064**	**0.154**

Note: Rates shown for previous years may differ from past publications due to newly received data or revisions made by reporting facilities after the prior data cutoff date.

Discussion

In 2024, Pennsylvania's LTC facilities submitted 26,501 infection reports to PA-PSRS and recorded 24.4 million resident days, with an overall infection rate of 1.08 per 1,000 resident days based on eligible reports. This marks a 10.6% increase in total infection reports and a 9.1% rise in the infection rate compared to 2023. The overall infection rate increased due to rising rates across all infection types except for device-related bloodstream infections. Notably, 2024 represents the third consecutive annual increase, with the rate rising from 0.77 in 2021 to 1.08 in 2024.

The continued increase in total number and rate of infections reported to PA-PSRS may be associated with enhanced detection and reporting of infections as a result of the Patient Safety Authority's (PSA) intensive outreach and educational efforts. To address the frequent turnover of infection preventionists (IPs) in LTC facilities, PSA infection prevention advisors have implemented a comprehensive program providing support, guidance, and education, including new IP orientations, regional educational symposia, newsletters, webinars, and evidence-based tools and resources. PSA has also worked to address potential underreporting by formally notifying LTC facilities in the bottom 10th percentile and those reporting zero infections during the previous year that they may not be meeting reporting requirements as set forth in Act 52. PSA infection prevention advisors have also contacted these facilities to offer support and guidance for performing surveillance and reporting.

Conclusion

In 2024, there was a rise in both the number of infection reports submitted to PA-PSRS and the overall infection rate across Pennsylvania's LTC facilities. The increase in overall rate in 2024 was driven by increases in the rates of all infection types except for device-related bloodstream infections. This third consecutive annual increase in the number and rate of reported infections may be associated with enhanced surveillance and reporting in LTC facilities stemming from PSA's intensive outreach and educational efforts.

Note

This analysis was exempted from review by the Advarra Institutional Review Board.

Data used in this study cannot be made public due to their confidential nature, as outlined in the Medical Care Availability and Reduction of Error (MCARE) Act (Pennsylvania Act 52 of 2007).

References

1. Pennsylvania Department of Health. Medical Care Availability and Reduction of Error (MCARE) Act, Pub. L. No. 331 Stat. 52 (2007). DOH website. https://www.pa.gov/content/dam/copapwp-pagov/en/health/documents/topics/documents/laws-and-regulations/Act%2052%20of%202007.pdf. Published 2007. Accessed March 1, 2025.

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Patient Safety Trends in 2024:

An Analysis of 315,418 Serious Events and Incidents From the Nation's Largest Event Reporting Database

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Abstract

Background: The Pennsylvania Patient Safety Reporting System (PA-PSRS) is the largest patient safety data repository of its kind in the United States and one of the largest globally, housing over 5 million reports submitted since 2004. In this article, we present data from reports submitted to PA-PSRS in 2024.

Methods: We used data extracted from PA-PSRS and obtained from the Pennsylvania Health Care Cost Containment Council (PHC4). Report counts are based on the date the report was submitted, while reporting rates are calculated using the event occurrence date. Rates are expressed per 1,000 patient days for hospitals or 1,000 surgical encounters for ambulatory surgical facilities (ASFs).

Results: In 2024, 315,418 reports were submitted to PA-PSRS, marking a 9.5% increase from 2023. Reports of serious events rose by 7.3%, while high harm events increased by 1.1%. Of all reports, 96.0% came from hospitals, while 4.0% originated from nonhospital facilities (ASFs, birthing centers, and abortion facilities). The vast majority (96.0%) were incidents, while the remaining 4.0% were classified as serious events. Preliminary 2024 reporting rates show 32.2 reports per 1,000 patient days for hospitals and 11.4 reports per 1,000 surgical encounters for ASFs, with both rates increasing by 1.1 points from 2023. Error Related to Procedure/Treatment/Test (P/T/T) remained the most frequently reported event type overall, accounting for 33.4% of reports from all facilities combined and 47.6% from nonhospital facilities. Among serious events, Complication of P/T/T was the most common type, making up 57.7% of serious event reports from all facilities combined and 71.4% from nonhospital facilities.

Conclusion: In 2024, the total number of reports, serious event reports, and high harm event reports increased, as did the preliminary reporting rates for hospitals and ASFs. The Patient Safety Authority will continue working with Pennsylvania healthcare facilities to enhance reporting quality and promote patient safety.

Introduction

Pennsylvania is the only state that requires healthcare facilities to report all events that cause harm or have the potential to cause harm to a patient. These patient safety events are reported to the Pennsylvania Patient Safety Reporting System (PA-PSRS)[a], which is the largest patient safety data repository of its kind in the United States and one of the largest globally, housing over 5 million reports submitted since 2004.

In this article, we present data from reports submitted to PA-PSRS in 2024 and offer comparisons and insights to highlight potential areas for patient safety improvement.

Definitions

While many terms are commonly used interchangeably to describe the occurrence and severity of patient safety events, in the context of this manuscript they hold distinct meanings and indications for reporting to PA-PSRS under the Medical Care Availability and Reduction of Error (MCARE) Act (Act 13 of 2002).[1] As defined in MCARE, an "incident" is "an event, occurrence, or situation involving the clinical care of a patient in a medical facility which could have injured the patient but did not either cause an unanticipated injury or require the delivery of additional healthcare services to the patient"[1] and a "serious event" is "an event, occurrence, or situation involving the clinical care of a patient in a medical facility that results in death or compromises patient safety and results in an unanticipated injury requiring the delivery of additional healthcare services to the patient."[1]

Each event report includes a harm score, assigned by the reporting facility, which indicates the potential or actual harm to the patient resulting from the event. **Table 1** provides the definitions for each harm score, as well as the groupings for incidents, serious events, and high harm events.

Methods

This analysis was conducted using data extracted from PA-PSRS on February 1, 2025, along with data from the Pennsylvania Health Care Cost Containment Council (PHC4)[b]. Report counts are based on the date the report was submitted, while reporting rates are calculated using the event occurrence date. Rates are expressed per 1,000 patient days for hospitals and per 1,000 surgical encounters for ambulatory surgical facilities (ASFs). The event occurrence date is used for rate calculations to maintain consistency with the time frame of patient days or surgical encounters. At the time of this analysis, PHC4 data was available through Q2 2024, allowing for the calculation of 2024 rates using the first two quarters of PA-PSRS data.

Table 1. PA-PSRS Harm Scores

	Harm Score	Definition
Incidents	A	Circumstances that could cause adverse events (e.g., look-alike medications, confusing equipment)
Incidents	B1	An event occurred but it did not reach the individual because of chance alone
Incidents	B2	An event occurred but it did not reach the individual because of active recovery efforts by caregivers
Incidents	C	An event occurred that reached the individual but did not cause harm and did not require increased monitoring
Incidents	D	An event occurred that required monitoring to confirm that it resulted in no harm and/or required intervention to prevent harm
Serious Events	E	An event occurred that contributed to or resulted in temporary harm and required treatment or intervention
Serious Events	F	An event occurred that contributed to or resulted in temporary harm and required initial or prolonged hospitalization
Serious Events / High Harm	G	An event occurred that contributed to or resulted in permanent harm
Serious Events / High Harm	H	An event occurred that resulted in a near-death event (e.g., required ICU care or other intervention necessary to sustain life)
Serious Events / High Harm	I	An event occurred that contributed to or resulted in death

[a]PA-PSRS is a secure, web-based system through which Pennsylvania hospitals, ambulatory surgical facilities, abortion facilities, and birthing centers submit reports of patient safety–related incidents and serious events in accordance with mandatory reporting laws outlined in the Medical Care Availability and Reduction of Error (MCARE) Act (Act 13 of 2002).[1] All reports submitted through PA-PSRS are confidential and no information about individual facilities or providers is made public.

[b]The Pennsylvania Health Care Cost Containment Council (PHC4) is an independent state agency responsible for addressing the problem of escalating health costs, ensuring the quality of healthcare, and increasing access to healthcare for all citizens regardless of ability to pay. PHC4 has provided data to this entity in an effort to further PHC4's mission of educating the public and containing healthcare costs in Pennsylvania. PHC4, its agents, and its staff have made no representation, guarantee, or warranty, express or implied, that the data—financial-, patient-, payor-, and physician-specific information—provided to this entity are error-free, or that the use of the data will avoid differences of opinion or interpretation. This analysis was not prepared by PHC4. This analysis was done by the Patient Safety Authority. PHC4, its agents, and its staff bear no responsibility or liability for the results of the analysis, which are solely the opinion of this entity.

Results

As shown in **Figure 1**, 315,418 reports were submitted in 2024, marking a 9.5% increase (27,424 reports) compared to 2023. This is the second largest percentage increase since 2006, following the highest increase in 2023. Of the 315,418 reports in 2024, 12,602 were classified as serious events, 617 of which were high harm. The number of serious and high harm event reports increased from 2023 by 7.3% and 1.1%, respectively. **Figure 2** illustrates the proportion of incidents and serious events within all reports. In 2024, 4.0% of reports were classified as serious events, the second highest percentage since the first full year of PA-PSRS reporting in 2005.

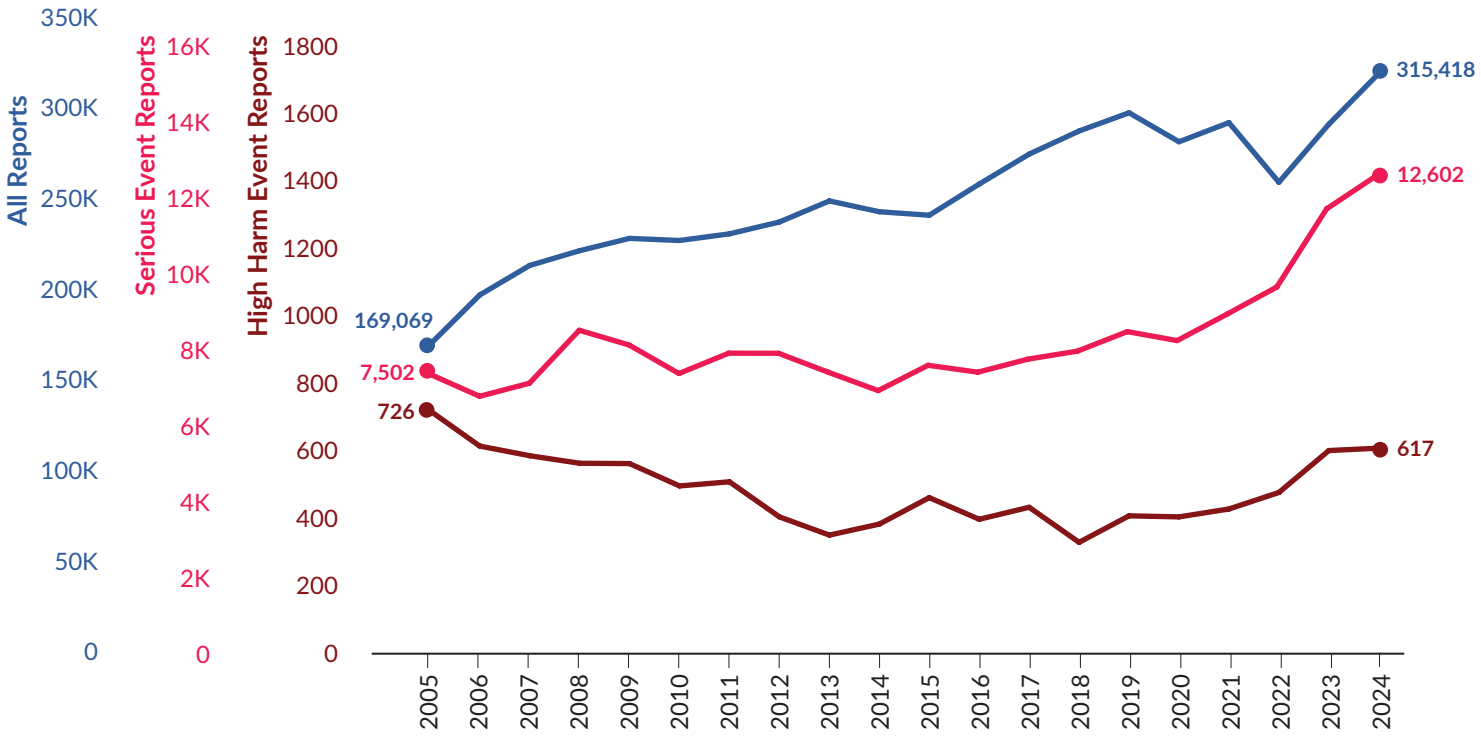
Table 2 shows a breakdown of incidents and serious events by facility type from the past three years. From 2023 to 2024, the number of reports submitted by hospitals increased by 26,321 (9.5%), and reports from nonhospital facilities (i.e., ASFs, birthing centers [BRCs], and abortion facilities [ABFs]) increased by 1,103 (9.5%).

Table 3 displays harm score distributions for reports submitted from 2022 to 2024. While harm score C remained the most common classification in 2024, harm score D showed the largest increase in number. Serious events accounted for 4.0% of all reports submitted in 2024, with harm scores E and F being reported most frequently. The largest percentage increase was observed with harm score B1, which rose by 45.9%. A closer examination of the B1 reports indicates that this increase was predominated by a few specific facilities rather than representing a widespread pattern across the state.

Reporting Rates Based on Event Occurrence Date

Unlike raw report counts, reporting rates provide a standardized measure for comparison over time. As shown in **Figure 3**, the preliminary hospital reporting rate for Q1 to Q2 of 2024 is 32.2 reports per 1,000 patient days, 1.1 points higher than the full-year 2023 rate. Similarly, **Figure 4** shows that the preliminary ASF reporting rate for 2024 is 11.4 reports per 1,000 surgical encounters, also reflecting a 1.1-point increase from 2023 and continuing the steady upward increase in ASF reporting.

Figure 1. All Reports, Serious Event Reports, and High Harm Event Reports Submitted to PA-PSRS



Note: High harm event reports are a subset of serious event reports, and serious event reports are a subset of all reports.

Figure 2. Incidents and Serious Events as a Percentage of All Reports Submitted to PA-PSRS

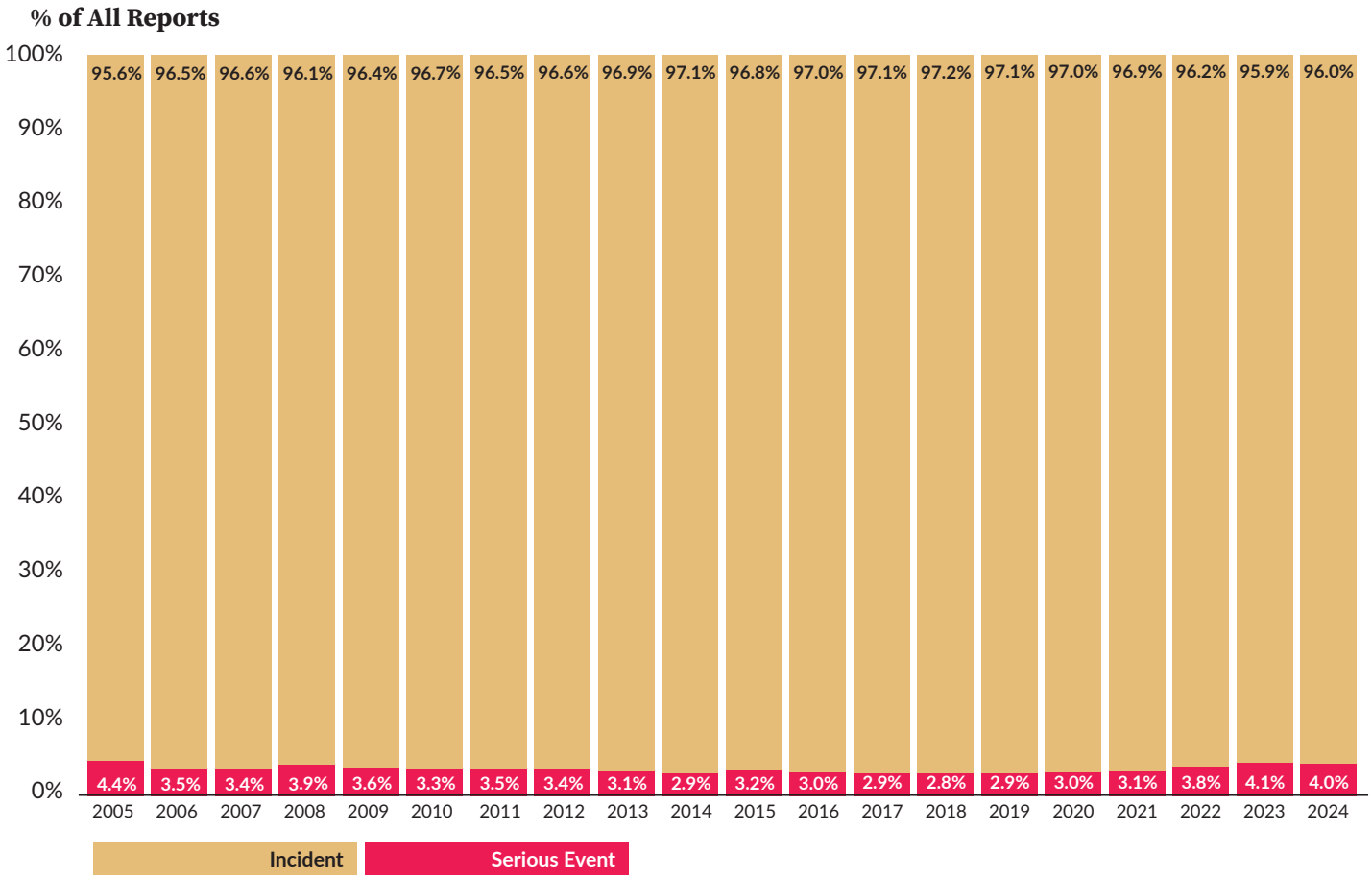


Table 2. Number and Percentage of Reports Submitted to PA-PSRS by Facility Type and Event Classification

Facility Types	Event Classification	Number of Reports			% of Total Reports		
		2022	2023	2024	2022	2023	2024
Hospitals	Incident	238,359	266,724	292,209	92.9%	92.6%	92.6%
	Serious Event	7,755	9,696	10,532	3.0%	3.4%	3.3%
	Subtotal	**246,114**	**276,420**	**302,741**	**95.9%**	**96.0%**	**96.0%**
Nonhospital Facilities	Incident	8,569	9,520	10,607	3.3%	3.3%	3.4%
	Serious Event	1,986	2,054	2,070	0.8%	0.7%	0.7%
	Subtotal	**10,555**	**11,574**	**12,677**	**4.1%**	**4.0%**	**4.0%**
All Facilities Combined	Incident	246,928	276,244	302,816	96.2%	95.9%	96.0%
	Serious Event	9,741	11,750	12,602	3.8%	4.1%	4.0%
	Total	**256,669**	**287,994**	**315,418**	**100.0%**	**100.0%**	**100.0%**

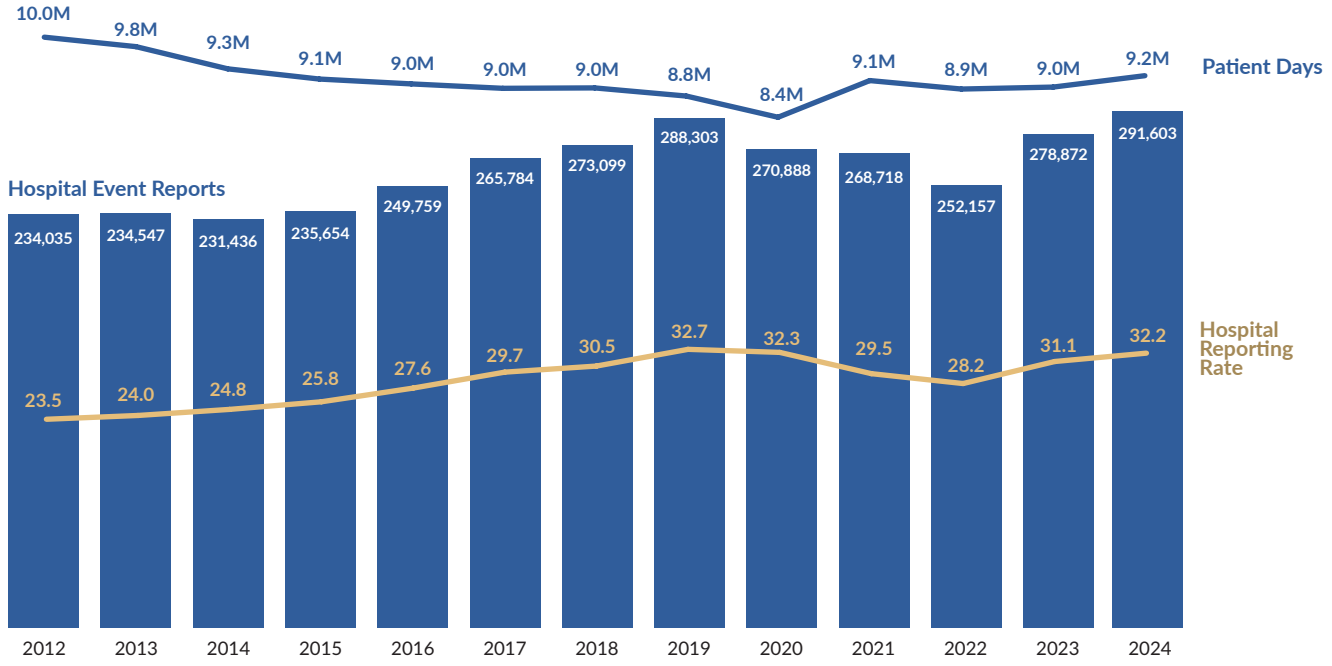
Note: Nonhospital Facilities include ambulatory surgical facilities, birthing centers, and abortion facilities. Numbers shown for prior years may differ from previously published numbers due to subsequent report deletions or classification changes made by reporting facilities. Sums of % of Total Reports for Event Classification may not equal the Subtotals and Total due to rounding.

Table 3. Number and Percentage of Reports Submitted to PA-PSRS by Harm Score With Change in Reports From 2023 to 2024

Harm Score	Number of Reports			% of Total Reports			Change in Reports 2023 to 2024	
	2022	2023	2024	2022	2023	2024	Number	Percent
A	29,658	32,725	29,631	11.6%	11.4%	9.4%	-3,094	-9.5%
B1	2,042	2,617	3,817	0.8%	0.9%	1.2%	1,200	45.9%
B2	22,236	26,668	31,655	8.7%	9.3%	10.0%	4,987	18.7%
C	105,104	118,753	129,399	40.9%	41.2%	41.0%	10,646	9.0%
D	87,888	95,481	108,314	34.2%	33.2%	34.3%	12,833	13.4%
Incidents - Subtotal	**246,928**	**276,244**	**302,816**	**96.2%**	**95.9%**	**96.0%**	**26,572**	**9.6%**
E	6,811	8,081	8,819	2.7%	2.8%	2.8%	738	9.1%
F	2,442	3,059	3,166	1.0%	1.1%	1.0%	107	3.5%
G	53	97	65	<0.05%	<0.05%	<0.05%	-32	-33.0%
H	165	211	271	0.1%	0.1%	0.1%	60	28.4%
I	270	302	281	0.1%	0.1%	0.1%	-21	-7.0%
Serious Events - Subtotal	**9,741**	**11,750**	**12,602**	**3.8%**	**4.1%**	**4.0%**	**852**	**7.3%**
Total	**256,669**	**287,994**	**315,418**	**100.0%**	**100.0%**	**100.0%**	**27,424**	**9.5%**

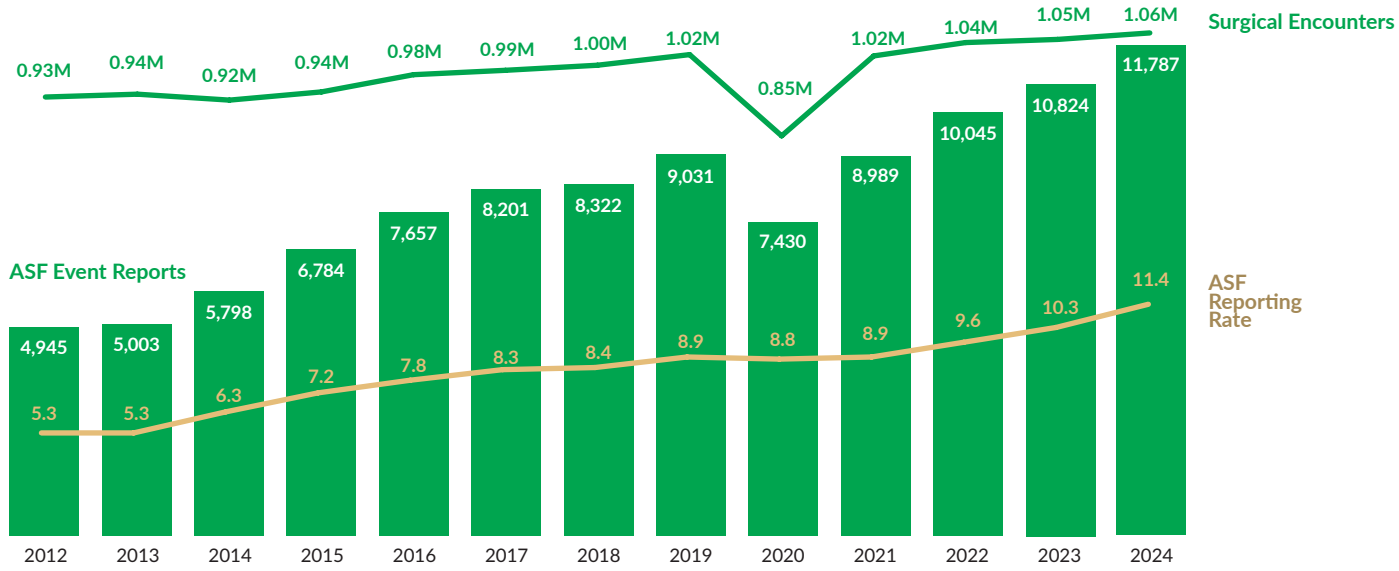
Note: Numbers shown for prior years may differ from previously published numbers due to subsequent report deletions or harm score changes made by reporting facilities. All percentages that are greater than 0 but would otherwise round to 0.0% are displayed as <0.05%. Sums of % of Total Reports may not collectively equal the Subtotals and Total due to rounding.

Figure 3. Hospital Event Reports, Patient Days, and Reporting Rates by Year



Note: The number of hospital event reports shown for each year is based on event occurrence date, rather than report submission date, to ensure consistency with the time frame in which the patient days occurred. The 2024 hospital reporting rate is based on event occurrence dates in Q1–Q2 only due to lagged data related to patient days. Rates shown for prior years may differ from previously published rates due to subsequent changes made by reporting facilities.

Figure 4. ASF Event Reports, Surgical Encounters, and Reporting Rates by Year



Note: The number of ASF event reports shown for each year is based on event occurrence date, rather than report submission date, to ensure consistency with the time frame in which the surgical encounters occurred. The 2024 ASF reporting rate is based on event occurrence dates in Q1–Q2 only due to lagged data related to surgical encounters. Rates shown for prior years may differ from previously published rates due to subsequent changes made by reporting facilities.

Event Types

Each PA-PSRS report includes an event type and subtype(s) that are assigned by the reporting facility. The reporting taxonomy for incidents and serious events provides for 10 main event types, with 228 possible combinations of event type and subtype.

Table 4 shows the number and percentage of all reports submitted for each main event type from 2020 to 2024. Over the past five years, the most frequently reported event type has been Error Related to Procedure/Treatment/Test (P/T/T), with 105,224 reports submitted in 2024, accounting for 33.4% of all reports. From a distribution perspective, the proportion of Equipment/Supplies/Devices reports grew more than any other event type in 2024, rising 0.4 percentage points from 3.3% in 2023 to 3.7% in 2024. Medication Error reports showed the largest decline, dropping from 14.1% in 2023 to 13.6% in 2024, a decrease of 0.5 percentage points.

Table 5 shows the number and percentage of serious event reports submitted for each main event type from 2020 to 2024. Over the past five years, Complication of P/T/T has been the most frequently reported serious event type, and in 2024 it showed the largest increase in reports, with 595 more submissions than the previous year. From a distribution standpoint, the largest increase was also seen for Complication of P/T/T for the second consecutive year, rising by 0.9 percentage points from 56.1% in 2023 to 57.0% in 2024. Skin Integrity reports showed the largest decline, decreasing by 0.5 percentage points in 2024. Notably, reports of serious Adverse Drug Reactions (ADRs) have shown a steady increase both in absolute numbers and as a proportion of serious event reports over the past five years. Further analysis reveals this trend is primarily driven by a small number of facilities that have individually demonstrated significant upward reporting patterns during this period. In fact, just two facilities account for 89.1% of the increase observed between 2023 and 2024.

Event Subtypes

Each of the 10 main event types is further classified into subtypes, with each type having between six and 13 subtypes. **Table 6** provides a detailed breakdown of all reports and serious event reports, along with their percentage distributions, based on the first level of subtypes for each main event type.

The event subtype with the largest increase in number of reports submitted from 2023 to 2024 was Other/Miscellaneous–Other (specify). Additionally, three subtypes under the Error Related to P/T/T event type saw increases of more than 2,000 reports in 2024: Radiology/imaging test problem, Other (specify), and Surgery/invasive procedure problem. The subtypes with the largest increase in serious event reports from 2023 to 2024 were under the Complication of P/T/T event type: Complication following surgery or invasive procedure, which increased by 111 serious event reports, followed by Catheter or tube problem, which increased by 90 serious event reports.

Event Type and Harm Score

Table 7 presents a cross tabulation of submitted reports by harm score for each of the 10 main event types. The colored cells highlight the most common intersections of event type and harm score in 2024, with darker shades indicating higher concentrations of reports. The intersection of Error Related to P/T/T and harm score C was the most common in 2024, with 52,305 reports and representing 16.6% of all reports. The second most common intersection was Complication of P/T/T and harm score D, with 24,958 reports, representing 7.9% of all reports.

Care Area and Harm Score

Within PA-PSRS, facilities have 168 options to specify the care area where an event occurred. These care areas are then grouped into 23 broader care area group categories. **Table 8** shows a cross tabulation of care area group with harm score. This reflects the same two areas of highest concentration that were seen in the data from 2023, in the cross sections of the Med/Surg care area group and harm scores C and D.

Care Area and Event Type

Table 9 shows a cross tabulation of care area group and event type. The three highest concentrations of reports are at the intersections of care area groups Surgical Services and Emergency with Error Related to P/T/T and of Med/Surg with Fall.

Nonhospital Facilities

Since the data primarily reflects reports from hospitals, it is important to separately analyze data from nonhospital facilities—mainly ASFs, along with BRCs and ABFs—to identify patient safety issues specific to those settings. **Table 10** presents the distribution of reports submitted by these facilities across the 10 main event types from 2020 to 2024. Compared to all facilities combined (**Table 4**), reports from nonhospital facilities show a distinct distribution. While Error Related to P/T/T remains the most common event type overall, it accounts for a larger share of reports from nonhospital facilities (47.6%) than from all facilities combined (33.4%). Reports of this event type from nonhospital facilities have increased annually, with a notable rise of 1,187 reports (24.5%) between 2023 and 2024. Further analysis indicates that this increase is primarily driven by reports of procedures that were canceled or not performed, with four facilities accounting for more than one-third of the increase.

Table 11 displays the distribution of serious event reports reported by nonhospital facilities from 2020 to 2024. These reports also show a different distribution compared to all facilities (**Table 5**). While Complication of P/T/T remains the most common serious event type overall, it represents a larger proportion of serious event reports from nonhospital facilities (71.4%) compared to all facilities combined (57.0%).

Table 4. Number and Percentage of **All Reports** Submitted to PA-PSRS by Event Type in Descending Order by 2024 Frequency

	Number of Reports					% of Total Reports				
Event Type	**2020**	**2021**	**2022**	**2023**	**2024**	**2020**	**2021**	**2022**	**2023**	**2024**
Error Related to P/T/T	89,335	90,452	84,287	95,189	**105,224**	32.1%	31.3%	32.8%	33.1%	**33.4%**
Complication of P/T/T	45,180	44,129	40,144	45,012	**49,305**	16.2%	15.3%	15.6%	15.6%	**15.6%**
Medication Error	46,559	48,714	33,980	40,680	**42,769**	16.7%	16.9%	13.2%	14.1%	**13.6%**
Fall	32,775	35,600	32,918	32,606	**35,450**	11.8%	12.3%	12.8%	11.3%	**11.2%**
Other/Miscellaneous	23,190	27,707	26,649	31,562	**34,372**	8.3%	9.6%	10.4%	11.0%	**10.9%**
Skin Integrity	19,697	20,583	17,146	17,930	**20,125**	7.1%	7.1%	6.7%	6.2%	**6.4%**
Equipment/Supplies/Devices	8,062	7,806	7,552	9,403	**11,690**	2.9%	2.7%	2.9%	3.3%	**3.7%**
Adverse Drug Reaction	5,624	5,868	6,526	7,063	**7,582**	2.0%	2.0%	2.5%	2.5%	**2.4%**
Transfusion	5,779	5,648	5,235	6,033	**6,372**	2.1%	2.0%	2.0%	2.1%	**2.0%**
Patient Self-Harm	2,329	2,351	2,232	2,516	**2,529**	0.8%	0.8%	0.9%	0.9%	**0.8%**
Total	**278,530**	**288,858**	**256,669**	**287,994**	**315,418**	**100%**	**100%**	**100%**	**100%**	**100%**

Note: Numbers shown for prior years may differ from previously published numbers due to subsequent report deletions or event type changes made by reporting facilities. The sum of % of Total Reports may not equal the Total due to rounding.

Table 5. Number and Percentage of **Serious Event Reports** Submitted to PA-PSRS by Event Type in Descending Order by 2024 Frequency

	Number of Reports					% of Total Reports				
Event Type	**2020**	**2021**	**2022**	**2023**	**2024**	**2020**	**2021**	**2022**	**2023**	**2024**
Complication of P/T/T	4,577	4,907	5,216	6,590	**7,185**	54.7%	54.3%	53.5%	56.1%	**57.0%**
Fall	940	1,046	1,140	1,097	**1,119**	11.2%	11.6%	11.7%	9.3%	**8.9%**
Other/Miscellaneous	708	849	850	919	**950**	8.5%	9.4%	8.7%	7.8%	**7.5%**
Adverse Drug Reaction	344	430	577	783	**939**	4.1%	4.8%	5.9%	6.7%	**7.5%**
Error Related to P/T/T	753	729	831	905	**938**	9.0%	8.1%	8.5%	7.7%	**7.4%**
Skin Integrity	575	610	633	765	**759**	6.9%	6.7%	6.5%	6.5%	**6.0%**
Medication Error	166	172	227	294	**269**	2.0%	1.9%	2.3%	2.5%	**2.1%**
Patient Self-Harm	166	171	141	234	**244**	2.0%	1.9%	1.4%	2.0%	**1.9%**
Equipment/Supplies/Devices	77	96	86	105	**108**	0.9%	1.1%	0.9%	0.9%	**0.9%**
Transfusion	58	33	40	58	**91**	0.7%	0.4%	0.4%	0.5%	**0.7%**
Total	**8,364**	**9,043**	**9,741**	**11,750**	**12,602**	**100%**	**100%**	**100%**	**100%**	**100%**

Note: Numbers shown for prior years may differ from previously published numbers due to subsequent report deletions or event type changes made by reporting facilities. The sum of % of Total Reports may not equal the Total due to rounding.

Table 6. Number and Percentage of All Reports and Serious Event Reports Submitted to PA-PSRS by Event Type and Subtype in Descending Order by 2024 Frequency

		2023				2024				Change in All Reports	
		All Reports		Serious Event Reports		All Reports		Serious Event Reports			
Event Type	Event Subtype	Number of Reports	% of Total Reports	Number of Reports	% of Total Reports	Number of Reports	% of Total Reports	Number of Reports	% of Total Reports	Number	Percent
Error Related to P/T/T	Laboratory test problem	40,034	13.9%	62	0.5%	41,814	13.3%	54	0.4%	1,780	4.4%
	Surgery/invasive procedure problem	22,118	7.7%	662	5.6%	24,338	7.7%	692	5.5%	2,220	10.0%
	Referral/consult problem	9,772	3.4%	15	0.1%	10,217	3.2%	11	0.1%	445	4.6%
	Other (specify)	9,160	3.2%	66	0.6%	11,561	3.7%	69	0.5%	2,401	26.2%
	Radiology/imaging test problem	8,199	2.8%	52	0.4%	10,861	3.4%	61	0.5%	2,662	32.5%
	Respiratory care	3,128	1.1%	40	0.3%	3,312	1.1%	38	0.3%	184	5.9%
	Dietary	2,778	1.0%	8	0.1%	3,121	1.0%	13	0.1%	343	12.3%
Complication of P/T/T	IV site complication (phlebitis, bruising, infiltration)	12,311	4.3%	350	3.0%	13,476	4.3%	392	3.1%	1,165	9.5%
	Other (specify)	7,593	2.6%	530	4.5%	8,787	2.8%	579	4.6%	1,194	15.7%
	Complication following surgery or invasive procedure	6,250	2.2%	3,698	31.5%	6,595	2.1%	3,811	30.2%	345	5.5%
	Maternal complication	3,414	1.2%	511	4.3%	3,199	1.0%	574	4.6%	-215	-6.3%
	Catheter or tube problem	3,056	1.1%	221	1.9%	3,643	1.2%	311	2.5%	587	19.2%
	Cardiopulmonary arrest outside of ICU setting	3,025	1.1%	72	0.6%	3,634	1.2%	104	0.8%	609	20.1%
	Extravasation of drug or radiologic contrast	2,662	0.9%	71	0.6%	3,153	1.0%	101	0.8%	491	18.4%
	Neonatal complication	2,461	0.9%	150	1.3%	2,318	0.7%	210	1.7%	-143	-5.8%
	Anesthesia event	1,227	0.4%	283	2.4%	1,291	0.4%	313	2.5%	64	5.2%
	Healthcare-associated infection	1,212	0.4%	567	4.8%	1,317	0.4%	635	5.0%	105	8.7%
	Onset of hypoglycemia during care	1,061	0.4%	34	0.3%	927	0.3%	28	0.2%	-134	-12.6%
	Emergency department	736	0.3%	102	0.9%	964	0.3%	127	1.0%	228	31.0%
	Complication following spinal manipulative therapy	4	<0.05%	1	<0.05%	1	<0.05%	0	0.0%	-3	-75.0%
Medication Error	Wrong	15,129	5.3%	128	1.1%	16,136	5.1%	119	0.9%	1,007	6.7%
	Other (specify)	10,935	3.8%	46	0.4%	11,381	3.6%	36	0.3%	446	4.1%
	Dose omission	4,755	1.7%	37	0.3%	5,010	1.6%	31	0.2%	255	5.4%
	Prescription/refill delayed	3,446	1.2%	5	<0.05%	3,408	1.1%	5	<0.05%	-38	-1.1%
	Monitoring error (includes contraindicated drugs)	2,610	0.9%	35	0.3%	2,939	0.9%	40	0.3%	329	12.6%
	Extra dose	2,024	0.7%	27	0.2%	1,905	0.6%	26	0.2%	-119	-5.9%
	Medication list incorrect	904	0.3%	15	0.1%	1,128	0.4%	11	0.1%	224	24.8%
	Unauthorized drug	792	0.3%	1	<0.05%	763	0.2%	1	<0.05%	-29	-3.7%
	Inadequate pain management	85	<0.05%	0	0.0%	99	<0.05%	0	0.0%	14	16.5%
Fall	Found on floor	7,687	2.7%	351	3.0%	8,786	2.8%	383	3.0%	1,099	14.3%
	Ambulating	5,319	1.8%	256	2.2%	5,730	1.8%	244	1.9%	411	7.7%
	Other/Unknown (specify)	4,242	1.5%	69	0.6%	4,420	1.4%	89	0.7%	178	4.2%
	Toileting	3,227	1.1%	152	1.3%	3,566	1.1%	153	1.2%	339	10.5%
	Lying in bed	2,968	1.0%	51	0.4%	2,921	0.9%	60	0.5%	-47	-1.6%
	Assisted fall	2,762	1.0%	18	0.2%	3,531	1.1%	26	0.2%	769	27.8%
	Sitting in chair/wheelchair	2,730	0.9%	60	0.5%	2,751	0.9%	53	0.4%	21	0.8%

Table 6. (continued.)

Event Type	Event Subtype	2023 All Reports Number of Reports	2023 All Reports % of Total Reports	2023 Serious Event Reports Number of Reports	2023 Serious Event Reports % of Total Reports	2024 All Reports Number of Reports	2024 All Reports % of Total Reports	2024 Serious Event Reports Number of Reports	2024 Serious Event Reports % of Total Reports	Change in All Reports Number	Change in All Reports Percent
Fall (cont.)	Sitting at side of bed	1,140	0.4%	30	0.3%	1,048	0.3%	31	0.2%	-92	-8.1%
	Transferring	902	0.3%	36	0.3%	1,045	0.3%	21	0.2%	143	15.9%
	Hallways of facility	659	0.2%	26	0.2%	710	0.2%	16	0.1%	51	7.7%
	From stretcher	398	0.1%	28	0.2%	422	0.1%	19	0.2%	24	6.0%
	Grounds of facility	288	0.1%	9	0.1%	291	0.1%	13	0.1%	3	1.0%
	In exam room/from exam table	284	0.1%	11	0.1%	229	0.1%	11	0.1%	-55	-19.4%
Other/ Miscella-neous	Other (specify)	20,929	7.3%	398	3.4%	23,611	7.5%	439	3.5%	2,682	12.8%
	Unanticipated transfer to higher level of care	8,777	3.0%	449	3.8%	9,047	2.9%	450	3.6%	270	3.1%
	Inappropriate discharge	1,769	0.6%	7	0.1%	1,628	0.5%	9	0.1%	-141	-8.0%
	Other unexpected death	82	<0.05%	60	0.5%	83	<0.05%	49	0.4%	1	1.2%
	Death or injury involving restraints	3	<0.05%	3	<0.05%	2	<0.05%	2	<0.05%	3	-33.3%
	Death or injury during inpatient elopement	1	<0.05%	1	<0.05%	1	<0.05%	1	<0.05%	0	0.0%
	Death or injury involving seclusion	1	<0.05%	1	<0.05%	0	0.0%	0	0.0%	-1	-100.0%
Skin Integrity	Pressure injury	6,158	2.1%	573	4.9%	7,210	2.3%	570	4.5%	1,052	17.1%
	Other (specify)	6,125	2.1%	51	0.4%	6,296	2.0%	43	0.3%	171	2.8%
	Skin tear	3,527	1.2%	42	0.4%	4,135	1.3%	42	0.3%	608	17.2%
	Abrasion	904	0.3%	1	<0.05%	1,089	0.3%	3	<0.05%	185	20.5%
	Blister	481	0.2%	5	<0.05%	540	0.2%	7	0.1%	59	12.3%
	Laceration	317	0.1%	47	0.4%	352	0.1%	56	0.4%	35	11.0%
	Burn (electrical, chemical, thermal)	271	0.1%	41	0.3%	319	0.1%	35	0.3%	48	17.7%
	Rash/hives	139	<0.05%	5	<0.05%	177	0.1%	3	<0.05%	38	27.3%
	Venous stasis ulcer	8	<0.05%	0	0.0%	7	<0.05%	0	0.0%	-1	-12.5%
Equipment/ Supplies/ Devices	Equipment malfunction	3,222	1.1%	41	0.3%	3,845	1.2%	43	0.3%	623	19.3%
	Equipment not available	1,018	0.4%	3	<0.05%	1,144	0.4%	2	<0.05%	126	12.4%
	Medical device problem	891	0.3%	13	0.1%	1,161	0.4%	16	0.1%	270	30.3%
	Broken item(s)	841	0.3%	24	0.2%	1,071	0.3%	18	0.1%	230	27.3%
	Sterilization problem	814	0.3%	5	<0.05%	1,352	0.4%	12	0.1%	538	66.1%
	Other (specify)	771	0.3%	9	0.1%	1,056	0.3%	4	<0.05%	285	37.0%
	Equipment misuse	497	0.2%	1	<0.05%	629	0.2%	3	<0.05%	132	26.6%
	Equipment safety situation	334	0.1%	0	0.0%	409	0.1%	4	<0.05%	75	22.5%
	Disconnected	328	0.1%	5	<0.05%	340	0.1%	4	<0.05%	12	3.7%
	Equipment wrong or inadequate	220	0.1%	2	<0.05%	204	0.1%	1	<0.05%	-16	-7.3%
	Inadequate supplies	210	0.1%	1	<0.05%	209	0.1%	1	<0.05%	-1	-0.5%
	Electrical problem	147	0.1%	1	<0.05%	160	0.1%	0	0.0%	13	8.8%
	Outdated item(s)	110	<0.05%	0	0.0%	110	<0.05%	0	0.0%	0	0.0%

Table 6. (continued.)

		2023				2024				Change in All Reports	
		All Reports		Serious Event Reports		All Reports		Serious Event Reports			
Event Type	Event Subtype	Number of Reports	% of Total Reports	Number of Reports	% of Total Reports	Number of Reports	% of Total Reports	Number of Reports	% of Total Reports	Number	Percent
Adverse Drug Reaction	Other (specify)	4,976	1.7%	394	3.4%	5,120	1.6%	413	3.3%	144	2.9%
	Skin reaction (rash, blistering, itching, hives)	1,455	0.5%	223	1.9%	1,669	0.5%	287	2.3%	214	14.7%
	Mental status change	186	0.1%	63	0.5%	330	0.1%	125	1.0%	144	77.4%
	Hypotension	166	0.1%	47	0.4%	189	0.1%	59	0.5%	23	13.9%
	Dizziness	107	<0.05%	7	0.1%	124	<0.05%	6	<0.05%	17	15.9%
	Hematologic problem	100	<0.05%	23	0.2%	73	<0.05%	22	0.2%	-27	-27.0%
	Arrhythmia	40	<0.05%	17	0.1%	46	<0.05%	18	0.1%	6	15.0%
	Nephrotoxicity	33	<0.05%	9	0.1%	31	<0.05%	9	0.1%	-2	-6.1%
Transfusion	Event related to blood product sample collection	1,685	0.6%	1	<0.05%	1,652	0.5%	0	0.0%	-33	-2.0%
	Other (specify)	1,659	0.6%	3	<0.05%	1,866	0.6%	2	<0.05%	207	12.5%
	Event related to blood product administration	986	0.3%	11	0.1%	1,074	0.3%	6	<0.05%	88	8.9%
	Apparent transfusion reaction	776	0.3%	42	0.4%	771	0.2%	81	0.6%	-5	-0.6%
	Event related to blood product dispensing or distribution	533	0.2%	0	0.0%	614	0.2%	2	<0.05%	81	15.2%
	Consent missing/inadequate	244	0.1%	0	0.0%	230	0.1%	0	0.0%	-14	-5.7%
	Wrong patient requested	46	<0.05%	0	0.0%	38	<0.05%	0	0.0%	-8	-17.4%
	Special product need not issued	26	<0.05%	0	0.0%	18	<0.05%	0	0.0%	-8	-30.8%
	Special product need not requested	25	<0.05%	0	0.0%	42	<0.05%	0	0.0%	17	68.0%
	Wrong component issued	24	<0.05%	0	0.0%	34	<0.05%	0	0.0%	10	41.7%
	Mismatched unit	19	<0.05%	1	<0.05%	18	<0.05%	0	0.0%	-1	-5.3%
	Wrong component requested	9	<0.05%	0	0.0%	10	<0.05%	0	0.0%	1	11.1%
	Wrong patient transfused	1	<0.05%	0	0.0%	5	<0.05%	0	0.0%	-5	-100.0%
Patient Self-Harm	Other self-harm (specify)	1,543	0.5%	64	0.5%	1,417	0.4%	82	0.7%	-126	-8.2%
	Self-mutilation	615	0.2%	23	0.2%	753	0.2%	35	0.3%	138	22.4%
	Ingestion of foreign object or substance	316	0.1%	114	1.0%	322	0.1%	98	0.8%	6	1.9%
	Suicide attempt - Injury	27	<0.05%	27	0.2%	22	<0.05%	22	0.2%	-5	-18.5%
	Anorexia/bulemia	10	<0.05%	1	<0.05%	8	<0.05%	0	0.0%	-2	-20.0%
	Suicide - Death	5	<0.05%	5	<0.05%	7	<0.05%	7	0.1%	2	40.0%
Total		**287,994**	**100%**	**11,750**	**100%**	**315,418**	**100%**	**12,602**	**100%**	**27,424**	**9.5%**

Note: Numbers shown for prior years may differ from previously published numbers due to subsequent report deletions or event type changes made by reporting facilities. All percentages that are greater than 0% but would otherwise round to 0.0% are displayed as <0.05%. The sum of % of Total Reports may not equal the Total due to rounding.

Table 7. Number of Reports Submitted to PA-PSRS in 2024 by Event Type and Harm Score in Descending Order by Event Type Frequency

Event Type	A	B1	B2	C	D	E	F	G	H	I	Total
Error Related to P/T/T	14,756	1,637	15,122	52,305	20,466	704	184	13	25	12	**105,224**
Complication of P/T/T	1,567	381	1,391	13,823	24,958	4,577	2,209	37	190	172	**49,305**
Medication Error	3,827	681	8,789	19,056	10,147	211	49	0	6	3	**42,769**
Fall	136	42	344	17,019	16,790	849	249	2	8	11	**35,450**
Other/Miscellaneous	5,554	812	3,107	12,388	11,561	560	304	10	12	64	**34,372**
Skin Integrity	247	9	54	4,846	14,210	734	24	1	0	0	**20,125**
Equipment/Supplies/ Devices	2,404	155	2,179	5,113	1,731	93	10	0	2	3	**11,690**
Adverse Drug Reaction	14	2	10	1,334	5,283	816	100	1	17	5	**7,582**
Transfusion	1,092	86	540	2,782	1,781	76	11	0	2	2	**6,372**
Patient Self-Harm	34	12	119	733	1,387	199	26	1	9	9	**2,529**
Total	**29,631**	**3,817**	**31,655**	**129,399**	**108,314**	**8,819**	**3,166**	**65**	**271**	**281**	**315,418**

Table 8. Number of Reports Submitted to PA-PSRS in 2024 by Care Area Group and Harm Score in Descending Order by Care Area Group Frequency

Care Area Group	A	B1	B2	C	D	E	F	G	H	I	Total
Med/Surg	4,954	505	3,744	23,572	24,813	1,449	319	9	34	40	**59,439**
Surgical Services	6,981	640	6,754	16,368	10,839	3,186	1,802	26	107	91	**46,794**
Emergency	3,932	578	2,696	17,116	9,005	430	107	5	15	21	**33,905**
ICU	1,875	153	1,439	8,493	10,549	715	92	5	18	28	**23,367**
Specialty Unit	1,545	167	1,419	7,493	8,587	466	108	0	21	19	**19,825**
Imaging/Diagnostic	1,336	282	1,888	8,836	6,272	394	120	4	17	17	**19,166**
Other	1,486	275	2,238	6,276	6,506	334	143	5	9	14	**17,286**
Clinic/Outpatient Office	754	160	2,402	4,713	4,294	308	73	4	3	6	**12,717**
Laboratory	848	191	1,350	7,563	2,172	31	11	1	0	0	**12,167**
Psychiatric Unit	512	91	594	4,440	4,821	351	109	0	3	6	**10,927**
Rehab Unit	409	117	550	3,823	4,372	146	49	0	1	5	**9,472**
Intermediate Unit	851	126	721	3,496	3,880	140	30	0	4	7	**9,255**
Pediatric	1,069	123	1,241	4,559	2,124	67	9	0	0	0	**9,192**
Labor and Delivery	282	54	381	1,883	3,678	403	100	2	20	15	**6,818**
NICU	943	74	773	3,206	1,580	61	13	2	2	7	**6,661**
PICU	797	74	1,242	2,732	955	36	2	2	1	1	**5,842**
OB/GYN Unit	363	71	524	1,865	2,005	253	54	0	15	3	**5,153**
Pharmacy	357	81	1,172	1,193	526	2	2	0	0	0	**3,333**
Rehab Services	67	19	123	1,057	664	21	11	0	1	0	**1,963**
Nursery	60	19	142	348	516	22	12	0	0	1	**1,120**
Administration	135	5	233	189	69	2	0	0	0	0	**633**
Respiratory	75	12	29	178	87	2	0	0	0	0	**383**
Total	**29,631**	**3,817**	**31,655**	**129,399**	**108,314**	**8,819**	**3,166**	**65**	**271**	**281**	**315,418**

Table 9. Number of Reports Submitted to PA-PSRS in 2024 by Care Area Group and Event Type in Descending Order by Care Area Group Frequency

Care Area Group	Error Related to P/T/T	Complication of P/T/T	Medication Error	Fall	Other/ Miscellaneous	Skin Integrity	Equipment/ Supplies/ Devices	Adverse Drug Reaction	Transfusion	Patient Self-Harm	Total
Med/Surg	11,123	7,796	10,908	12,178	8,440	5,698	1,181	733	1,180	202	**59,439**
Surgical Services	23,221	8,844	1,896	635	4,259	2,156	4,766	358	649	10	**46,794**
Emergency	15,524	3,348	4,296	3,667	4,087	319	645	424	1,405	190	**33,905**
ICU	6,373	3,765	4,399	1,147	1,750	3,970	896	247	782	38	**23,367**
Specialty Unit	3,921	2,598	3,764	3,617	2,696	1,818	279	492	587	53	**19,825**
Imaging/Diagnostic	8,633	6,054	238	839	1,093	520	678	1,071	33	7	**19,166**
Other	6,186	1,814	2,278	2,388	1,688	1,155	559	914	258	46	**17,286**
Clinic/Outpatient	4,305	1,080	1,792	824	796	217	480	2,908	290	25	**12,717**
Laboratory	11,363	115	40	74	129	21	45	2	378	0	**12,167**
Psychiatric Unit	739	272	802	4,200	2,465	394	78	52	1	1,924	**10,927**
Rehab Unit	994	596	1,582	2,800	1,303	1,929	133	101	28	6	**9,472**
Intermediate Unit	1,958	1,489	1,601	1,184	1,470	975	209	147	210	12	**9,255**
Pediatric	1,996	2,293	2,161	524	1,386	228	405	35	152	12	**9,192**
Labor and Delivery	1,580	3,940	380	118	399	53	204	25	119	0	**6,818**
NICU	2,927	1,199	1,024	9	846	138	421	3	94	0	**6,661**
PICU	1,836	1,217	1,442	47	561	201	438	2	97	1	**5,842**
OB/GYN Unit	1,420	2,159	557	201	513	57	145	24	77	0	**5,153**
Pharmacy	58	10	3,177	2	24	0	20	39	1	2	**3,333**
Rehab Services	169	203	47	949	293	252	47	1	1	1	**1,963**
Nursery	492	453	58	10	66	9	28	1	3	0	**1,120**
Administration	188	37	275	22	67	8	7	2	27	0	**633**
Respiratory	218	23	52	15	41	7	26	1	0	0	**383**
Total	**105,224**	**49,305**	**42,769**	**35,450**	**34,372**	**20,125**	**11,690**	**7,582**	**6,372**	**2,529**	**315,418**

Table 10. Number and Percentage of **Reports** Submitted to PA-PSRS by Nonhospital Facilities (ASF, BRC, ABF) by Event Type in Descending Order by 2024 Frequency

	Number of Reports					% of Total Reports				
Event Type	**2020**	**2021**	**2022**	**2023**	**2024**	**2020**	**2021**	**2022**	**2023**	**2024**
Error Related to P/T/T	3,048	3,333	4,126	4,850	**6,037**	39.0%	35.8%	39.1%	41.9%	**47.6%**
Complication of P/T/T	2,265	2,816	2,659	2,822	**2,824**	29.0%	30.3%	25.2%	24.4%	**22.3%**
Other/Miscellaneous	1,766	2,283	2,843	2,867	**2,775**	22.6%	24.5%	26.9%	24.8%	**21.9%**
Equipment/Supplies/Devices	145	160	213	285	**294**	1.9%	1.7%	2.0%	2.5%	**2.3%**
Skin Integrity	206	245	272	296	**292**	2.6%	2.6%	2.6%	2.6%	**2.3%**
Fall	161	222	225	228	**226**	2.1%	2.4%	2.1%	2.0%	**1.8%**
Medication Error	129	137	130	149	**133**	1.7%	1.5%	1.2%	1.3%	**1.0%**
Adverse Drug Reaction	77	100	79	71	**86**	1.0%	1.1%	0.7%	0.6%	**0.7%**
Patient Self-Harm	10	5	6	6	**7**	0.1%	0.1%	0.1%	0.1%	**0.1%**
Transfusion	0	3	2	0	**3**	0.0%	<0.05%	<0.05%	0.0%	**<0.05%**
Total	7,807	9,304	10,555	11,574	**12,677**	100%	100%	100%	100%	**100%**

Note: Numbers shown for prior years may differ from previously published numbers due to subsequent report deletions or event type changes made by reporting facilities. The sum of % of Total Reports may not equal the Total due to rounding.

Table 11. Number and Percentage of **Serious Event Reports** Submitted to PA-PSRS by Nonhospital Facilities (ASF, BRC, ABF) by Event Type in Descending Order by 2024 Frequency

	Number of Reports					% of Total Reports				
Event Type	**2020**	**2021**	**2022**	**2023**	**2024**	**2020**	**2021**	**2022**	**2023**	**2024**
Complication of P/T/T	1,179	1,372	1,343	1,447	**1,477**	72.0%	70.9%	67.6%	70.4%	**71.4%**
Other/Miscellaneous	300	417	473	428	**397**	18.3%	21.6%	23.8%	20.8%	**19.2%**
Error Related to P/T/T	74	55	74	83	**102**	4.5%	2.8%	3.7%	4.0%	**4.9%**
Skin Integrity	23	21	36	30	**33**	1.4%	1.1%	1.8%	1.5%	**1.6%**
Adverse Drug Reaction	24	17	23	21	**24**	1.5%	0.9%	1.2%	1.0%	**1.2%**
Fall	18	29	23	26	**24**	1.1%	1.5%	1.2%	1.3%	**1.2%**
Equipment/Supplies/Devices	10	13	11	15	**10**	0.6%	0.7%	0.6%	0.7%	**0.5%**
Medication Error	5	8	2	3	**2**	0.3%	0.4%	0.1%	0.1%	**0.1%**
Patient Self-Harm	5	1	1	1	**1**	0.3%	0.1%	0.1%	<0.05%	**<0.05%**
Transfusion	0	1	0	0	**0**	0.0%	0.1%	0.0%	0.0%	**0.0%**
Total	1,638	1,934	1,986	2,054	**2,070**	100%	100%	100%	100%	**100%**

Note: Numbers shown for prior years may differ from previously published numbers due to subsequent report deletions or event type changes made by reporting facilities. The sum of % of Total Reports may not equal the Total due to rounding.

Discussion

The number of reports submitted to PA-PSRS has varied over the past five years. In 2024, 315,418 reports were received, marking the first time more than 300,000 reports were submitted in a single calendar year. Reporting rates, which allow for normalized comparisons over time, show that the hospital reporting rate has increased for the second consecutive year, while the ASF rate has risen for the fourth. While our analysis identified increases related to several specific variables in 2024, further examination showed these were largely influenced by shifts in a limited number of facilities.

Conclusion

In 2024, the total number of reports, serious event reports, and high harm event reports increased, as did the preliminary reporting rates for hospitals and ASFs. The Patient Safety Authority will continue working with Pennsylvania healthcare facilities to enhance reporting quality and promote patient safety.

Note

This analysis was exempted from review by the Advarra Institutional Review Board.

Data used in this study cannot be made public due to their confidential nature, as outlined in the Medical Care Availability and Reduction of Error (MCARE) Act (Pennsylvania Act 13 of 2002).

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2024 Pennsylvania Patient Safety Reporting:

Updated Rates for Acute Care Event Reports

By **Shawn Kepner**, MS[1]

Keywords: reporting rates, hospitals, ambulatory surgical facilities

[1]Patient Safety Authority

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Introduction

In the patient safety trends article published on April 21, 2025,[1] reporting rates for 2024 were calculated based on data from the first half of the year, as data for Q3 and Q4 were not available as of the publication date. This brief update provides the final rates for 2024 using all quarters of data and compares them to the 2024 rates based on Q1 and Q2 as well as rates for prior years.

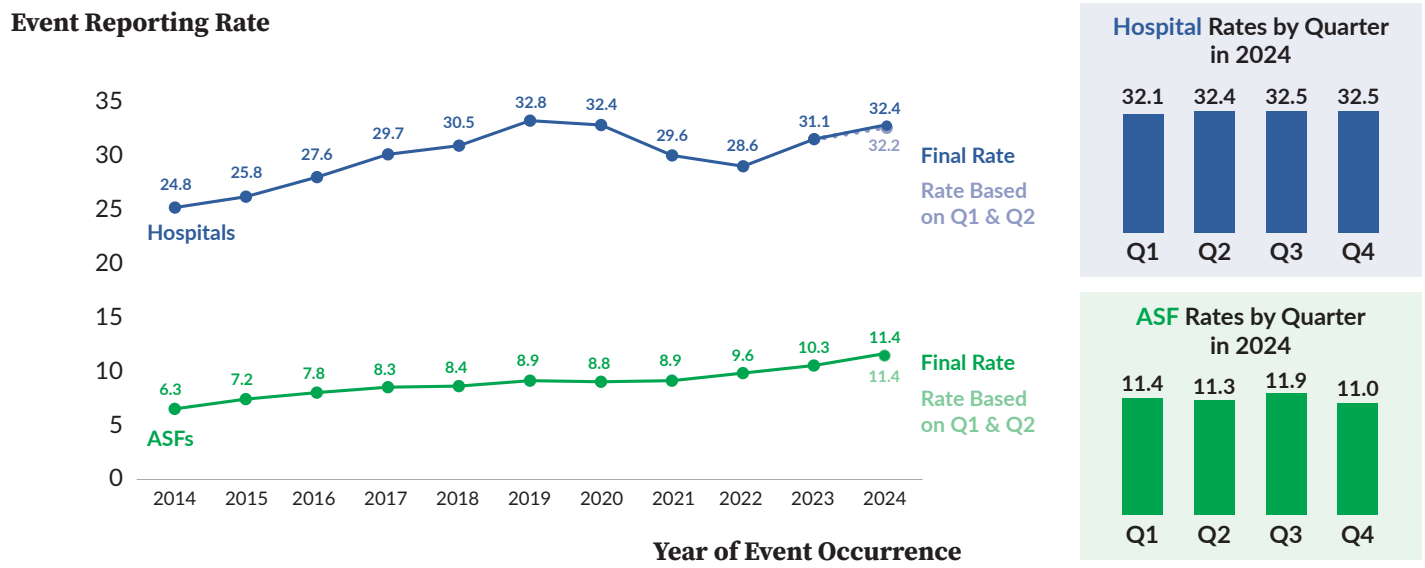
Methods

This analysis was performed using data extracted from the Pennsylvania Patient Safety Reporting System (PA-PSRS)[a] on June 30, 2025, and data obtained from the Pennsylvania Health Care Cost Containment Council (PHC4)[b] on June 9, 2025. Rates are calculated as the number of reports of events occurring in a given time frame per 1,000 patient days for hospitals and per 1,000 surgical encounters for ambulatory surgical facilities (ASFs). Since rates are based on the event occurrence date, and not submission date, some rates

[a]PA-PSRS is a secure, web-based system through which Pennsylvania hospitals, ambulatory surgical facilities, abortion facilities, and birthing centers submit reports of patient safety–related incidents and serious events in accordance with mandatory reporting laws outlined in the Medical Care Availability and Reduction of Error (MCARE) Act (Act 13 of 2002). All reports submitted through PA-PSRS are confidential and no information about individual facilities or providers is made public.

[b]The Pennsylvania Health Care Cost Containment Council (PHC4) is an independent state agency responsible for addressing the problem of escalating health costs, ensuring the quality of healthcare, and increasing access to healthcare for all citizens regardless of ability to pay. PHC4 has provided data to this entity in an effort to further PHC4's mission of educating the public and containing healthcare costs in Pennsylvania. PHC4, its agents, and its staff have made no representation, guarantee, or warranty, express or implied, that the data—financial-, patient-, payor-, and physician-specific information—provided to this entity are error-free, or that the use of the data will avoid differences of opinion or interpretation. This analysis was not prepared by PHC4. This analysis was done by the Patient Safety Authority. PHC4, its agents, and its staff bear no responsibility or liability for the results of the analysis, which are solely the opinion of this entity.

Figure 1. PA-PSRS Event Report Rates for Hospitals and ASFs From 2014 Through 2024



Note: Since rates are based on the event occurrence date, and not submission date, some rates may be slightly different than previously published. This is due to reports for events that occurred in prior periods being submitted after prior published results.

in this brief update are slightly different than previously published rates. This is due to reports for events that occurred in prior periods being submitted after the original data extraction dates. To determine whether a significant trend exists over time, simple linear regression analyses were used with a level of significance of α=0.05.

Results

Figure 1 shows rates by year from 2014 through 2024. With the addition of Q3 and Q4 data, the final hospital rate for 2024 increased by 0.2 points compared to the rate using only Q1 and Q2. The 2024 hospital rate of 32.4 represents the second increase since 2019 and has rebounded to a level comparable to 2020. For ASFs, the final rate for 2024 stayed the same as the rate using only Q1 and Q2. The 2024 ASF rate of 11.4 continued a significant upward trend (R^2=0.92, $F(1,9)$=110.78, $p < 0.0001$) from 2014 through 2024. The accompanying bar charts in **Figure 1** show rates for each of the four quarters of 2024 for hospitals and ASFs and show why 2024 final rates have values close to the rates based on Q1 and Q2 only.

Note

This analysis was exempted from review by the Advarra Institutional Review Board.

Data used in this study cannot be made public due to their confidential nature, as outlined in the Medical Care Availability and Reduction of Error (MCARE) Act (Pennsylvania Act 13 of 2002).[2]

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Promoting a Culture of Patient Safety:

Using the Principles of Just Culture to Improve Transparency and Risk Reporting in the Hospital Setting

By **Tanisha R. Davis**, DNP, RN*[1], **Kathryn Straatmann**, MHA*[1], **Nathan Snyder**, MSN, RN[1], **Darcy Shiner**, MSN, RN[1], **Addie Evans**, MSN, RN[1], **Carla Caruso**[1] & **Maria Alton**, MSN, RN[1]

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Abstract

Background: Improving patient safety culture is crucial in healthcare organizations. An inner-city tertiary care center with over 4,000 employees faced challenges with low participation rates in patient safety surveys and incident reporting, showing areas for improvement in leadership support and information exchange.

Methods and Interventions: The hospital implemented a comprehensive strategy addressing these challenges through updated educational resources, direct feedback on missed reporting opportunities, and robust Patient Safety and Quality team collaboration emphasizing leadership engagement.

Results: These efforts led to improvements shown through the Surveys on Patient Safety Culture (SOPS) participation increasing from 32.2% in 2021 to 44.4% in 2023. There was also a significant increase of 37.31% ($p<0.001$) in event reporting in 2023 compared to the average from 2019–2022. Leadership response to error improved significantly, with the SOPS results showing a shift from a low positive response (30% in 2017) to a majority positive response (>60% in 2023).

Conclusion: The integrated approach to patient safety resulted in enhanced transparency and a statistically significant, positive shift in the culture of safety. The collaborative efforts between Patient Safety and Quality departments, along with strong leadership support, were instrumental in these improvements. These findings highlight the importance of collaboration and leadership support in enhancing patient safety culture and transparency in healthcare organizations.

Introduction

Patient safety is a cornerstone of quality healthcare, focusing on preventing harm to patients from medical errors or system failures. Despite its importance, healthcare organizations often struggle to cultivate a culture of safety and transparency. A 528-bed inner-city tertiary academic care center with over 4,000 employees faces similar challenges. The hospital conducts biannual Surveys on Patient Safety Culture (SOPS) via the Agency for Healthcare Research and Quality (AHRQ). While these surveys have historically low participation, they have shown opportunities involving leadership support, information exchange, and culture of patient safety. The hospital and its greater health system uses RL6 as its internal risk reporting system available to all staff. Historically, RL6 reflected a low reporting volume when compared to intersystem hospitals with similar or lower numbers of beds and staff, which validated the need for advancements in educational opportunities, transparent sharing of events and lessons learned, and improved safety culture.

The hospital's challenges in patient safety culture and transparency have significant implications. With a participation goal of 60%, low participation rates in surveys (32.2% in the 2021 SOPS by AHRQ) and low RL6 reporting suggest gaps in leadership support, communication, and safety culture. These gaps can affect patient outcomes, staff morale, and the overall performance of the organization.[1]

Existing research underscores the importance of leadership support, communication, and a reporting culture in enhancing patient safety. Studies have shown that a positive safety culture is linked to reduced medical errors, decreased adverse events, and improved patient satisfaction.[1] Moreover, the principles of Just Culture emphasizing fairness and accountability in error reporting have been shown to promote reporting rates and organizational learning.

The hospital's need for interventions was guided by established frameworks such as the SOPS and the RL6 risk reporting system. Using these frameworks as a basis of improvement measurement, a multiphase project was developed. This project included educational initiatives surrounding resource updates, training, and follow-up; the establishment of quality improvement teams (QITs) aimed at enhancing patient safety culture and transparency; and leadership engagement.

This article looks to outline the implemented interventions, their impact on patient safety culture and transparency, and the insights gained for future initiatives. Improving patient safety culture and transparency is crucial for healthcare organizations like this hospital. By addressing the identified challenges and implementing effective interventions, the hospital aims to enhance patient safety, improve organizational performance, and provide better care for its patients.

Available Knowledge

In 1997, Lucian Leape, MD, testified to Congress that "the single greatest impediment to error prevention in the medical industry is that we punish people for making mistakes."[2] This testimony launched a new movement in healthcare, leading to the acceptance of a Just Culture. A Just Culture is a culture of learning, where staff trust they will not be punished for reported errors and accountability is accepted at all levels of an organization.[3] In a Just Culture, human errors are not punitive and are recognized as unintentional and inevitable, leading to system examination and redesign, where the staff involved is treated with compassion.[4]

There are several barriers that make the creation of a Just Culture in the healthcare setting a challenging endeavor. A systematic review named trust as an essential aspect of a Just Culture and defined this as the belief in an error reporting culture that "is honest, safe, and dependable." This review noted significant barriers to trust, including "lack of confidence in clinical skills, more fear of shame/blame by less experienced workers, and knowledge of the existing error reporting system" regarding users' perception of event reporting.[5] Voluntary reporting of patient safety events is vital to the sustainability of a Just Culture, and barriers to reporting can inhibit both the process and the success of a system.

A cross-sectional study utilizing historic data from the AHRQ SOPS Hospital Survey found common barriers to reporting were the lack of feedback on outcomes, action planning, or improvements following an event.[6] In addition, the study found that punitive action toward errors significantly deterred voluntary reporting of patient safety events and can have a negative impact on the trust in an organization's Just Culture.[6] Other studies on organization safety culture have shown leadership barriers, including fear of management retaliation or no change due to reporting a patient safety error.[7]

The literature supports a variety of recommendations to help with implementing a sustainable culture of safety within healthcare organizations. Literature suggests that leadership engagement is crucial to setting the tone for an open and learning-oriented environment. It is recommended that leaders actively communicate and show their commitment to patient safety, thereby inspiring confidence among staff members. By engaging with frontline healthcare providers, leaders can bridge the gap between management and implementation, leading to more effective safety initiatives. In a *Sentinel Event Alert* issue published by The Joint Commission it is noted that leadership engagement encourages reporting.[8] By building trust and encouraging reporting, leaders can empower staff to always be vigilant in reporting hazards despite the varying conditions faced in healthcare.[8]

Building trust is another crucial element in establishing a Just Culture. Research indicates that fear of retribution or punishment often prevents staff from reporting errors and near misses.[9] To address this, leaders should create a culture of psychological safety where staff feel comfortable speaking up about potential issues without the fear of negative consequences. Trust, critical to shared accountability, can be fostered through transparent communication, active listening, and consistently addressing concerns raised by staff.[9] In cultures of safety, staff routinely identify and report unsafe conditions and errors because they trust that their leaders want to know what is not working and will implement improvements with this information.[9]

Feedback can also play a critical role in the promotion of a Just Culture. Studies suggest placing priority on improving event feedback mechanisms and communication of event-related improvements made in response can increase the likelihood that a patient safety event will be voluntarily reported.[6] Timely and nonpunitive feedback is crucial for staff to feel comfortable sharing their experiences. Leaders should actively engage with staff by providing feedback, recognizing their efforts, and highlighting the impact of reporting on patient outcomes. This process not only instills trust

but also serves as a motivator for staff to continue participating in error reporting.

Commitment to the implementation of Just Culture is vital to sustaining Just Culture within an organization. Literature recommends the integration of safety practices into everyday processes, emphasizing that patient safety should be a core value within the organization.[9] One example suggested for this is the implementation of an interdisciplinary team debrief following events to help destigmatize events overall.[9] Collaborative debriefing following an incident helps in understanding the decision-making and identifying opportunities for system redesign.

In conclusion, Just Culture is crucial for fostering a climate that promotes error reporting and learning from near misses. Leadership engagement, building trust, feedback reporting, and commitment to implementation emerge as essential elements that contribute to the success of Just Culture. By actively incorporating these recommendations into healthcare organizations, leaders can create an environment where staff feel empowered to prioritize patient safety, resulting in improved outcomes for all.

Methods

The study was performed at a 528-bed academic medical center serving low-income neighborhoods, with over 4,000 total employees. The biannual SOPS survey, electronically deployed to staff via email, in 2021 showed that less than half the hospital staff completed the survey. Lack of survey completion by staff was a concern; additionally, the survey results demonstrated that 56.3% of the staff had not utilized the patient safety reporting system, known as RL6, in the previous 12 months. Validating low staff incident reporting and a decreasing trend, the mean of patient safety events reported monthly ranged from 532 in 2019 to 485 in 2022 (**Figure 1**). Enhancing the culture of safety at this comprehensive academic medical center was identified as a priority goal for 2023 by the chief executive officer, chief medical officer, and chief nursing officer.

Key stakeholders, sponsored by the executive leadership team, were assembled in quarter 4 of 2022 to analyze gaps, review the latest evidence-based literature, and develop tactics to implement in 2023. They identified areas within the surveys as top-priority opportunities to improve the hospital's culture of safety, including management support for event reporting, closed-loop communication regarding events reported, and a need for proactive reporting prior to the event reaching the patient (**Figure 2**). The team utilized The Joint Commission's Robust Process Improvement (RPI) framework to guide change-management methods in a phased approach.

To enhance understanding, the team updated educational resources and shared them broadly. Detailed examples of what to report on in the RL6 system, required and recommended events by the Patient Safety Authority, were provided to all staff, utilizing a single-point lesson and educational sessions at hospital- and department-level meetings. For example, this education was provided during new-hire orientations, physician resident Quality Improvement and Patient Safety (QIPS) rotations, service departmental meetings, and hospital leadership meetings. To keep the focus on improving a culture of safety and creating continuing engagement, the team also presented at the monthly Quality Webinar Series and coordinated to educate staff and visitors during Patient Safety Awareness Week and national Healthcare Quality Week.

Phase I of the performance improvement began in January 2023. Phase I interventions included efforts to promote transparency in patient safety reporting with the goal of multidisciplinary collaboration and improvement in culture of safety. To share events with all levels of staff and within the multidisciplinary team, a patient safety component was added into the existing QITs within each physician institute. These teams include representation from physicians, nursing, Quality, Patient Safety, and multiple other disciplines as applicable to each institute. The patient safety team reviewed departmental-specific reporting and case reviews, providing a forum for open discussion and feedback. The QIT platform linked disclosure and system improvement, employed an integrated team approach to safety and transparency, and allowed for accountable review of opportunities and trends.

Phase II began in May 2023. Efforts to build upon the educational initiatives and progress in phase I, to promote accountability and sustainability, were implemented. The Quality team staff reviewed all mortalities, complications, readmissions, resuscitations, and other quality reviews for missed Patient Safety incident reporting opportunities. A weekly review of events was conducted collaboratively with the patient safety team and direct feedback and education was provided to nursing, physician, and operations staff. This partnership ensured identification of patient events, provided direct feedback to the units on reportable events, and ensured that documentation of events was captured within the RL6 risk reporting platform.

Phase III began in October 2023. In response to the results from the 2023 SOPS results, all hospital units and departments were requested to develop an action plan targeting their area's top three opportunities identified in the survey. These action plans were to be monitored and updated at least quarterly for progress or barriers. Additionally, there was an overall hospital action plan approved and endorsed by senior leadership. This action plan was aimed at the hospital's top three opportunities: staffing, work pace, and hospital management support for patient safety. Initiatives from the hospital action plan directly tying into this culture of safety project include management involvement in patient safety committee meetings, a 2024 rollout of a Just Culture algorithm, and optimization of the risk reporting system RL6. RL6 improvements included mobile RL6 risk reporting introduced to all staff in November along with the preexisting desktop access and a physician-specific short form for quick event reporting in December.

To evaluate the success of the phased initiatives to improve the overall culture of safety, a variety of reports and tools were utilized. To evaluate the staff perception of the hospital's culture of safety, the SOPS results from 2021 and 2023 were compared and analyzed. Incident reporting practices and volume were captured within the RL6 incident reporting system and analyzed for statistically significant changes using R version 4.2.1 (R Foundation for Statistical Computing). Based on distribution of the data, a Wilcoxon signed-rank test and report medians and interquartile ranges (IQR) were used to analyze changes in reporting monthly compared to overall hospital patient days. Monthly data trending during the intervention was performed using a statistical process control chart to evaluate efficacy of interventions. And lastly, accountability and compliance with direct staff feedback and education from quality improvement reviews was captured and trended using a run chart.

Figure 1. Baseline Incident Reporting Trends

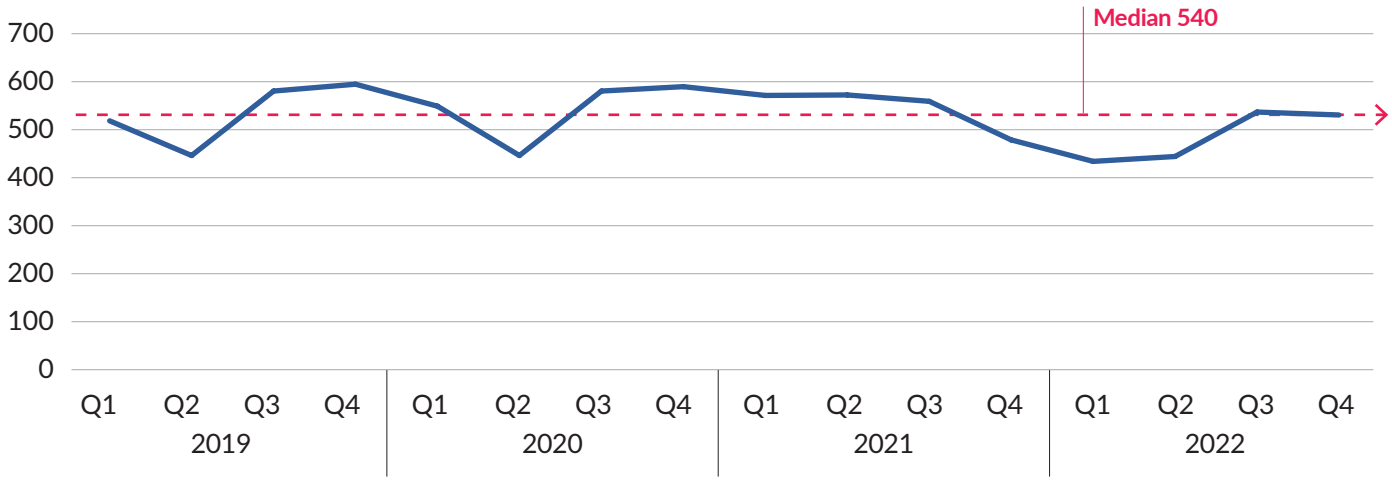
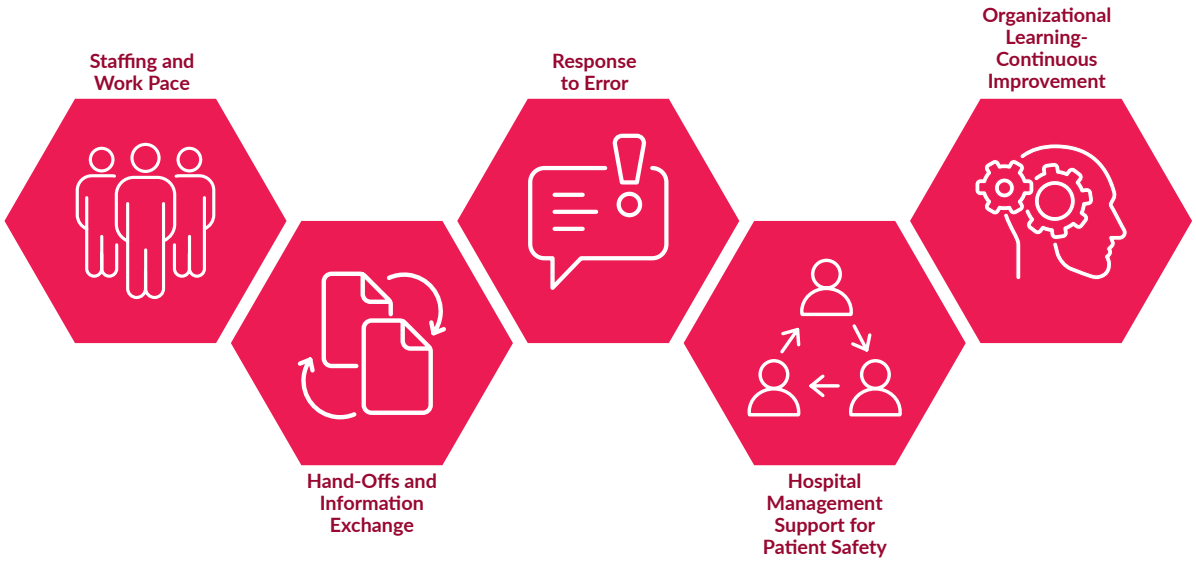
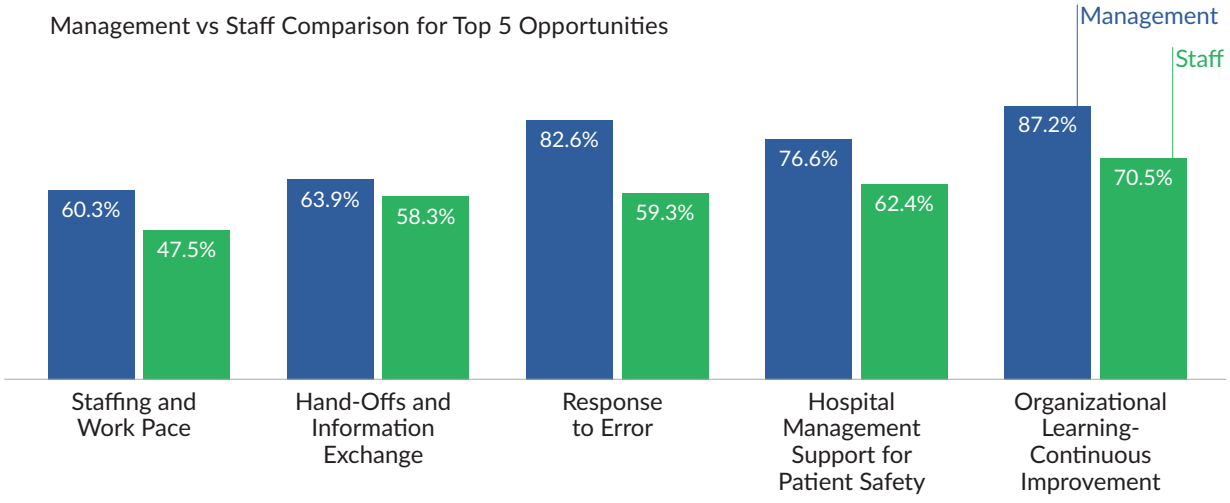


Figure 2. Survey of Patient Safety Top Five Opportunities





Results

For the SOPS, the teams worked together to raise awareness during the education initiative and multilevel meeting presentations to improve participation of all hospital staff from 32.2% in 2021 to 44.4% participation in 2023. In addition, the SOPS results around "Leadership Response to Error" improved significantly, with the SOPS results showing a shift from a low positive response (30% in 2017) to a majority positive response (>60% in 2023). The Quality and Patient Safety teams' improvements in transparency and collaboration resulted in a statistically significant 37.31% increase (p<0.001) in event reporting in 2023, despite concurrent increases in post-pandemic patient volume, compared to the average number of reports from 2019–2022 (**Figure 3**).

Positive increases in patient reporting by staff began in January 2023, corresponding with the inclusion of patient safety in QITs in January and in April when RL6 direct feedback began (**Figure 4**). Quality team review and staff feedback and education escalations peaked over the summer months, with an average of 30 escalations per month to reach a steady state of 10–11 escalations and reeducation of required RL6 reporting categories monthly by fall 2023 (**Figure 5**). Incidentally, the most notable increase in patient safety reporting was noted from December 2023 to January 2024, corresponding to an increase in laboratory leadership and team reporting patient safety events that were not previously captured. Management attendance in patient safety committee meetings improved from consistently less than 10 attendees to consistently more than 25 attendees after October.

Figure 3. Wilcoxon Signed-Rank Test and Report Medians and IQR

Characteristic	Pre-Initiative	Post-Initiative	*p*-value
RL6	461 (444, 525)	633 (596, 659)	<0.001
Patient Days	362 (349, 364)	394 (385, 395)	0.0015
RL6 per Patient Days	1.31 (1.26, 1.45)	1.64 (1.54, 1.67)	0.0015

Figure 4. Statistical Process Control Map of Incident Reporting (Jan. 2022 to Feb. 2024)

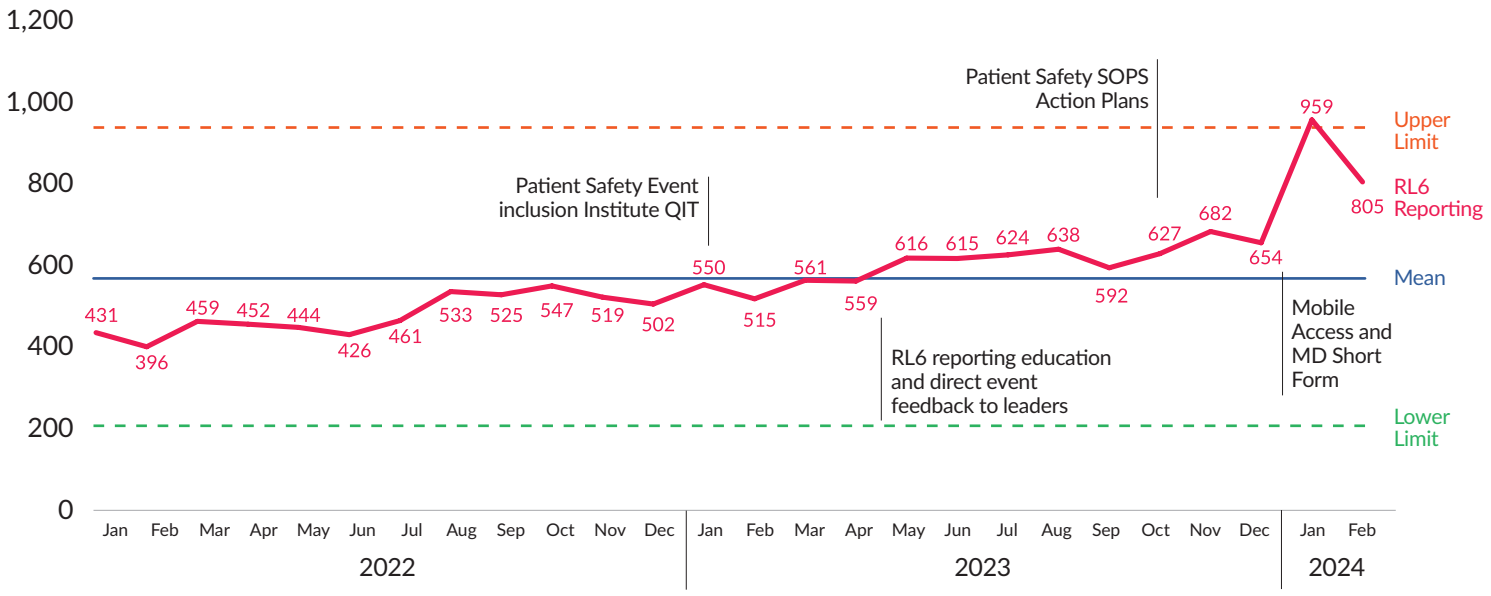
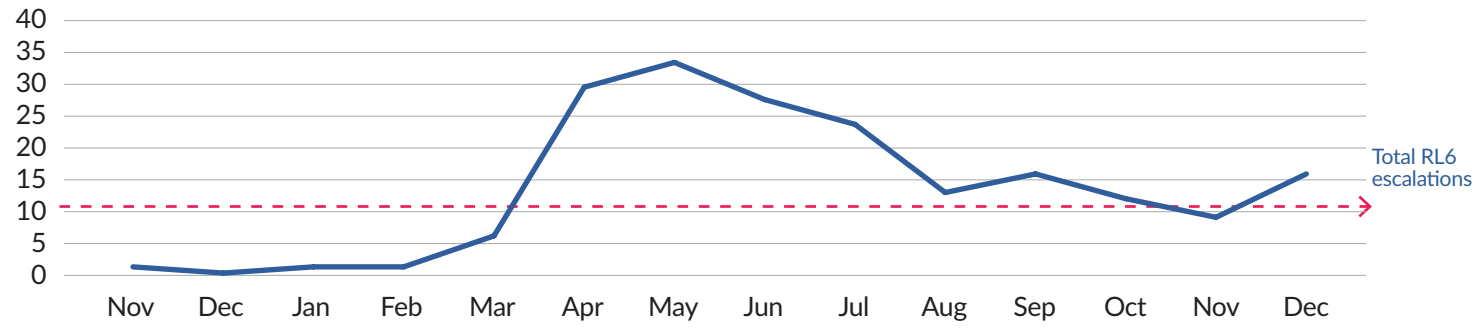


Figure 5. Total RL6 Staff Feedback and Education Escalation Run Chart



Discussion

The project aimed to enhance patient safety culture and transparency at this hospital through education, collaboration, and increased reporting. Key findings include an increase in survey participation and event reporting, and improvements in leadership response to errors. These findings are relevant to rationale and specific aims, demonstrating the effectiveness of the interventions in addressing identified barriers.

The interventions were associated with positive outcomes, indicating a statistically significant association between the interventions and the improvement in patient safety culture and transparency. These results are aligned with findings from other publications that emphasize the importance of leadership support, education, and collaboration in enhancing patient safety.[1] The project's impact on people and systems was significant, with increased trust in the reporting system and a more open culture regarding error reporting, shown by the remarkable increase in risk reporting in RL6 (**Figure 3**). These outcomes suggest that the interventions may have been successful in changing attitudes and behaviors related to patient safety.

The results of this project are consistent with previous studies that have demonstrated the effectiveness of educational initiatives and collaborative approaches in improving a hospital's patient safety culture.[1] The findings also support the importance of leadership support and transparent communication in fostering a culture of safety.[5] The project had a positive impact on both individual staff when reporting patient safety risks and the healthcare system in creating a positive feedback loop shown by the increased risk reporting and survey result improvements. The implementation of the various institute QITs facilitated multidisciplinary collaboration and improved communication, further enhancing the culture of safety.

The observed outcomes exceeded expectations, particularly in terms of increased event reporting and improved leadership response to errors in their participation with patient safety through the committee and the QITs. This may be attributed to the comprehensive approach taken by the project team, which included targeted educational initiatives, collaboration with key stakeholders, and regular feedback mechanisms. While the project required resources for implementation, including extensive Patient Safety and Quality teams' time and educational materials, the long-term benefits in terms of improved patient safety and organizational performance outweighed these costs. The strategic trade-offs involved reallocating resources to prioritize patient safety initiatives, which proved to be a worthwhile investment.

An initial limitation of this project included low levels of staff engagement, particularly among the medical staff who were hesitant to encourage reporting due to legal or peer review implications. However, medical staff quickly adapted and supported the new level of transparency that the hospital and institute leaders led by example. A second limitation was the increase in reporting starting in December 2023, relating to the lab team RL6 submission volume, which exceeded the statistical process control limits as an outlier. Due to the outlier, efficacy of the RL6 mobile access and physician short-form risk reporting initiatives to promote ease of use will require more trending and evaluation. Another limitation of the project is its generalizability to other healthcare settings. The findings may be specific to the context and size of the urban academic medical center where the project was conducted. Also, while efforts were made to minimize bias and confounding factors, these limitations cannot be eliminated in a real-world setting.

Conclusion

In conclusion, the project successfully improved patient safety culture and transparency, shown primarily by improved survey results and increased event reporting, a core tenet of Just Culture. The interventions implemented were effective in addressing barriers to a Just Culture and promoting a more open, initiative-taking, and collaborative approach to patient safety. The sustainability of these improvements will depend on continued leadership support and ongoing monitoring and evaluation.

The teamwork by Patient Safety and Quality to employ an integrated approach to patient safety at this hospital resulted in improved transparency and advancement in the culture of safety. With strong leadership support, the 2023 SOPS results were broadly distributed and led to action plans to improve the culture of safety, which were targeted with clear, measurable goals and centered around encouragement of event reporting, improvement in report follow-ups, and learning from other units' reports. To build on the success of this project, future efforts could focus on further enhancing the "Good Catch" program to encourage reporting of near misses and potential safety hazards. This could include the implementation of a reward system for staff members who identify and report potential safety issues and conduct regular audits to identify and address system-level issues. Additionally, ongoing education and training for staff members on patient safety best practices could help maintain a culture of safety over time.

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Enhancing Childhood Asthma Control and Reducing Emergencies Through the Implementation of the Centers for Disease Control and Prevention's **EXHALE** Strategy

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Abstract

Background: Globally, asthma causes a significant amount of morbidity and mortality among the pediatric population. Asthma affects about 25% of children in Saudi Arabia and is a common reason for emergency visits, with a significant social and financial burden. The EXHALE strategy, developed by the U.S. Centers for Disease Control and Prevention (CDC), offers a comprehensive approach to asthma management. Our project aimed to reduce pediatric asthma-related emergency department visits and hospital admissions by 20%.

Method: Our team developed a tailored approach at a tertiary hospital in Taif Region, Saudi Arabia, to meet the specific needs of our pediatric asthma patients as per the EXHALE strategy. The strategy consists of six components: education on asthma self-management, extinguishing smoking and exposure to secondhand smoke, home-based trigger reduction, achievement of guideline-based medical management, linkages and coordination of care across providers and settings, and encouragement of patients and engagement of healthcare practitioners. A pre- and post-design along with multiple Plan-Do-Check-Act cycles were used to implement this multifaceted approach, ensuring that young asthma patients receive the comprehensive support and resources needed to effectively manage their condition and enjoy an improved quality of life.

Results: There was a 60.61% reduction in the monthly average visits to the emergency department for asthma-related issues. The average monthly admission rate for asthma for pediatric population was reduced by 50%. The overall healthcare costs savings was 1,046,603 Saudi riyals during the project implementation from January to September 2023.

Conclusions: The EXHALE strategy is an effective approach to improve asthma care management while reducing the healthcare costs and improving the quality of life. This strategy also exemplifies a comprehensive and forward-thinking approach that aligns with both the specific goals of Saudi Vision 2030 and the broader mission of elevating healthcare standards.

Introduction

Problem Description

At Armed Forces Hospital, our team observed that 62% of asthmatic patients were uncontrolled in the year 2022. This represented 6% of the total monthly emergency department (ED) visits and 10% of the monthly pediatric hospital admissions. In addition, 60% of individuals referred to Pediatric Pulmonology were identified as asthma mimickers. This factor contributed to the extended third next available appointment (TNAA) for Pediatric Pulmonology, which was 23 days, surpassing the hospital's targeted timeframe of 14 days, thus emphasizing the need for a thorough and qualitative approach in ensuring accurate diagnosis and proficient management.

Available Knowledge

Asthma is a significant global health issue characterized by chronic airway inflammation, resulting in recurrent episodes of wheezing, breathlessness, chest tightness, and coughing. This condition poses a considerable burden on individuals' quality of life and healthcare systems due to frequent hospitalizations, ED visits, and medication costs. Asthma is ranked 16th among the leading causes of years lived with disability and 28th among the leading causes of burden of disease, as measured by disability-adjusted life years. Around 300 million people have asthma worldwide, and it is likely that by the end of 2025 a further 100 million may be affected.[1] Also, asthma is associated with a significant number of deaths, with an estimated 455,000 asthma-related fatalities reported globally in 2019.[2,3]

In the Kingdom of Saudi Arabia (KSA), more than 2 million people struggle from asthma, and a considerable number of them experience uncontrolled symptoms that significantly diminish their quality of life.[4,5] Annually, the cost of asthma was 88 million dirham in United Arab Emirates, 37.2 million U.S. dollars in the United States, and 27,014,735 Omani rials in Oman.[6-8]

The National Asthma Control Program (NACP) of the U.S. Centers for Disease Control and Prevention (CDC) developed a program called EXHALE, consisting of six strategies designed to enhance asthma control. These strategies are designed to complement each other to reinforce their impact. However, it's worth noting that the full implementation of this program in the KSA has not been realized yet.

Rationale

Saudi Vision 2030 sets out the directions, objectives, and commitments that the KSA seeks to increase citizens' well-being and quality of life. This can be achieved through promoting physical, psychological, and social well-being.

Asthma has a major impact on lifestyle and accounts for millions of missed school days each year. Thirty percent of young people with asthma have limited activity, compared with 5% of children without asthma.[9]

The implementation of the EXHALE strategy is driven by several compelling reasons in enhancing the control of asthma in patients, improving asthma management, and reducing the need for acute care services. This helps mitigate the economic burden associated with asthma-related healthcare utilization.

Aim

The key aim was to attain a 20% reduction in asthma-related visits to the ED, decreasing from 295 to 240 visits with a simultaneous reduction in hospitalizations due to asthma from 111 to 90 admissions by the end of September 2023.

Context

According to national guidelines, achieving comprehensive asthma control encompasses two primary facets. The first dimension involves reducing impairment, which entails preventing asthma symptoms, minimizing the utilization of emergency medications, maintaining optimal lung function, and ensuring individuals can participate in their regular physical activities while keeping up with their work or school attendance. The second dimension, on the other hand, focuses on reducing risk. This involves efforts to minimize the necessity for ED visits and hospitalizations by proactively preventing recurrent asthma attacks.

Our team adapted the CDC's EXHALE strategy by replacing the final component—environmental policies to reduce asthma triggers—with a focus on encouraging patients and engaging healthcare practitioners. This adjustment ensured the strategy better aligned with local needs and cultural context.

Methods

Interventions

The project spanned from January to September 2023, during which baseline data were retrospectively gathered by reviewing the patient medical records admitted in the hospital due to asthma exacerbation.

The EXHALE project has been implemented holistically throughout the hospital, ensuring quality care from the moment a patient arrives at the ED, admission to the inpatient ward or pediatric intensive care unit (PICU), and follow-up in the Outpatient Department (OPD) clinic.

The team is composed of pediatric physicians, pediatric pulmonologists, health educators, patients, and caregivers and quality representatives.

The EXHALE strategy, reconfigured at our facility, encompasses a range of interventions that are fundamental for enhancing the quality of care provided to pediatric patients with asthma (**Figure 1**). This serves as the framework of the project containing the strategies and approach applied to pediatric asthma patients.

The asthma management process incorporates the EXHALE strategies at specific steps to ensure comprehensive care. First, all pediatric asthma patients with follow-up appointments or those admitted to the ED, inpatient units, or visiting the OPD are referred to Health Education for asthma self-management education (AS-ME) and guidance on reducing exposure to secondhand and thirdhand smoke. This includes proper medication use, reviewing action plans, improving inhaler techniques, and promoting smoke-free environments and smoking cessation.

Next, Health Education experts provide targeted support on asthma trigger reduction and reinforce self-management techniques, revisiting these if asthma remains uncontrolled. Evidence-based clinical practice guidelines (CPG) are implemented in the ED, PICU, and pediatric ward to standardize

Figure 1. EXHALE Strategy Framework and Project Approach

	Strategy	Approach
E	Education on asthma self-management	Expanding access to and delivery of asthma self-management education (AS-ME). The AS-ME includes: • Informing the patient/family how to use medication correctly. • Reviewing patient asthma action plans. • Observing how the patient uses an inhaler. • Helping the patient improve their inhaler technique.
X	eXtinguishing secondhand and thirdhand smoke	Reducing exposure to secondhand and thirdhand smoke through family education.
H	Health education for trigger reduction and education on asthma self-management	Patients are referred to health education experts in asthma management for asthma trigger reduction and AS-ME.
A	Achievement of guideline-based medical management	Improving access and adherence to asthma medications and devices. Clinical practice guidelines for asthma management in ED, PICU, and pediatric ward.
L	Linkages and coordination of care across settings	Promoting coordinated care for people with asthma. Asthma education should be conducted by a well-trained healthcare worker and is coordinated through the Health Education department. It is essential to get feedback from the patient to maintain a bidirectional rapport.
E	Encouragement of patients and engagement of healthcare practitioners	Encouragement of patient and family to reduce or eliminate asthma triggers and engagement of healthcare workers on the approved clinical practice guidelines.

assessment, treatment, and monitoring. Coordinated care is promoted through the Health Education Department with patient feedback fostering bidirectional communication. Finally, patients and families are encouraged to minimize asthma triggers, while healthcare practitioners are engaged to adhere to approved CPG, ensuring consistent, evidence-based care and better outcomes.

The team has engaged in a structured process of Plan-Do-Check-Act (PDCA) cycles to optimize the implementation of the EXHALE strategy. Each cycle targeted specific aspects, from CPG implementation and asthma assessment forms to educational programs for patients, parents/caregivers, and collaboration with Health Education. These cycles demonstrated an adaptive approach, responding to initial successes, identifying challenges, and refining strategies for pediatric asthma management.

Study of the Intervention

Our measures focus on the key performance indicators (KPIs) on asthma-related hospitalizations, emergency department visits, and associated healthcare costs. These KPIs were reviewed and validated by the quality department of the hospital. Baseline data (January–December 2022) were collected and compared with the current data to effectively measure the strategy's impact. The team meets on a monthly basis to discuss the results and identify the challenges and generate action plans.

Measure

In terms of outcome measures, we measured the percentage of ED visits attributed to asthma exacerbation, the admission rate due to asthma exacerbation, and the percentage of controlled asthma patients based on defined criteria. Patient experience was evaluated qualitatively through a consented survey.

For the process domain, we measured the compliance with CPG in the ED, PICU, and pediatric ward. Additionally, we collected data regarding compliance with OPD appointments, analyzed the percentage of unnecessary ED visits, and tracked the percentage of patients who received health education on asthma management. The waiting time for education among uncontrolled asthma patients and the percentage of patients demonstrating correct device use were also assessed as process indicators.

Balancing measures focused on ensuring accuracy in asthma diagnoses, examining the percentage of patients correctly diagnosed as having asthma in comparison to the total number of admissions due to asthma.

These measures collectively provide a comprehensive understanding of the strategy's effectiveness in improving patient outcomes and optimizing processes in asthma management. The strategy enhances care by improving access through streamlined scheduling and referrals, ensuring adherence to clinical guidelines, and prioritizing AS-ME with trained educators. It also fosters coordination among multidisciplinary teams and implements regular monitoring to ensure seamless care transitions and effective tracking of patient progress. Additionally, families are educated on reducing asthma triggers to support better outcomes. By focusing on these processes, the strategy aims to reduce healthcare utilization, enhance patient and caregiver satisfaction, and drive continuous improvement through monthly evaluations.

Analysis

The project employed a quasi-experimental pre- and post-period design to assess the impact of the intervention. In this project, participants were not randomly assigned to groups, but rather, the study involved the introduction of an intervention and the comparison of outcomes before and after its implementation. The initial phase focused on gathering baseline data to understand the existing conditions related to the outcome variable. Subsequently, the intervention was introduced, and post-intervention data were collected to evaluate any changes in the outcome.

The quasi-experimental design allows for the assessment of the intervention's effectiveness in a real-world setting. Random assignment might not be feasible or ethical, and thus, this design provides a practical way to measure the impact of the intervention. The comparison of pre- and post-period data helps in understanding whether the observed changes can be attributed to the intervention. However, it's important to note that the absence of randomization introduces the possibility of nonequivalence between groups, and statistical methods are employed to control for potential confounding variables. While this design offers valuable insights into the intervention's effects, making causal inferences requires careful consideration of alternative explanations for any observed changes.

Ethical Considerations

As per hospital policy, Institutional Review Board (IRB) approval was not required because this was a quality improvement initiative.

Results

The strategy's effectiveness underwent a thorough evaluation, involving the collection and validation of data related to asthma outcomes, processes, and balancing measures (**Figure 2**). This systematic approach allowed for a detailed analysis of the strategy's influence across five distinct outcome measures and the assessment of the effectiveness of six implemented processes.

Emergency Department Visits

The primary outcome of the project was the targeted reduction in ED visits related to asthma exacerbation. The monthly average visits were reduced from 33 in the pre-project phase to 13 during the project implementation phase (**Figure 3**). Therefore, the targeted reduction in ED visits related to asthma resulted in an approximate 60.61% reduction in monthly average visits.

Asthma-Related Hospitalizations

The average monthly admission rate decreased from 13 patients to 6 patients (**Figure 4**). Therefore, the reduction in the average monthly admission rate was approximately 53.85%.

Figure 2. Data Collection Plan for EXHALE Strategy

Type of Measure	Indicator Title	Numerator	Denominator	Frequency
Outcome	% of ED visits with bronchial asthma exacerbation	Total number of pediatric ED visits with bronchial asthma exacerbation	Total number of ED visits (pediatric population)	Monthly
	Admission rate due to asthma exacerbation	Total number of admissions due to bronchial asthma	Total number of admissions	Monthly
	% of controlled asthma patients	Total number of controlled asthma patients as per definition	Total number of patients in the registry	Monthly
	Patient experience	Total number of patients who choose the top box per question	Total number of patients who took the survey	
Process	% of clinical practice guidelines (CPG) compliance in ED, PICU, and pediatric ward	Total number complied with the approved CPG	Total number of patients	Monthly
	% of compliance to Outpatient Department (OPD) appointments	Total number of patients booked	Total number of patients seen	Monthly
	% of unnecessary visits in ED	Total number of asthma patients not indicated for ED management (Green)	Total number of ED visits	Monthly
	% of patient who received health education regarding asthma management	Total number of patients seen by health educator	Total number of patients in the registry	Monthly
	Waiting time to education for uncontrolled asthma patients (Days)	Day referred to health educator	Day seen and received education about asthma management from health educator	Monthly
	% of patients who demonstrated correct device use	Total number of patients correctly demonstrated device use	Total number of patients	Monthly
Balancing	% of patients accurately diagnosed as asthma	Total number of correctly diagnosed patients	Total number of admitted patients due to asthma	Monthly

Figure 3. Before and After I-MR Chart of ED Admissions Due to Asthma Exacerbation 2022 (Pre-Project) vs 2023 (Project Implementation)

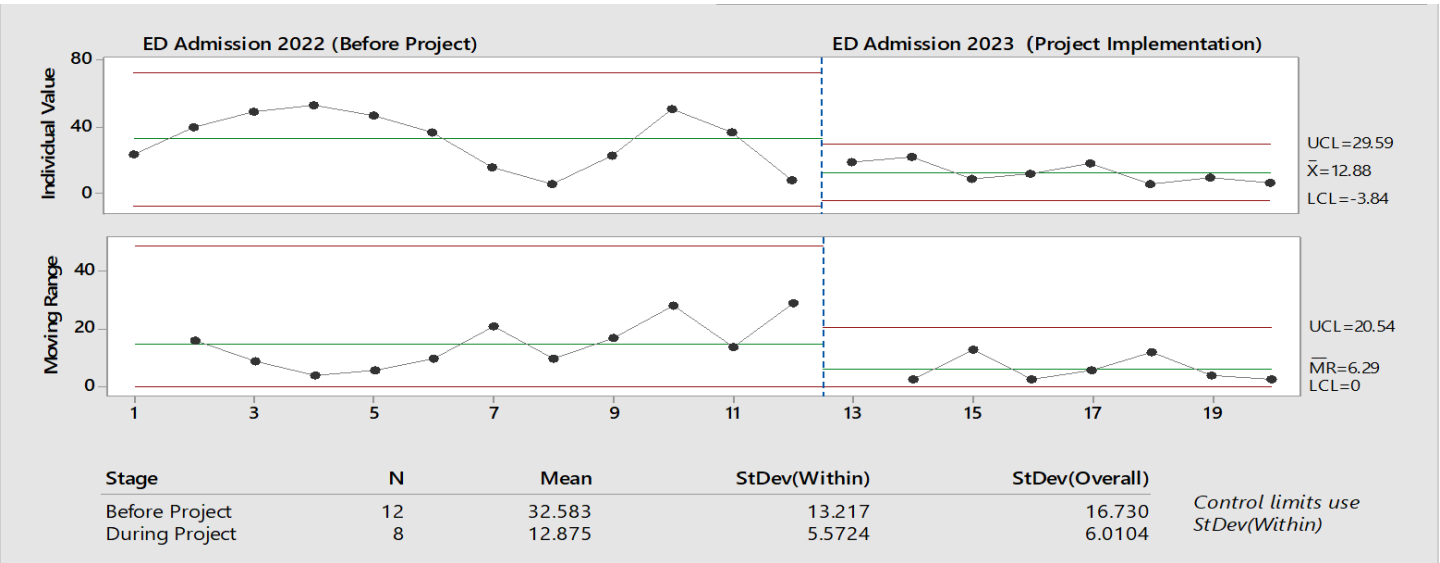
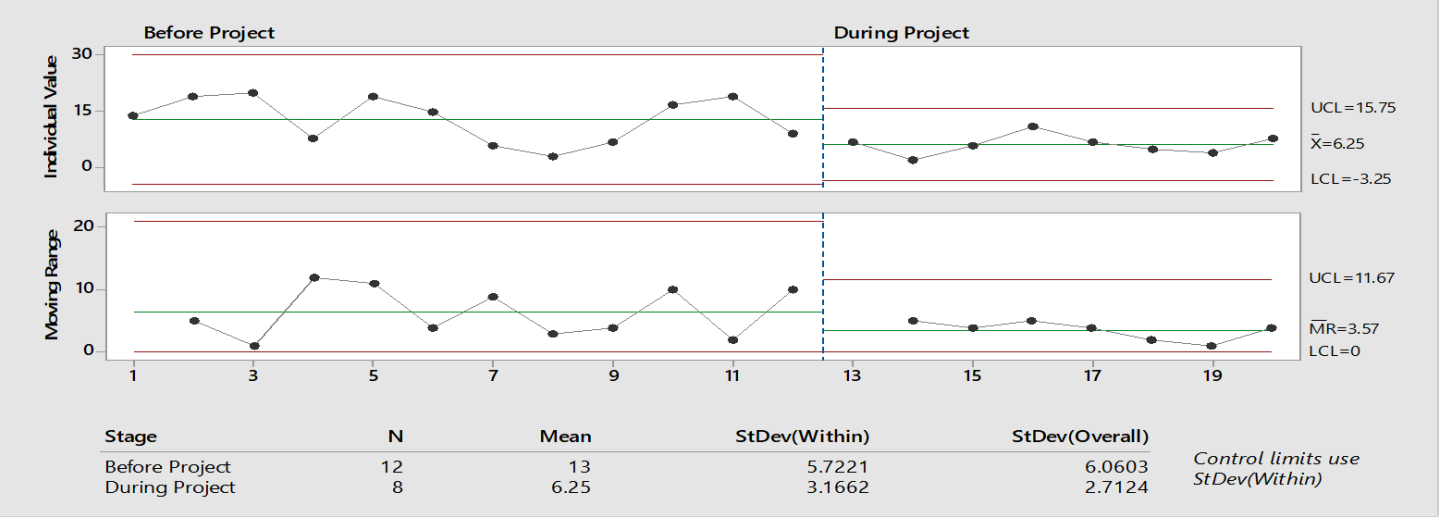


Figure 4. Before and After I-MR Chart of Hospital Admissions Due to Asthma Exacerbation 2022 (Pre-Project) vs 2023 (During Project)



Percentage of Controlled Asthma Patients

Shown in **Figure 5**, there was a substantial increase in the average of controlled asthma from 38.33% in 2022 to 72.44% during the project implementation.

Operational Gains (Healthcare Cost Reduction)

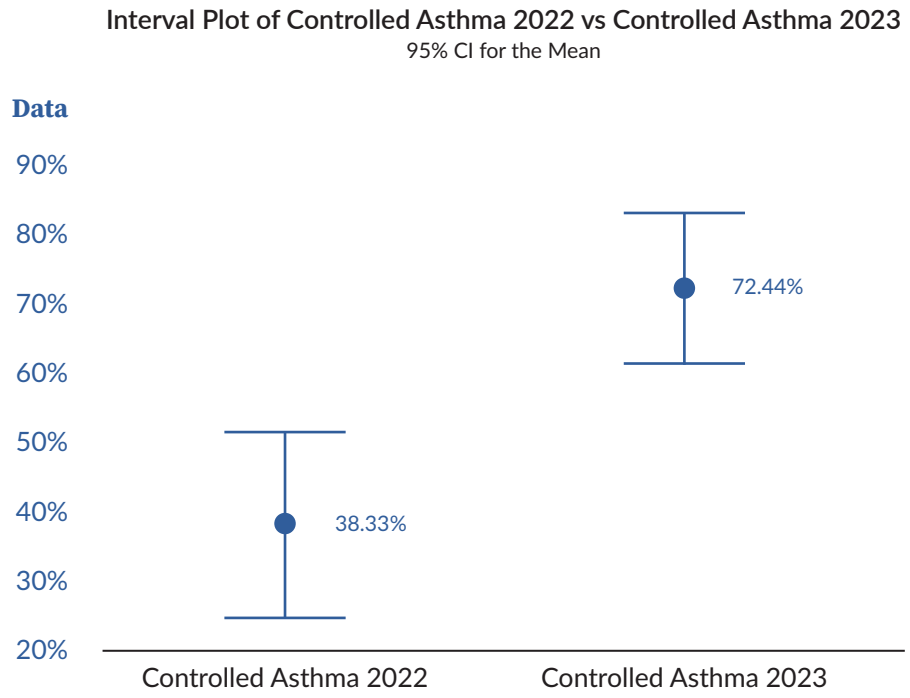
Saudi Arabia's healthcare system is government-funded and provided free of charge to all citizens and expatriates. The primary source of healthcare financing is the national budget, predominantly supported by the oil sector.[10] Consequently, minimizing costs associated with the disease burden is crucial. Through our project, we achieved a 60.61% reduction in asthma-related ED visits and a 53.85% decrease in hospital admissions. These improvements translated into substantial cost savings of 1,046,603 Saudi riyals during the implementation period.

We decreased the financial burden of the asthma-related ED visits by 60.61% and admissions by 53.85%. This led to significant cost savings of 1,046,603 SAR throughout the project implementation. (**Figure 6** and **Figure 7**).

Number of Asthma Patient Visits and Admissions

In the ED, there was a reduction from 295 visits in 2022 to 117 in 2023. In the pediatric ward, the number of visits decreased from 111 to 54. Similarly, in the PICU, there was a decline from 5 to 3 admissions. The OPD experienced a decrease from 744 visits in 2022 to 615 in 2023 (**Figure 8**).

Figure 5. Average Controlled Asthma for 2022 (Pre-Project) vs 2023 (Project Implementation)



Individual standard deviations were used to calculate the intervals.

Figure 6. Overall Asthma Management Costs Q1–Q3 2022 vs Q1–Q3 2023 (Saudi Riyal Currency)

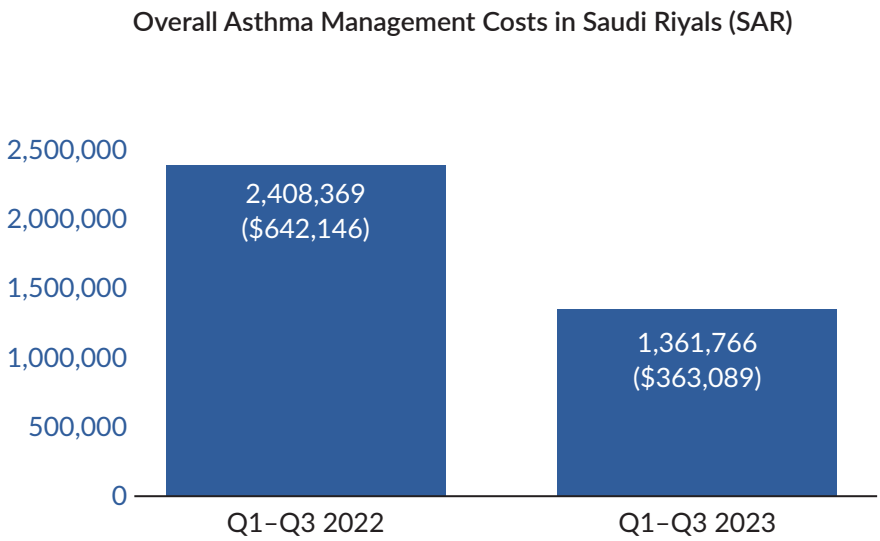


Figure 7. Asthma Management Expenses in ED, Pediatric Ward, PICU, and OPD Q1–Q3 2022 (Pre-Project) vs Q1–Q3 2023 (Project Implementation)[11,12]

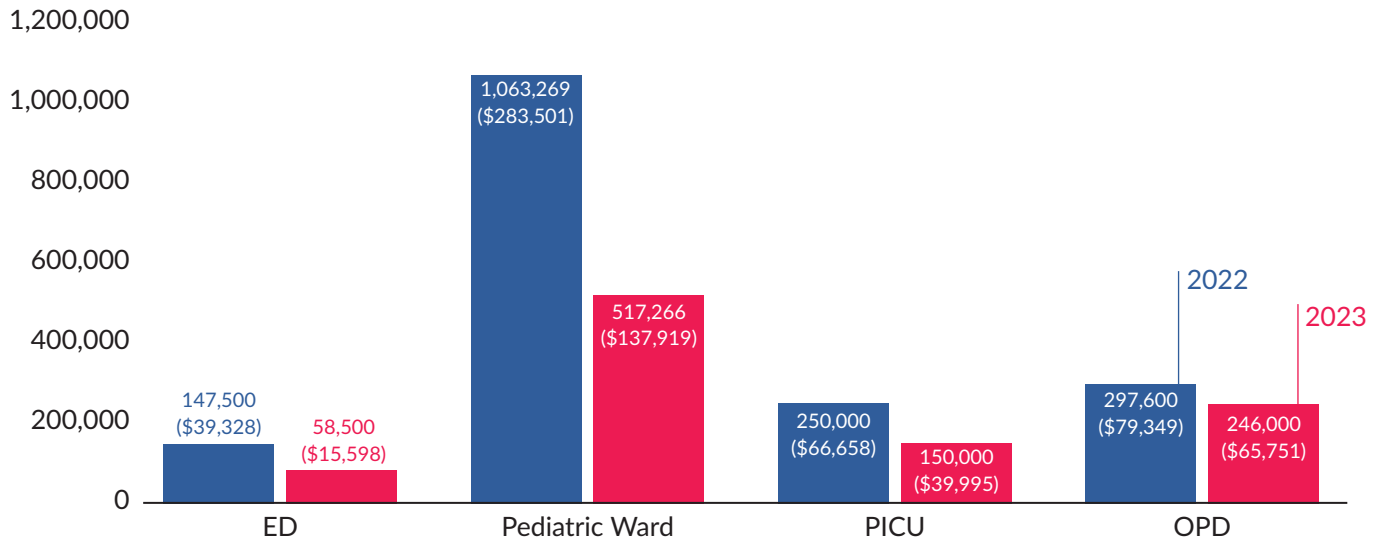
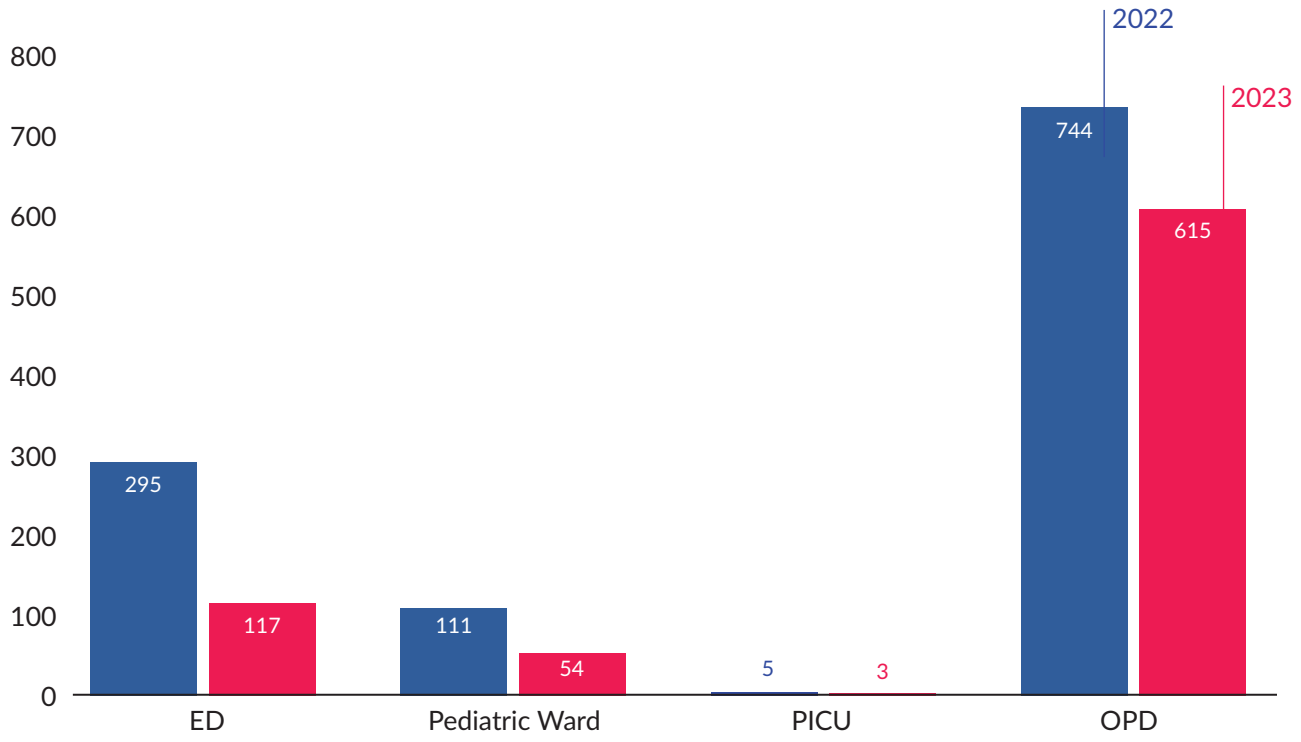


Figure 8. Number of Asthma Patient Visits and Admission 2022 (Pre-Project) vs 2023 (Project Implementation)



The decline in the number of visits in OPD had a great impact on the TNAA, which refers to the third earliest appointment that is available for scheduling. The TNAA for 2022 was initially 23 days; however, following the project kickoff, there was significant improvement and the average TNAA decreased to 10 days (**Figure 9**).

Patient Experience (Quality of Life Improvement)

The results from the Patient and Family Satisfaction Survey revealed an 88% for the overall project satisfaction (**Figure 10** and **Figure 11**).

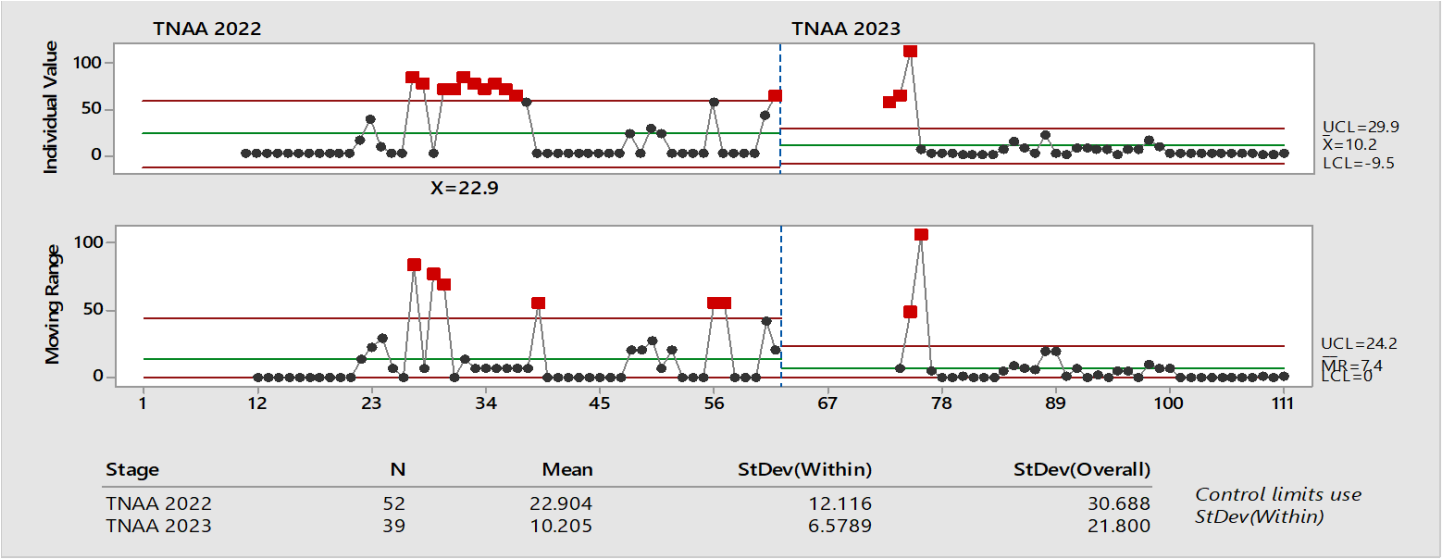
Average Compliance to Asthma Clinical Practice Guidelines by Physicians

The ED demonstrated an 82% compliance rate, the pediatric ward reached 86% compliance, and the PICU achieved 100% compliance (**Figure 12**).

Percentage of Compliance With OPD appointments

The team discussed the process measure involving compliance with OPD appointments (**Figure 13**), averaging at 73%, with administration. To enhance accessibility, especially for school-age patients, the team proposed initiating a virtual or telehealth program.

Figure 9. Before and After I-MR Chart of Third Next Available Appointment in Pediatric Pulmonology 2022 (Pre-Project) vs 2023 (Project Implementation)



Stage	N	Mean	StDev(Within)	StDev(Overall)
TNAA 2022	52	22.904	12.116	30.688
TNAA 2023	39	10.205	6.5789	21.800

Control limits use StDev(Within)

Figure 10. Top Box Percentages for Patient and Family Satisfaction Survey (Outcome Measure)

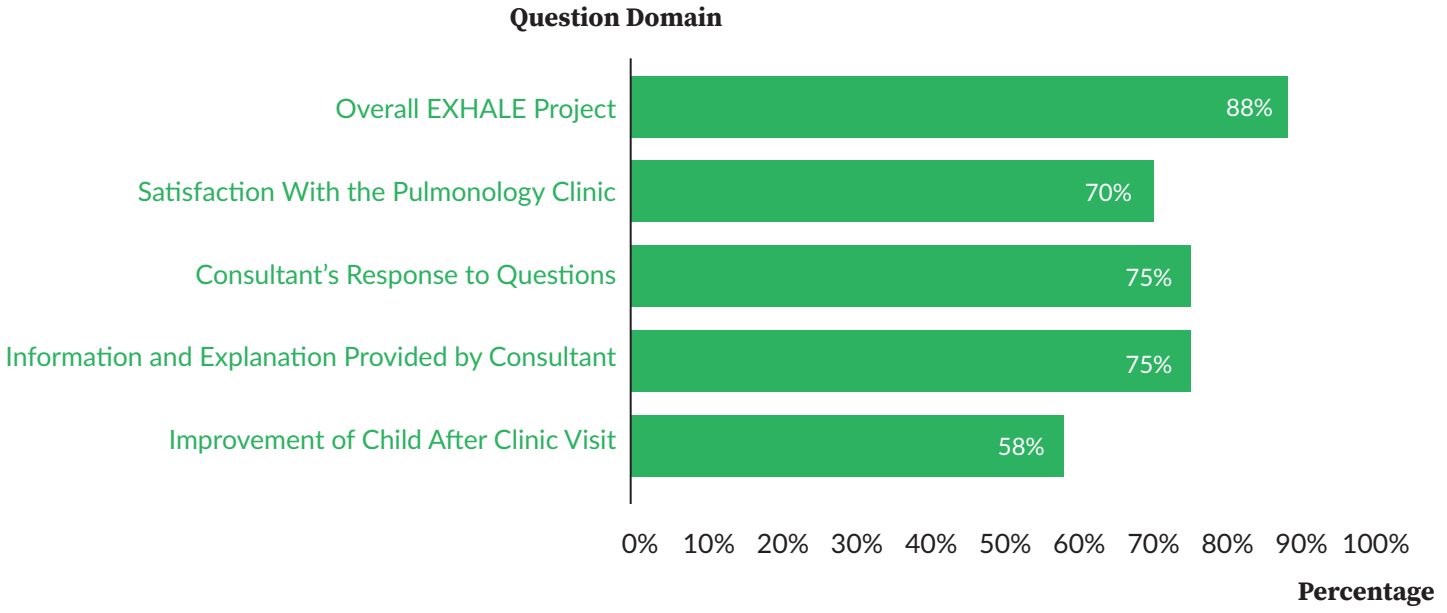


Figure 11. Patient and Family Satisfaction Survey for EXHALE Project — October 2023 (Outcome Measure)

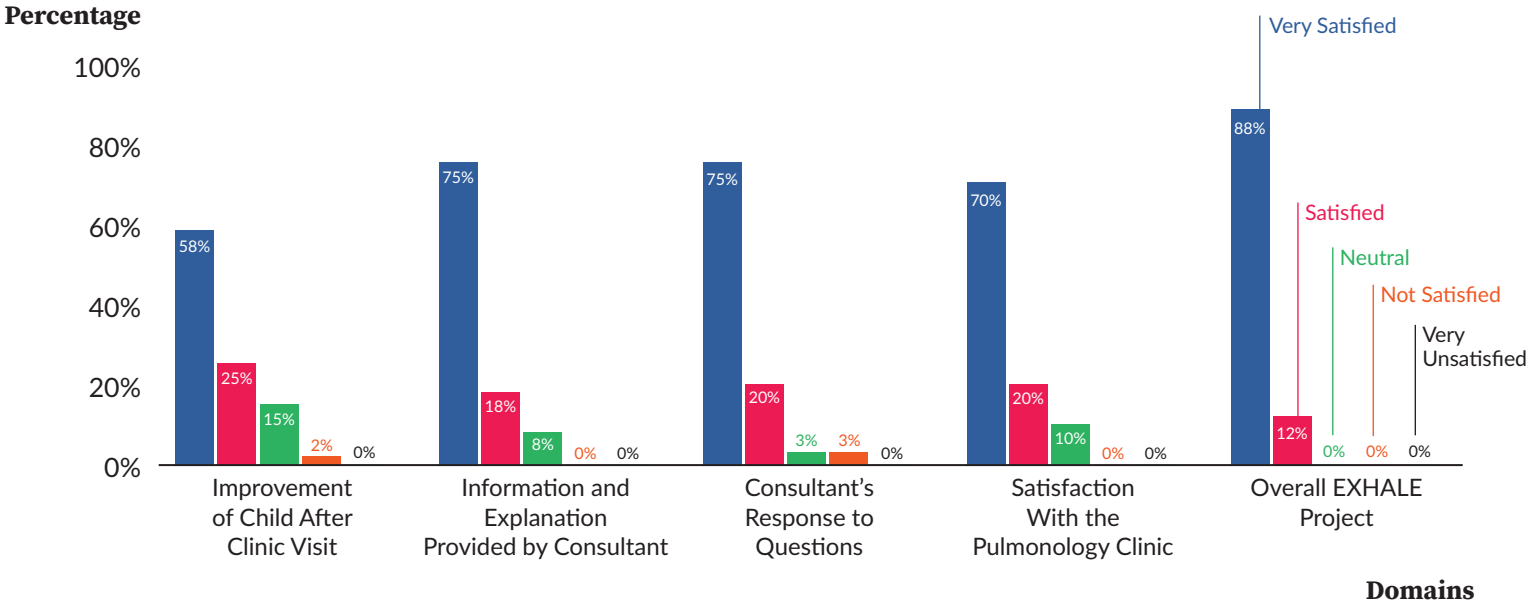


Figure 12. CPG Compliance to Asthma Management in ED, Pediatric Ward, and PICU (Process Measure)

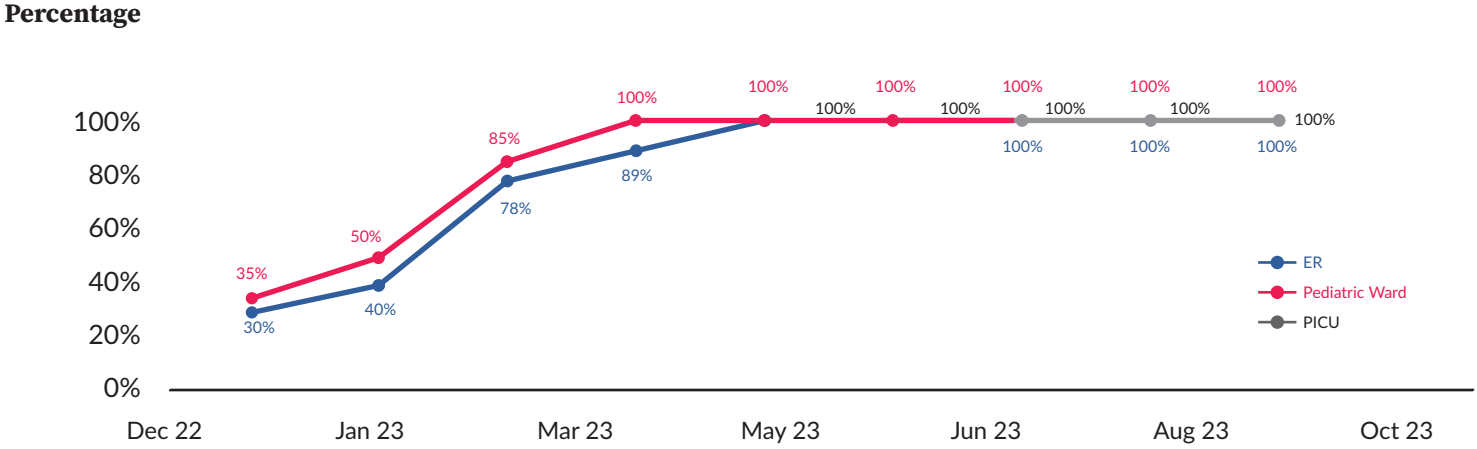
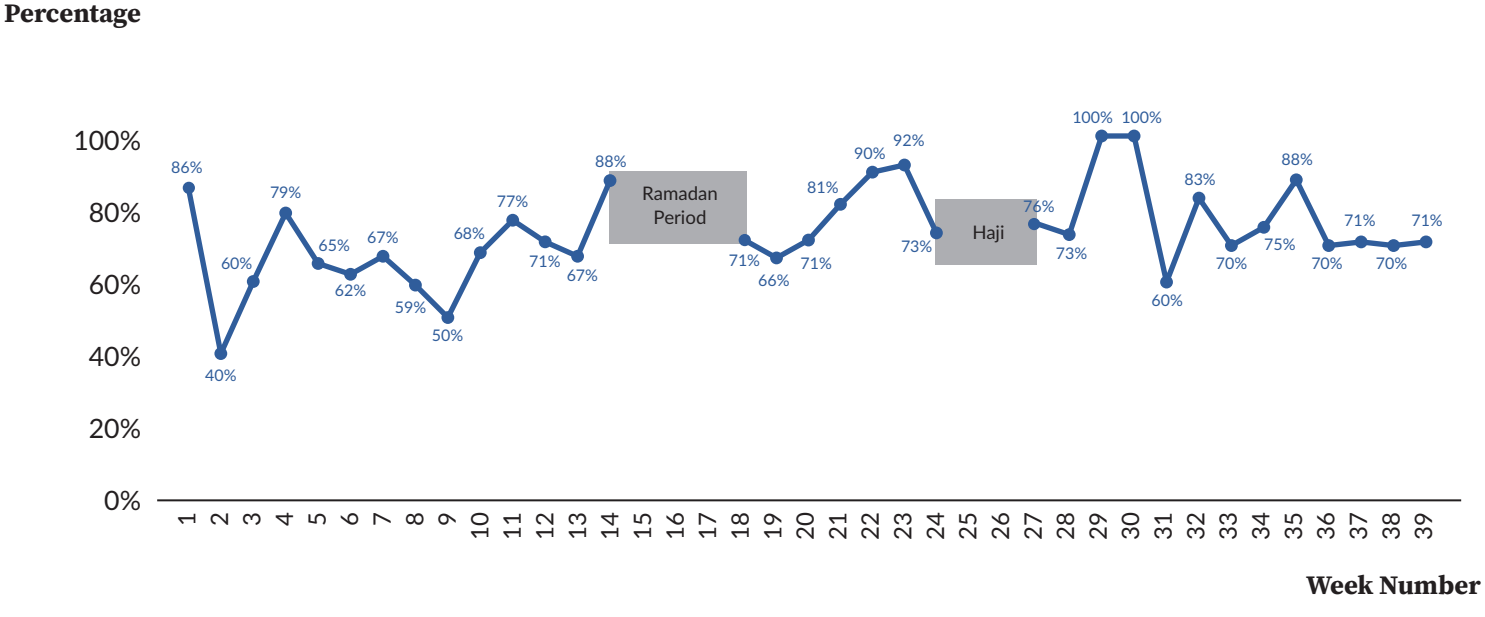


Figure 13. Compliance to OPD Appointments (Process Measure)



Unnecessary ED Visits

The process measure indicating the percentage of unnecessary ED visits is notably low at 1.6% (**Figure 14**).

Patients Received Health Education About Asthma Management

The collection of data on patients referred to Health Education who received AS-ME measures the effectiveness of the strategy's educational interventions. Initially, challenges were encountered, as health educators were not strategically integrated into the team and the team received no training. However, during the second quarter, a strategic addition was made with the introduction of trained health educators (**Figure 15**).

Average Waiting Time to Receive Education From Referral

The average waiting time for referred patients to receive AS-ME in the Health Education Department indicates an average waiting time of 32 minutes in the OPD and 43 minutes in the pediatric ward (**Figure 16**).

Percentage of Correct Inhaler Usage

Shown in **Figure 17**, correct inhaler device use through return demonstration indicates an average of 96%.

Percentage of Correctly Diagnosed Patients

The collection of the percentage of correctly diagnosed patients served as a balancing measure for our project. In the ED, the average correct patient diagnosis reached 96%. Similarly, the pediatric ward demonstrated accuracy of 98%. The PICU attained 100%, signifying precise diagnoses in critical care scenarios. Additionally, the OPD achieved a 100% accuracy in patient diagnoses (**Figure 18**).

Figure 14. Unnecessary ED Visits vs ED Patients Due to Asthma Exacerbation (Process Measure)

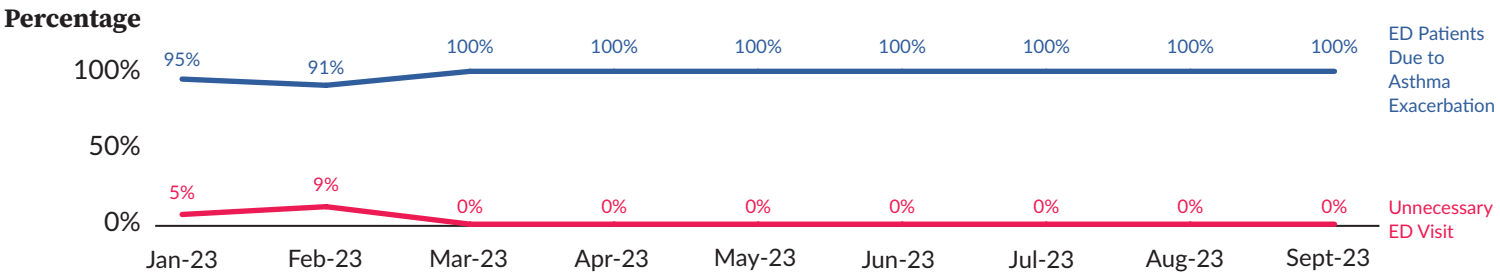


Figure 15. Asthma Patients Referred to Health Education Who Received Asthma Self-Management Education (Process Measure)

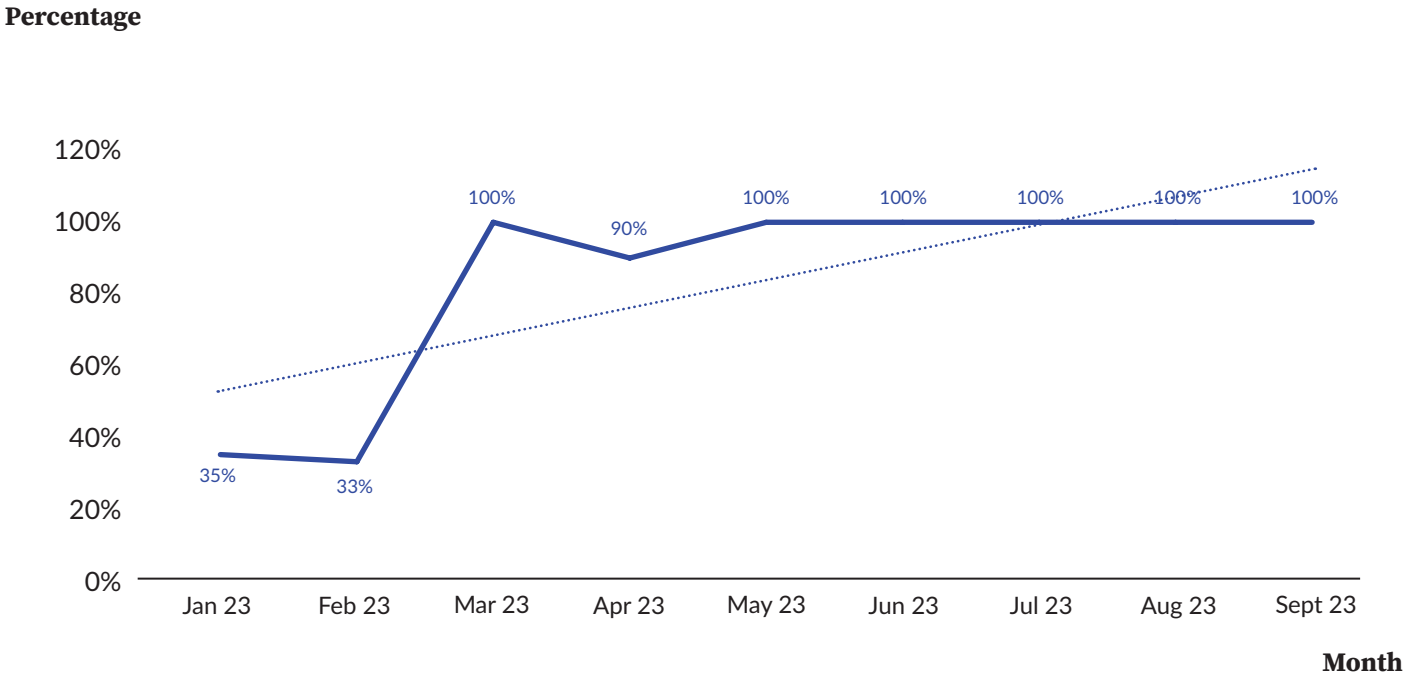


Figure 16. Waiting Time to Received Asthma Self-Management Education From Health Educators (Process Measure)

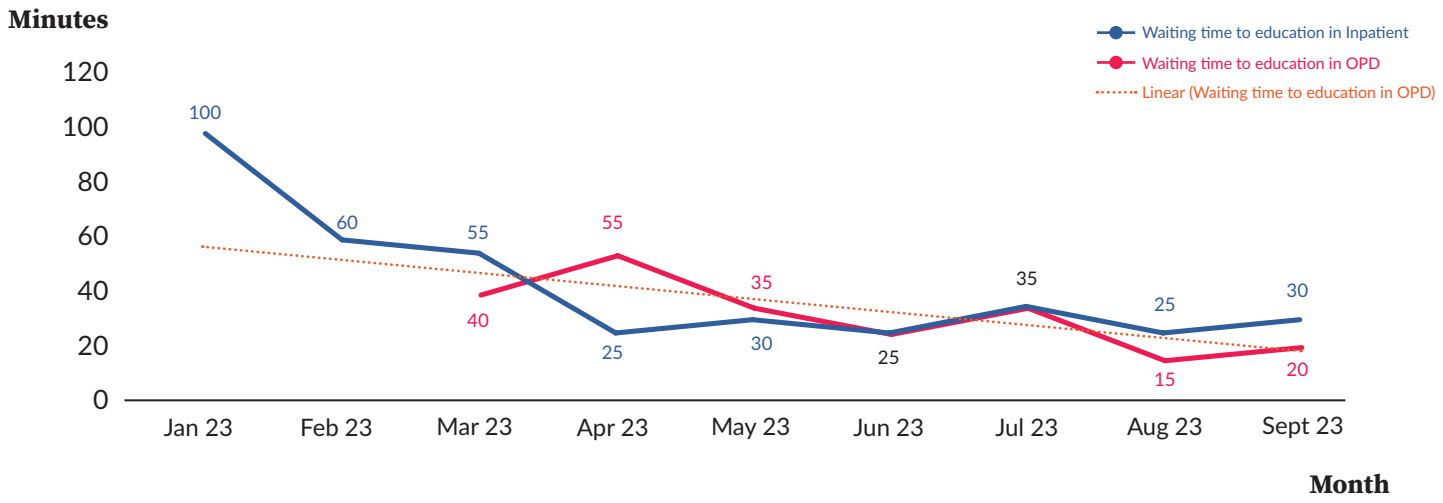


Figure 17. Percentage of Asthma Patients Who Demonstrated Correct Inhaler Use (Process Measure)

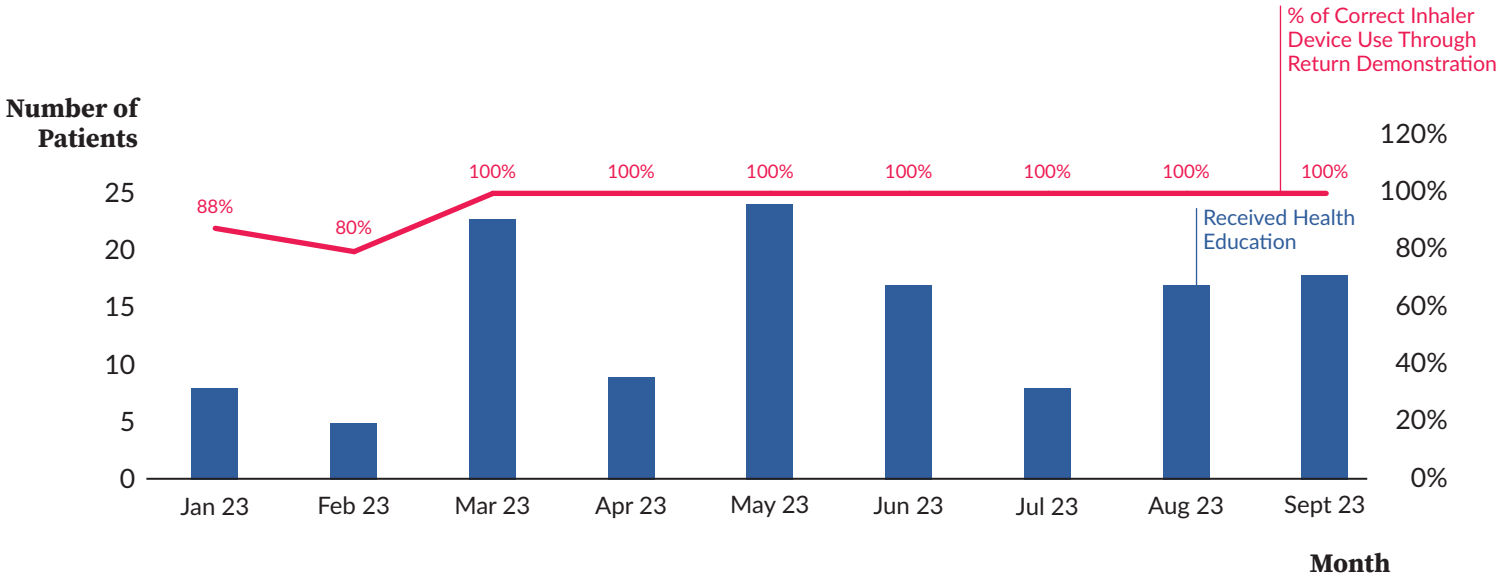
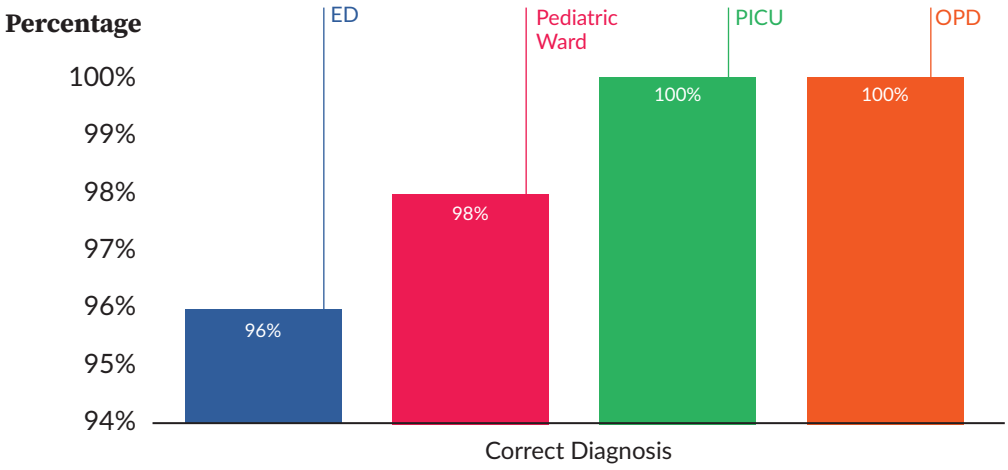


Figure 18. Correctly Diagnosed Patients With Asthma (Balancing Measure)



Summary

The EXHALE strategy in pediatric asthma management demonstrated significant success, including a remarkable 60.61% reduction in ED visits; a 53.85% decrease in monthly admissions; and a substantial improvement in controlled asthma, rising from 38.33% to 72.44%. The percentage of controlled patients increased from 38% to 72%. Additionally, the implementation led to a commendable cost reduction of 1,046,603 SAR from January to September 2023, highlighting the strategy's success in improving healthcare efficiency and patient outcomes.

The positive impact on process measures further reinforces this success, with a 73% compliance rate with OPD appointments, CPG compliance of 89%, unnecessary ED visits reduced to 2%, and an effective education rate of referred patients about AS-ME. Further, the low 1.6% rate of unnecessary ED visits contributed to the overall positive outcomes.

In terms of balancing measures, correct patient diagnosis resulted to an average of 98.5%. Overall, the EXHALE strategy has demonstrated comprehensive success in pediatric asthma management, including positive clinical outcomes, cost reduction, and accurate patient diagnoses.

Discussion

Interpretation

The outcomes of the implemented EXHALE strategy stand strongly with the CDC's principles for pediatric asthma management. The strategy's significant reduction in ED visits aligns with the CDC's emphasis on preventive measures and timely interventions to minimize acute asthma exacerbations.

Additionally, the outcomes of the EXHALE strategy distinctly align with fundamental healthcare quality domains, underscoring its impact on pediatric asthma care. Firstly, for the safety domain, our project's impact on the reduction in ED visits and admissions and maintaining an average patient diagnosis accuracy of 98.5% ensures safety and commitment to patient well-being. Effectiveness is evident in enhancing controlled asthma cases, with an increase from 38.33% to 72.44%. Efficiency is addressed through a cost reduction of 1,046,603 SAR, emphasizing the strategy's contribution to the efficient allocation and utilization of resources within the healthcare system. The patient-centeredness is evident in high compliance rates with outpatient appointments and effective education about AS-ME.

The findings of our project align with and expand upon results from previous implementations of the EXHALE strategy in various healthcare systems. For instance, the Missouri Asthma Prevention and Control Program (MAPCP) achieved significant cost savings by integrating AS-ME and environmental assessments into Medicaid-reimbursed services.[13] Their focus on increasing guideline-based medication use aligns closely with this project's emphasis on clinical guideline adherence, with similar reductions in healthcare utilization.

Throughout the project's duration, the implementation of the EXHALE strategy has yielded positive outcomes for the ongoing patient flow "ENSIAB" project in the OPD, particularly within the Pediatric Pulmonology clinic. The reduction in TNAA wait times from 23 days to 10 days underscores the strategy's effectiveness in enhancing the efficiency and responsiveness of healthcare services, aligning seamlessly with the patient flow project's objectives.

Limitations

The EXHALE strategy, while successful in achieving positive outcomes, is not without its limitations. One key limitation is the potential variability in the implementation of the strategy across different healthcare settings. The success observed in this particular context may not necessarily be replicated in diverse settings with distinct patient populations and healthcare infrastructures. Additionally, the reliance on self-reported measures, such as patient satisfaction and compliance, introduces the possibility of social desirability bias and may not fully capture objective indicators of the strategy's impact. Another limitation is the dependence on historical data for comparison, which may not fully account for external factors influencing outcomes over time. Furthermore, the study's duration may limit the assessment of the strategy's long-term sustainability and its adaptability to evolving healthcare landscapes. Despite these limitations, the EXHALE strategy serves as a valuable initiative in pediatric asthma management, and ongoing evaluations and adaptations can address these challenges for continuous improvement.

Conclusions

The success of the EXHALE project extends beyond qualitative measures, encompassing significant enhancement in the quality of life for asthmatic patients. The project's multifaceted approach, incorporating game-changing ideas, teamwork, training, and patient engagement, has resulted in a transformative impact on the overall well-being of individuals living with asthma.

By adopting patient-centered strategies, the EXHALE project addressed not only the medical aspects of asthma management, but also the broader aspects of patients' lives. The emphasis on education, awareness, and self-management empowered patients to take an active role in their health, fostering a sense of control and confidence in managing their condition. As a result, patients experienced fewer asthma attacks, improved symptom control, and better overall respiratory health.

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Data Statement: The authors confirm that the data supporting the findings of this study are available within the article.

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Decreasing Surgical Specimen-Handling Errors:

A Network Quality Improvement Journey

Keywords: multidisciplinary teams

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Abstract

Background: Surgical specimen handling is a complex, multidisciplinary process that involves ordering, collecting, labeling, preserving, transporting, testing, and reporting results so a patient receives a diagnosis or treatment plan. A multihospital healthcare network identified specimen handling as a problem-prone process.

Methods: A project team formed to complete a failure mode and effects analysis (FMEA), identify high-risk specimen-handling steps, and implement practice changes to prevent future specimen-handling errors. The project team used the FMEA seven-step process to evaluate the practice problem and identify opportunities for improvement.

Intervention: The project team identified 82 failure modes in the FMEA. The 10 failure modes with the highest risk score were selected for a process improvement project. The perioperative project subteam and pathology laboratory project subteam initiated process improvement efforts after evaluating evidence-based practices for the 10 highest-risk process steps.

Outcomes: The project has been sustained through monthly quality monitoring and reporting. At the time of this publication, 11 months post-implementation, no serious events for surgical specimens have been reported.

Introduction

Surgical specimen handling is a multistep process that includes ordering, collecting, labeling, preserving, transporting, testing, and reporting results so the patient receives a diagnosis or treatment plan. The individual steps of the specimen-handling process are categorized into phases, including the preanalytic phase (starting with the decision to collect a specimen until the specimen leaves the operating room), analytic phase (starting at the time the lab personnel receive the specimen until the testing is completed), and the postanalytic phase (starting when the testing is completed and lasting until the results are reported).[1,2] Multidisciplinary collaboration is required between the surgeon, circulating nurse, surgical technologist, and pathology team to process a surgical specimen successfully. The specimen-handling process is an inherently complex workflow and problem-prone. When surgical specimens are mishandled, it contributes to increased morbidity, mortality, and healthcare costs.[1,2]

Problem Description

This project took place at a healthcare network of nine hospitals and four ambulatory surgery centers in the northeast United States. Approximately 22,500 specimens are processed quarterly in the healthcare network, with an error rate of 1.6 per 1,000 cases. The network quality team identified specimen handling as a problem-prone workflow when two serious events prevented a patient from receiving a diagnosis or treatment plan. The National Quality Forum defines a serious event as a harmful clinical event that is largely preventable.[3] One serious event involved a lost specimen, and one serious event involved a mislabeled specimen. The quality team conducted a root cause analysis (RCA) in collaboration with hospital leadership and identified opportunities to strengthen system procedures to prevent future errors. A recommendation of the RCA was to conduct a failure mode and effects analysis (FMEA) for the specimen-handling workflow to prevent future errors from occurring.

Specific Aims

The objectives of the project were to

- Conduct an FMEA analysis of the specimen-handling process to identify and select high-risk workflows for a quality improvement project.
- Design and implement evidence-based changes to improve specimen-handling workflows and prevent future errors with frontline staff input.
- Monitor outcomes of the process improvement project and adjust as indicated to maintain success with the practice changes.

Available Knowledge

Surgical specimen errors are reported most often during the preanalytic phase, with rates of 45%–71% across all specimen-handling error reports.[2] Common specimen-handling errors ascribed to the preanalytic phase include mislabeled or unlabeled specimens, mismatches between specimens and the requisition form, incorrect order entry, lost specimens, incorrect preservation methods, transportation delays, or delivery to the incorrect lab location.[1] Factors that contribute to specimen-handling errors include workflow variations and workarounds for collecting and processing specimens; knowledge and competence deficits; incomplete policies and procedures; failure to follow policies and procedures; environmental factors, including distractions or interruptions; miscommunication; and human factors for errors.[1]

Reason's Swiss cheese model of system accidents is commonly used to explain the impact of human factors on errors in complex systems like healthcare. The Swiss cheese model describes the interplay between errors, system failures, and safe practices.[4] Errors are defined as unintentional deviations from safe practices and are classified into two categories, active and latent.[4] Active errors are events that occur at the point of contact between frontline personnel and a system interface and include errors of planning (mistakes) and errors of execution (slips or lapses).[4,5] Contributing factors for mistakes include knowledge, skill gaps, lack of training, or narrowed focus.[4] Contributing factors for slips or lapses include fatigue, noise, distractions, performance pressure, and inability to recall information to complete the task.[4] Latent errors describe system design flaws like institutional factors, work environment factors, or team factors contributing to active errors.[4,5]

High-reliability organizations focus on eliminating errors by introducing practices that make the system error-resistant.[6] Systems-focused error prevention strategies include cognitive aids, reporting systems, communication techniques, and effective training.[6] Cognitive aids are just-in-time resources like algorithms or checklists that provide memory or decision support to frontline staff so they can correctly complete protocols or tasks. Successful cognitive aids are based on policies or guidelines, provide relevant information while eliminating unnecessary information, and organize information in the correct sequence.[6] Hospitals use reporting systems to identify near misses and actual events, complete analysis of contributing factors, and strengthen systems to prevent future errors.[6] Accurate and timely communication is critical to a safety culture.

The healthcare industry has adopted closed-loop communication techniques and structured communication templates from aviation and military training through programs like TeamSTEPPS and crew resource management.[7,8] Training and competency evaluation are conducted at predetermined and periodic intervals to ensure that frontline staff have the knowledge, skills, and behaviors to successfully perform work tasks and support the safety culture within the organization.[6] Finally, there are multiple tools to analyze errors and prevent future occurrences using a systems approach, including the RCA and FMEA. The RCA is a retrospective method used to analyze contributing factors and identify actions to implement to prevent a future occurrence.[5] In contrast, the FMEA is a prospective method to identify problem-prone steps within a complex process to design and implement systems changes that would prevent future errors.[9]

The 2023 Association of periOperative Registered Nurses (AORN) *Guidelines for Perioperative Practice* addresses 21 topics in the section on specimen handling. Topics pertinent to this project include intraoperative team communication, transfer from the sterile field, handling, containment, labeling and requisition forms, policies and procedures, education, and quality. First, team communication should start at the preoperative briefing when the surgeon identifies specimen collection needs. AORN advocates for using a read-back method during any handover process and verbal confirmation of the correct specimen, labeling, number of specimens, requisition, and preservation methods.[10] Next, the specimen will be transferred as soon as possible from the sterile field, and the specimen will be contained and labeled immediately, labeling one specimen at a time, and the specimen identification

will be confirmed verbally.[10] Finally, ensure multidisciplinary involvement in the development and review of policies and procedures, assess staff knowledge and competency levels, monitor and evaluate data on specimen handling, implement changes in specimen management based on data, and use a systems approach to reduce the risk of specimen-handling errors.[10]

Methods

The project team selected the Centers for Medicare & Medicaid Services (CMS)–supplied FMEA tool *Guidance for Performing Failure Mode and Effects Analysis With Performance Improvement Projects* as the framework for this project.[9] This tool identifies seven key steps to complete an FMEA, described in this section as it applies to this project. The project was initiated in September 2022 by identifying key stakeholders to participate in an interdisciplinary committee to complete the FMEA process. In October 2022, the project leaders conducted a kickoff meeting to state the project objectives and desired outcomes and evaluate best practices for specimen handling. The project team mapped the process flow identifying each step of the specimen-handling process between November 2022 and January 2023. The identification and scoring of failure modes was completed by March 2023. The project teams created action plans for the top 10 highest risk failure modes between April 2023 and July 2023, with network socialization of the project plan in August 2023. Auditing and follow-up of strategies began in September 2023. Sustainability continues to be evaluated.

The first step of FMEA is to select a topic. The scope of this FMEA was specimen handling from operating room (OR) to result completion. The process steps include preoperative huddle communication to identify potential specimens, verbal specimen orders, order entry, specimen retrieval, specimen hand-off, specimen preparation and labeling, specimen transport, specimen testing, and specimen results. The opportunity for error and patient impact were key drivers for choosing this high-risk clinical process.

The second step is to create a project charter and identify the key stakeholders. The project charter described the project's scope, identified project participants, and set objectives and outcomes. Three key experts led the project in specimen handling and performance improvement. The facilitators included the network director for Quality and Patient Safety to guide the team with the FMEA methodology, the director of Nursing Education and Professional Practice: Perioperative, Procedural, and Paraprofessional Education, and the quality director for the Pathology Institute. Additional team members included one surgeon, one pathologist, one OR director, two OR managers, one OR nurse, one laboratory manager, and hospital-specific patient safety officers. Each committee member was considered a subject matter expert (SME) and voluntarily committed to participate in the FMEA process. To complete the FMEA process, the team met every other week.

The third step of FMEA is to describe the process. A process flow diagram was completed, identifying each step of obtaining a specimen from the OR through result completion (**Figure 1**). In the fourth step, the project team identifies what can go wrong during each process step. The SMEs participated in a series of brainstorming sessions that identified contributors to error, or failure modes, throughout each step in the specimen-handling process. The facilitators identified the failure modes by adding each failure mode to the FMEA tool (**Figure 2**).

In the fifth step, the project team selects problems to work on. Eighty-two failure modes were identified in the brainstorming sessions. The SMEs evaluated each mode on a scale from 1–10 (10 was the highest concern) for likelihood to occur, likelihood for detection, and level of severity. A risk profile number was calculated, and the top 10 failure modes were identified by the facilitators for action planning (**Table 1**). The top 10 list was socialized with the FMEA team and was adopted as the key areas of concentration for improvement activity.

Figure 1. Process Flow for Specimen FMEA

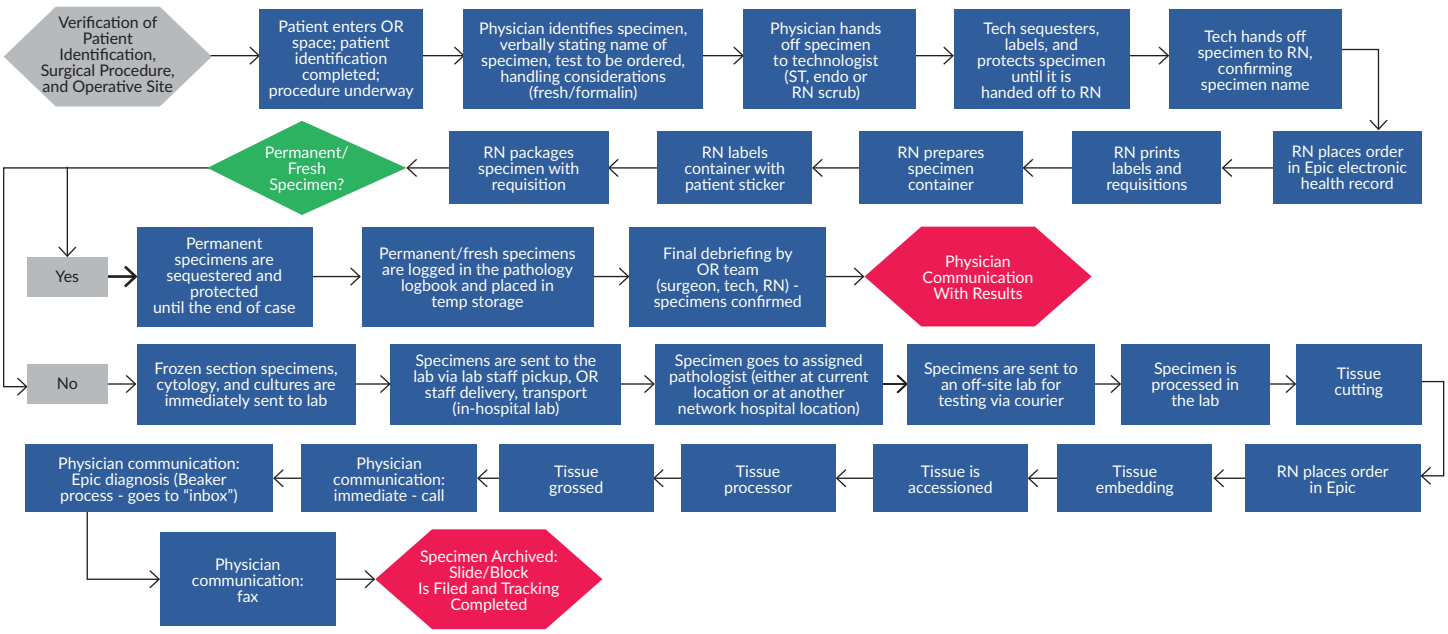


Figure 2. FMEA Tool

Steps in the process	Failure Mode	Failure Causes	Failure Effects	Likelihood of Occurrence	Likelihood of Detection	Severity	Risk Profile Number	Actions to Reduce Occurrence
List each step	What could go wrong?	Why would the failure happen?	What would be the consequence of the failure?	On a scale of 1–10, how likely is this to occur?	On a scale of 1–10, what is the likelihood this WON'T be detected?	On a scale of 1–10, what is the likelihood this failure would cause severe harm?	Multiply the three numbers together	List possible actions to prevent the failures

Interventions

In the sixth step of FMEA, the project team designs and implements changes to reduce problems. The facilitators worked with their SME and departmental teams to develop action plans for each of the top 10 failure modes identified during the FMEA process. Specific activities were shared with the entire FMEA committee and approved for implementation.

The OR team created a network specimen-handling council comprised of nurses and surgical technologists representing the hospital and surgery center OR and gastrointestinal (GI) lab departments. The council created a network-standardized, specimen-handling procedure based on the 2023 AORN guidelines. Key interventions selected that support accurate specimen-handling workflows included:

- Discussion of specimens during the preoperative huddle
- Immediate documentation of the specimen orders by the nurse as the physician is retrieving the specimen
- Use of read-back methods to confirm the specimen name during every hand-off
- Implementation of a double-check process by the surgical scrub and circulating nurse to verify all specimens before they leave the procedural room for specimen transport
- Implementation of a double-check process by the laboratory to verify all specimens at the time of pickup in the procedural area, education, and widespread socialization of the project[10]

Each OR and GI lab manager selected a physician champion, and the project was presented at each facility's perioperative executive meeting. An education module was assigned to all OR nurses, surgical technologists, and endoscopy technicians, and huddles were used to reinforce the new process.

The lab team focused on standardizing a log utilized to document specimens and a process to barcode specimens to track delivery. A redesign of the specimen log sheet both in the OR space and for dropped-off specimens allowed for better identification of labeling and ordering errors. Lab staff were instructed not to fix errors but to ask the submitting department to correct issues before accepting specimens. This led to the identification of information technology solutions for ordering difficulty. In addition, for specimens collected in the ambulatory space or remote surgical centers, the team set up weekly meetings with our contracted courier service to implement barcoding for tracking purposes. A portal system was designed for clients to place pickup orders and allowed for printing labels with the correct address and barcodes. Couriers were instructed to scan the specimen barcode at its origin and final lab destination. A weekly report of scanning activity was reviewed at each meeting, and improvement opportunities were identified.

In the seventh FMEA step, the team measures the success of process changes. The facilitators worked with the electronic incident reporting administrator and patient safety officers to develop a specific report related to specimen handling for each location in the network. This report was received monthly and shared with the FMEA SME and the hospital-based patient safety committees (PSC). Additionally, the OR teams developed an audit of the specimen process to confirm that the specimens were correctly labeled, and both double-check verifications were completed. The OR audit results are reported at the facility's PSC meetings. Fifteen random audits were conducted in the OR until the department had three consecutive months with equal to or greater than 85% compliance with each process using a standardized form. Finally, the facilitators sustained the project by reviewing and reporting specimen-handling errors monthly. The facilitators will initiate a quality improvement cycle if the number of specimen errors exceeds the baseline recording or if the type of errors reported is serious or problematic.

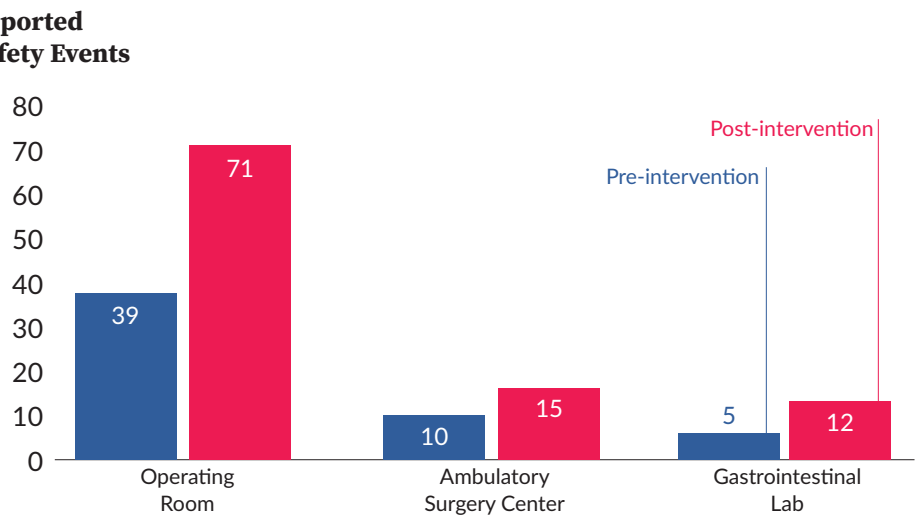
Measures

Process measures and outcome measures were recorded to determine compliance with the project and impact on outcomes. The process measures for the project included an internally created audit to determine compliance with the new specimen-handling process in the OR, for lab pickup, and for barcode scanning with the courier service. Outcome measures include the number and type of reported mishandled specimens obtained from the network patient safety reporting system. Process and outcome measures were submitted to the network specimen-handling committee. The number and type of reported mishandled specimens by month and the results of the monthly OR audit were reported monthly to the project team, the network specimen-handling committee, and the perioperative leaders. The perioperative leaders report this information quarterly at their perioperative executive committee meetings and the facility patient safety meetings.

Table 1. Failure Modes for the 10 Highest-Risk Scores With Interventions

Failure Mode Score	Area	Failure Mode	Interventions
256	Lab	Specimen sent to lab by courier: specimen delivered to incorrect location/delayed pickup/lost during transportation	Barcode tracking of specimens
256	OR	Circulating nurse places order in electronic health record: incorrect information entered	• Discuss anticipated specimens in preoperative huddle • Use of read-back techniques to confirm the verbal specimen order • Immediate documentation of the specimen order • Electronic health record optimization for specimen ordering
256	OR	Surgical scrub hands off specimen to nurse confirming specimen name: mix-up in hand-off/labeling	• Use of read-back techniques to confirm specimen name during hand-offs • Only one unlabeled specimen is permitted on the workspace at a time
256	OR	Permanent/fresh specimens are sequestered and protected until the end of the case: specimens thrown away/lost	• Final debriefing process • Specimen double-check process (OR Staff)
200	OR	Permanent/fresh specimens are sequestered and protected until the end of the case: specimens left in the room at the end of the case	Specimen double-check process (lab staff)
192	OR	Final debriefing surgical team confirms specimens with surgeon before they leave the surgical/procedural suite: not completed with all stakeholders present	• Education • Site-based champions and leadership dyad team communication and feedback
192	OR	Circulating nurse prints labels and requisitions: wrong label on specimen/wrong requisition	• Only one unlabeled specimen is permitted on the workspace at a time • Final debriefing process • Specimen double-check process (OR Staff)
192	OR	Circulating nurse prints labels and requisitions: wrong patient information	• Throw away unused labels at the end of every care • Only one unlabeled specimen is permitted on the workspace at a time • Final debriefing process • Specimen double-check process (OR Staff)
192	OR	Wrong size container/medium for specimen	• Education • Job aid: specimen handling
192	Lab	Specimens sent off-site for testing: wrong lab, packaging, instructions	Specimen double-check process (lab staff)

Figure 3. Data Comparison Pre-Intervention (April 2023 to Sept. 2023) vs Post-Intervention (Nov. 2023 to April 2024)



Results

Using the FMEA process, the SMEs identified 82 failure modes throughout the 28 steps in specimen handling. Once the top 10 failure modes were identified and process improvement activities commenced, workflow enhancements were monitored with the network patient safety reporting system, monthly OR audits, and partnering with the contracted courier service to track and resolve specimen transport issues. Monthly OR audits found that 16 out of 23 departments demonstrated three consecutive months of greater than 85% compliance with new workflows during the project's first three months. Twenty of the 23 departments demonstrated three consecutive months of greater than 85% compliance with new workflows within six months.

Weekly meetings with the contracted courier service to create a transport issue tracking log demonstrated improved specimen tracking with newly implemented package labels and barcodes. Barcoding of packages and standardizing labels for packages was effective in the timely delivery of specimens. The team did not report any lost specimens; there was an improved delivery to the correct lab for testing. At the time of publication, the barcode scanning compliance was 83% with pickup and delivery. Reported near miss and actual mishandled specimens increased by 26% in the first three months after implementation when compared with the calendar year 2023/24 baseline (**Figure 3**). However, there were zero reports of serious events post-project implementation.

Discussion

Consistent with the literature, the project leaders found inconsistencies in workflows, workarounds, human factors for error, and knowledge deficits during the FMEA process.[1] The project team used the FMEA methodology to pinpoint areas of opportunity and prioritize strategies based on potential impact. There were crucial learnings throughout the process. The team noted the importance of defining reporting criteria and emphasizing the process for submitting actual and near miss specimen-handling errors. Project leads determined it was critical to collaborate with stakeholders, including the contracted courier service and the transporters responsible for specimen pickup and delivery. The involvement of the operating room frontline staff was key to identifying gaps in the process during the FMEA review. Human factors for error identified during the FMEA include distractions, miscommunication, knowledge gaps, and competing priorities. In addition, creating a standard specimen-handling process was pivotal to improving communication between staff and providers. Focusing on improvement efforts throughout the continuum positively influenced willingness to participate in the review process.

Post-intervention implementation, there was an increase in events reported in the network patient safety reporting system from the baseline data time frame, signifying a heightened awareness of the process improvement initiative. The increase in reporting validated the engagement of staff related to the specimen error prevention project. Additionally, the increased reporting of actual and near miss specimen-handling errors assisted the team with evaluating whether the action items implemented sufficiently addressed the opportunities identified in the FMEA. This is similar to findings by Simeile et al. suggesting that the use of cognitive aids, effective reporting systems, closed-loop communication techniques, and effective education are key drivers in the success of eliminating errors in high-reliability organizations.[6]

Multiple factors facilitated change in this project, including frontline staff engagement and empowerment in designing the specimen-handling procedure and evidence-based process changes, leadership support, and project reporting in multiple avenues. Perioperative nurses and technologists reviewed the literature and AORN guidelines to recommend practice changes, creating ownership of the project and positive influence with their peers. Leadership at all levels was aware of the project through communication channels and presentations, creating high support and visibility. The OR and GI managers partnered with physician champions, increasing buy-in and support for the evidence-based practice changes. Finally, frequent reporting through multiple meetings and communication channels created space for interprofessional collaboration and problem-solving, advancing the project's success.

Conclusions

The project team conducted a quality improvement project using the FMEA tool because the evidence-based methodology is used to evaluate complex processes that could impact patient safety. The project team identified 82 failure modes that could occur during specimen handling in the OR and GI lab. The top 10 failure modes were selected based on risk score and evidence-based interventions were designed to mitigate patient harm. Over six months, process and outcome measures were tracked, which revealed compliance with industry guidelines and the new network procedures for 20 out of the 23 impacted departments. This project engaged frontline staff in problem-solving and process improvement, which was key to the success of the program. The project has been sustained through monitoring and reporting of the process and outcomes measures over 11 months with no serious events reported. The approach was logical and detail-oriented, enabling a thorough review of the problem and identifying action items to prevent harm.

Data Availability Statement

The raw/processed data required to reproduce the above findings cannot be shared at this time due to legal/ethical reasons.

Disclosure

The organization's Human Research Protection Office guidance and procedure noted that data-guided activities designed to implement promising ways to improve clinical care, patient safety, and healthcare operations were exempt from Institutional Review Board approval. The activity was designed to bring immediate positive changes in healthcare delivery programs in the local setting. The intent was limited to improving care and operations. There were no patient identifiers for this quality improvement project.

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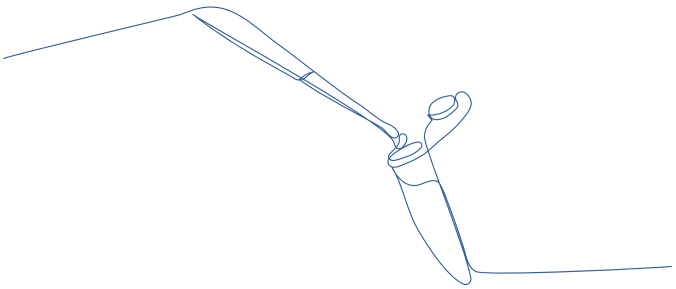

Standardizing IV Electrolyte Administration in Pediatric Oncology:

A Quality Improvement Initiative

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Abstract

Background: Intravenous (IV) electrolyte infusions, or electrolyte boluses (EB), are high-alert medications commonly administered to pediatric oncology patients in the inpatient setting. In our institution's two inpatient oncology units, variation in nursing EB administration practice posed a risk to patients and highlighted an opportunity for standardization. This quality improvement (QI) initiative aimed to standardize IV EB administration for intermittent infusions of IV magnesium sulfate, potassium chloride, potassium phosphate, and calcium gluconate.

Methods: A multidisciplinary team including nurses, advanced practice providers (APPs), a physician, and a pharmacist was formed. The team first sought to understand why registered nurses (RN) deviated from policy and provider order. We implemented interventions using 10 Plan-Do-Study-Act (PDSA) cycles beginning in January 2022, with the last PDSA cycles implemented in January 2024. Interventions included creating an RN job aid for each of the four EBs, adding these job aids into the electronic "Administration of IV Electrolytes" policy, and modifying the formulary monograph. For APPs, we developed an ordering guide for each EB. We used statistical process control charts to analyze our outcome measure: proportion of EBs administered at the ordered rate. The team used a run chart to track our process measure: the number of times per month a healthcare worker opened the electronic policy document.

Results: The proportion of EBs administered at the ordered rate increased from 15% to 85% over the observed 36-month period. APPs reported satisfaction with EB ordering guides. The median number of times a healthcare worker accessed the IV electrolyte policy increased from 7 to 110 times per month after all four job aids were added.

Conclusions: Creating accessible administration job aids for RNs coupled with useful APP ordering guides significantly impacted standardization of administration for high-risk electrolyte infusions in an inpatient pediatric oncology setting.

Introduction

Electrolyte imbalances in pediatric oncology patients result from disease processes as well as treatment and may present an oncologic emergency.[1] The administration of intravenous (IV) electrolytes is a crucial aspect of supportive care the registered nurse (RN) provides.[2] The Institute for Safe Medication Practices (ISMP) includes IV magnesium sulfate, IV potassium chloride, and IV potassium phosphate among its list of high-alert medications which have a "heightened risk of causing significant patient harm when they are used in error."[3] ISMP recommends strategies to reduce risk of errors related to high-alert medications, including standardizing ordering and administration methods and implementing redundancies.[3]

Available Knowledge

A "smart pump" is an infusion pump equipped with dose error reduction system (DERS) software and drug libraries designed to reduce dose and rate infusion errors.[4] They are used in all inpatient areas across our hospital. Smart pumps may reduce incorrect programming errors but have not eliminated IV medication infusion errors.[5] Even when the RN uses smart pump integration with the drug library, wrong infusion rate errors can occur if the RN overrides the "soft" limit alert for infusion rates.[6] In an observational study of 10 U.S. hospitals where smart pumps were in use, infusion rate errors were the most frequent type of serious IV medication administration errors.[5] In another study documenting IV infusion deviations from a prescriber's order or the hospital's policy, 7.6% of the 2,008 IV infusions were administered at a different rate than ordered.[7] The authors concluded that many deviations did not cause patient harm, and nurses deliberately used deviations to improve efficiency in care delivery.[7] Not all deviations represented errors, but normalized discrepancies in the infusion rate can represent system weaknesses, risk for serious error, and opportunities to modify policy to match the reality of the care environment.[7]

Problem Description

Nurse leaders at our pediatric hospital were concerned that the variability in nursing practice on the two oncology units and lack of detail in existing policy for this subset of high-risk IV infusions could lead to patient harm events. Furthermore, it was challenging to teach all RNs on the units the method to administer electrolyte boluses (EB), as the steps were complex and methods varied between nurses. The most frequently administered EBs were in scope for this improvement initiative and included IV magnesium sulfate, potassium chloride, potassium phosphate, and calcium gluconate. Despite calcium gluconate not being recognized as a high-alert medication by ISMP, the team chose to include it in this initiative to highlight standardization for *all* institution-specific dual sign-off EBs.

Specific Aims

The global aim of this improvement initiative was to improve the quality and safety of care by standardizing IV electrolyte administration in the inpatient pediatric oncology setting. To determine if the interventions led to an improvement, the proportion of times that the EB documented infusion rate matched the ordered infusion rate was measured. Our improvement team set the specific, measurable, achievable, relevant, and time-bound (SMART) aim: to increase the proportion of administrations where the documented EB infusion rate matches the ordered EB infusion rate from a baseline of 15% to a goal of 60% by March 1, 2024, for all administrations of IV magnesium sulfate, potassium chloride, potassium phosphate, and calcium gluconate in the pediatric oncology units. We chose the goal of 60% because of the many barriers to compliance, and because we viewed it as achievable within a limited period of time. This article was written according to Standards for Quality Improvement Reporting Excellence (SQuIRE) 2.0 guidelines, as it provides a framework for reporting quality improvement methods and outcomes.[8]

Methods

Context

Our institution's main hospital is a 600-bed urban, freestanding, academic, quaternary care children's hospital. There is a combined total of 51 beds in the two inpatient pediatric oncology units (bone marrow transplant and general oncology) that are staffed by approximately 130 RNs. For high-risk medications including EBs, our institution requires an independent double check by two RNs; each RN is responsible to determine that the ordered medication is safe for the patient before starting the IV infusion. The hospital policy requires the RN to infuse the EB at the ordered infusion rate (milliliters per hour) and duration of infusion. The institution's policy for EB administration prior to beginning this improvement project outlined steps for performing a two-clinician independent check, necessary equipment, proper selection of medication from the pump's drug library, IV line/pump check, and documentation. RNs on the inpatient oncology units administered 623 EBs during a 15-month baseline period from October 1, 2020, to December 31, 2021. During this baseline period, the proportion of administrations in which the EB infusion rate matched the ordered infusion rate was 15%, representing variation in nursing practice, methods not supported by hospital policy, and a disconnect between the provider's order and the RN's actions.

Interventions

A multidisciplinary improvement team was formed with stakeholders from each stage of the drug delivery process. The seven-person team included a nurse leader, a frontline RN, two nurse practitioners, a clinical pharmacist, a physician, and an improvement advisor. The team used the organization's improvement framework, which is based on the Institute for Healthcare Improvement's Model for Improvement, which breaks improvement projects into steps, including forming a team, establishing aims and measures, testing and implementing changes, and finally sustaining and spreading changes.[9] Improvement tools used included a project charter, metric definition, fishbone diagram, driver diagram, impact/effort matrix and Plan-Do-Study-Act (PDSA) cycles.

Current state process maps of the ordering provider, the pharmacist, and the RN's workflow in ordering, verifying, and administering EBs were developed. The RN process maps illustrated the multiple steps involved in EB administration, which varied among the four different EBs, adding to the complexity of the problem. Additionally, a shared mental model did not exist between the ordering provider and RNs regarding concurrently infusing electrolyte-containing fluids or total parenteral nutrition (TPN) with EBs. Order verification pharmacists used a standard operating procedure to verify all medication orders including EBs. As order verification pharmacists are not at the bedside, their workflow was outside the scope of this project.

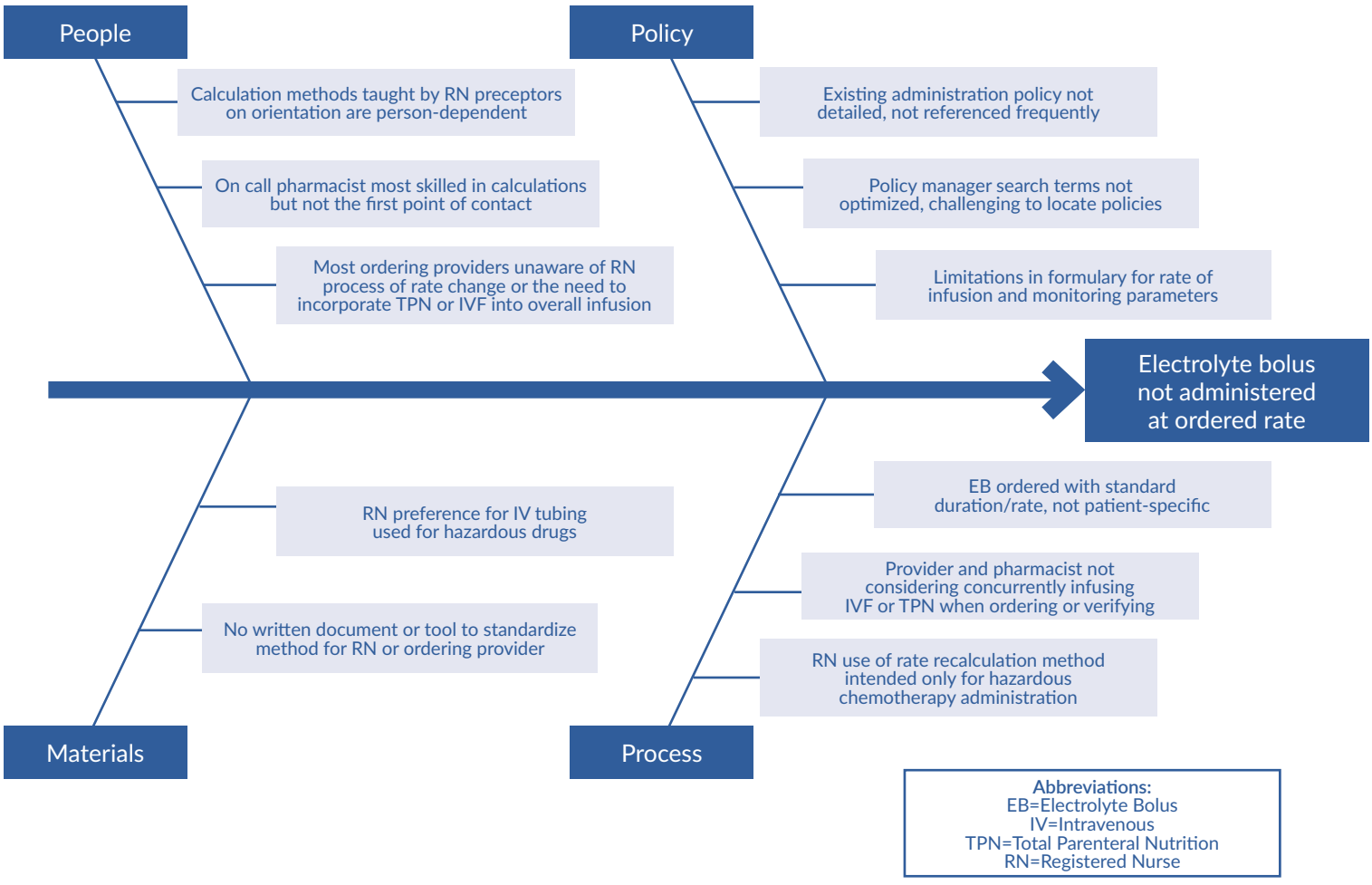
When the administration rate did not match the order, the team sought to understand the discrepancy and to introduce interventions that would create more standardization. The team gathered information in several ways, including through a survey of RNs on the oncology units, chart review, and direct observation. Based on this information, the team developed a fishbone diagram detailing barriers to standardization related to people, policy, materials, and processes (**Figure 1**).

A total of 59 inpatient oncology RNs completed a voluntary survey in June 2020. The RN survey included a binary-choice question asking whether the RN could complete an independent check independently or whether they were unable to complete steps independently. Of the 59 RN respondents, 39% (n=23) reported they could not complete an independent check of EBs due to lack of clarity in the process and instead relied on the second RN to assist in calculations before administration. RNs reported an inability to confirm the safe duration of infusion independently, especially when the IV electrolyte was infused concurrently with TPN or other electrolyte-containing fluids. Often nurses would call a pharmacist for support in calculations. The survey also included open-ended questions about challenges and potential solutions to EB administration. The results highlighted an overall need for more detailed written guidance to instruct the RN on the correct methods to calculate EB infusion rate.

The nurse leader conducted a chart review of the 39 EB administrations in September 2021 in which the RNs' documented rate did not match the ordered rate. Using a Pareto chart to analyze the chart review data of these 39 EB administrations, the team found that the most frequent reason (55%) for rate changes was due to the practice of rate recalculation intended for hazardous drugs. The second most frequent reason (27%) was that RNs decreased the magnesium sulfate infusion rate to avoid vital sign monitoring required by our hospital's formulary if infused in less than two hours. Less frequent reasons included RNs increasing potassium phosphate or potassium chloride infusion rates to maximize efficiency (12%) and RNs decreasing the EB infusion rate to account for concurrently infusing electrolyte-containing fluids (6%).

The team discovered that medication rate recalculation was normalized among RNs on the units, as rate recalculations were needed for chemotherapy administration per institutional guidelines. This hospital uses hyper-priming for all large-volume pump IV hazardous chemotherapy infusions. Hyper-priming, or "quick prime," is the process of rapidly infusing diluent to reduce the dead space in the administration set.[10] This method of administration requires the RN to recalculate the rate of administration for all IV hazardous chemotherapy. In these instances, correct infusion rate for IV chemotherapy differs from the rate ordered by oncology providers and verified by pharmacists. Through direct observation

Figure 1. Barriers to Standardization of Electrolyte Bolus Administration



and chart review, the team recognized that RNs used infusion rate recalculations intended only for IV chemotherapy administration for other IV infusions, including EBs.

The team brainstormed interventions to address some of the identified barriers to standardizing EB administration and used an impact effort matrix to prioritize and select interventions for implementation (**Table 1**). We carried out interventions in a series of Plan-Do-Study-Act (PDSA) cycles,[11] and the team evaluated each intervention based upon clinician feedback.

Interventions

In January 2022, PDSA 1 was implemented, which consisted of nurse leaders successfully administering 15 EBs without hazardous drug tubing or rate recalculations. This intervention was selected first to build confidence in RNs and RN leaders that EBs could be administered without the processes used for IV hazardous chemotherapy administration. PDSA 2, implemented in March 2022, involved the following:

- Sharing EB administration information at RN huddles and through email
- Instructing RNs to administer EBs at the ordered rate
- Instructing RNs to contact the ordering provider if the RN determined the ordered rate was incorrect or unsafe

In May 2022, for PDSA 3, the team created and posted on both units a document titled "The What and Why Behind Large Volume Electrolyte Bolus Administration," which outlined the RN's process of large-volume pump EB administration along with the reasoning behind each step. Our interprofessional improvement team then developed four job aids intended for use by RNs, one for each of the four EBs. The job aids were formatted to the organization's policy template. These job aids described each step of checking the EB order before administration, including confirming the correct indication, dose, concentration, duration, and rate. Additional steps were included if the electrolyte was infused with TPN or IV fluids that contained the same electrolyte.

Our team tested the calcium gluconate and potassium chloride job aids with RNs in October 2022, after dissemination via paper copies and email. In PDSA 4 in December 2022, the team clarified text in the calcium gluconate formulary monograph to differentiate between the intensive care unit (ICU) duration of infusion (30 to 60 minutes) and the non-ICU duration of infusion (60 minutes). The team continued to revise the job aids based on RN feedback. Next, the team added the calcium gluconate and potassium chloride job aids to the existing "Administration of IV Electrolytes" policy (PDSA 5) in January 2023. For PDSA 6 in February 2023, we added a hyperlink to the job aids within their respective monographs in the online hospital formulary to increase RN access and awareness of the job aids.

To address the provider ordering process, the team developed four "ordering guide" documents, one for each of our in-scope EBs, describing each step for the provider to order the EB. The ordering guides included additional steps for the ordering provider if the electrolyte was infused with TPN or IV fluids containing the same electrolyte. In PDSA 7, all four ordering guides were shared with the inpatient oncology advanced practice providers (APPs) in April 2023.

Table 1. Barriers to Standardizing IV Electrolyte Administration and Associated Interventions

Barriers	Interventions
RN use of rate recalculation and IV tubing intended only for IV hazardous chemotherapy administration	• Clinical nurse leaders to administer at least 15 EBs without hazardous drug tubing or rate recalculations • Message to RNs to administer EBs at the ordered rate and to contact the provider if the ordered rate is incorrect or unsafe • Create document to guide large volume pump EB administration; instruct RN to use standard IV tubing
RN administration policy lacks detail to establish standard process for RN EB administration	Create RN job aids and publish in policy manager to standardize RN administration process
Limitations in formulary for non-ICU maximum rates of infusion and monitoring parameters	• Clarify guidance in calcium gluconate formulary monograph to differentiate between ICU and non-ICU units • Remove from the formulary required, non-evidence-based vital sign monitoring for IV magnesium sulfate infusions of one hour duration or greater
Ordering providers do not always consider patient-specific maximum infusion rates in cases where intravenous fluids (IVF) or TPN are concurrently infused (for example: potassium chloride maximum infusion rate 0.3 milliequivalents per kilogram per hour)	Create stepwise process for ordering provider that includes guidance for concurrently infusing IVF and TPN

In October 2023, we completed PDSA 8 by publishing the potassium phosphate and magnesium sulfate job aids into the policy after sharing them with frontline nurses and modifying the job aids based on RN feedback. In November 2023, nurse leaders presented a proposal at this institution's Drug Use Evaluation (DUE) committee to eliminate vital sign monitoring for IV magnesium sulfate in which the duration of infusion was greater than or equal to one hour. A literature review and critical appraisal of the evidence demonstrated no indication for vital sign monitoring, as hypotension or other adverse reactions were not observed for adult or pediatric patients treated with infusions of IV magnesium sulfate greater than or equal to one hour duration.[12-17] The interprofessional DUE committee approved the proposal and, subsequently, the drug formulary was modified to remove required vital sign monitoring for infusions of one hour duration or greater (PDSA 9) in January 2024. In the same month, the team completed PDSA 10 by adding a hyperlink to the potassium phosphate and magnesium sulfate job aids within their respective formulary monographs.

Study of Interventions

Fifteen months of baseline data on EB administration were extracted from the electronic health record (October 2020 to December 2021). Data included the medication, date, time of administration, ordered infusion rate, and RN documented infusion rate. The team collated and reviewed EB administration data each month during the intervention period. We compared EB administration during the baseline period with an intervention period from January 2022 to June 2024.

Measures

The outcome measure for our improvement project was percentage of EB administration compliance, defined as the proportion of EB administrations in which the documented infusion rate equaled the ordered infusion rate divided by the total administrations. The documented infusion rate in milliliters per hour (mL/hr) was used as a proxy for infusion duration. When the ordered infusion rate matched the RNs' documented infusion rate, the administration was considered "compliant." If the documented infusion rate did not match the ordered infusion rate, the administration was considered "not compliant." This team audited all infusions of IV magnesium sulfate, potassium chloride, potassium phosphate, and calcium gluconate administered on the inpatient oncology units each month.

The number of times a healthcare worker opened the policy in our organization's electronic policy manager per month was the process measure. As the RN job aids were added to the "Administration of IV Electrolytes" policy, the number of times a healthcare worker opened the policy was expected to increase. The baseline period for this measure was October 2020 through December 2022, and the intervention period was January 2023 (when the first and second EB job aids were added to the policy) to October 2023 (when the third and fourth EB job aids were added to the policy). We continued to collate the data through April 2024. The team was unable to quantify the unique users accessing the policy or measure the proportion of users who were RNs on inpatient oncology.

A post-intervention survey was distributed to APPs in July 2023 to measure provider satisfaction with using the EB provider ordering guides. The APP survey included the statement "This guide was useful in ordering the electrolyte bolus." The APP answered using a five-point Likert scale ("strongly agree" to "strongly disagree"). Additionally, the team included one open-ended question to solicit suggested changes to the guides, and one yes/no question asking if the provider would want to use the ordering guide again.

Analysis

The outcome measure was tracked using a statistical process control (SPC) p-chart and the team used SPC rules to interpret special cause variation (**Figure 2**).[18] The eight-point rule (EPR) is one of the 10 rules for identification of special cause variation in Shewhart control charts.[19] We used the EPR to evaluate for special cause after implementing our interventions. The process measure was evaluated using a run chart, applying rules for interpretation, including the rule for a centerline shift, defined as greater or equal to six consecutive points above or below the median (**Figure 3**).[20] We evaluated APP satisfaction with ordering guides by collating responses to survey questions.

Ethical Considerations

This project was undertaken as a quality improvement initiative and as such does not constitute human subjects research.

Results

Outcome Measure

The number of EBs administered on the units varied from 17 to 123 per month. During the baseline period, 15% of all EBs were administered at the ordered rate. Eight months after the first intervention, special cause variation was observed, resulting in a positive centerline shift, with 45% of all EBs being administered at the ordered rate. This shift was sustained for 19 months. In August 2023, a second positive centerline shift occurred, with 70% of EBs administered at the ordered rate. In April 2024, a third positive centerline shift occurred, with 85% of EBs administered at the ordered rate.

Process Measure

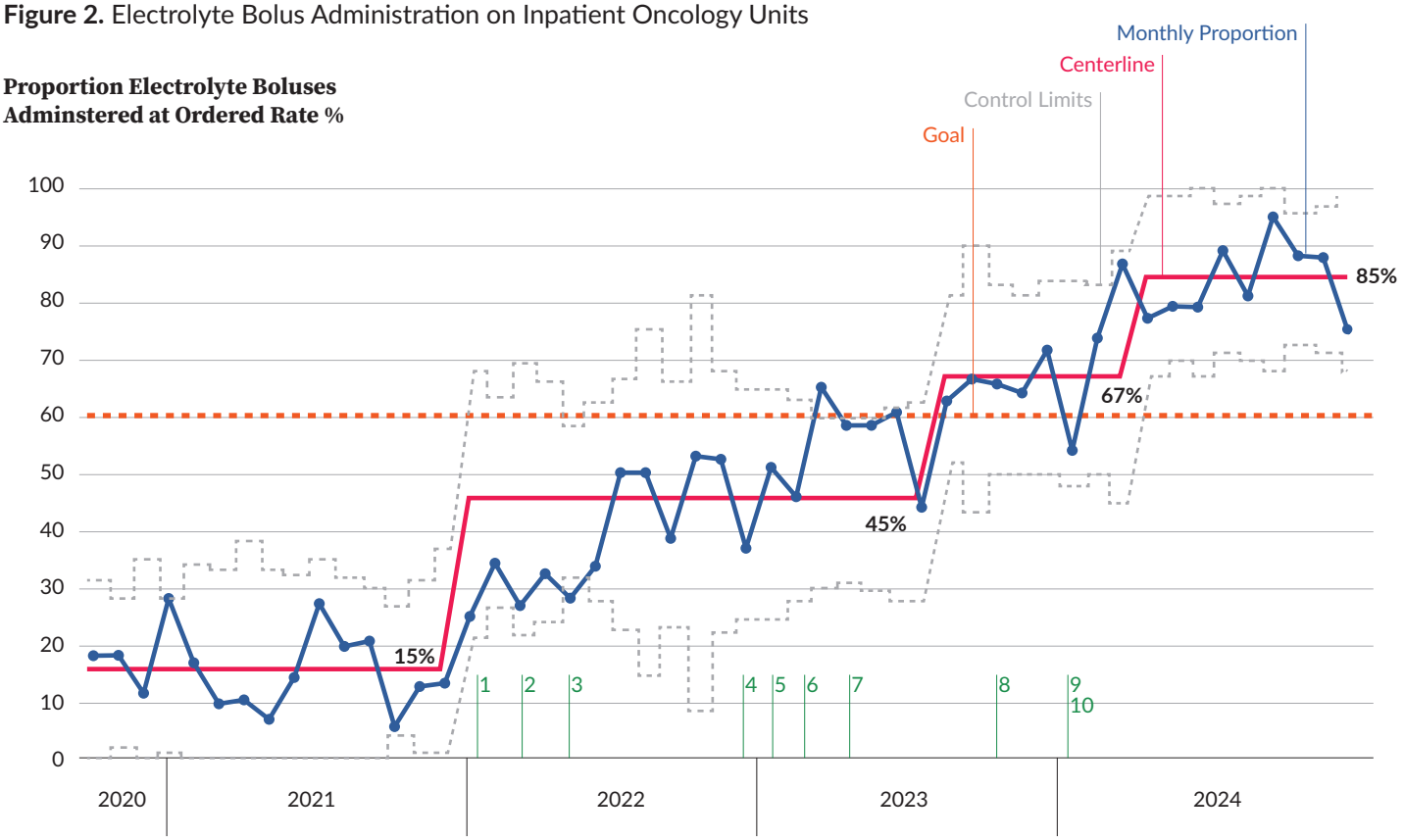
The "Administration of IV Electrolytes" policy on the hospital's electronic policy manager was accessed a median of seven times a month during the baseline period. After the first two job aids were embedded within the existing policy in January 2023, the run chart demonstrated six data points above the median, resulting in a positive shift. From January 2023 to April 2024, the policy was accessed a median of 110 times each month. In a voluntary survey in July 2023, all seven of the APPs surveyed responded that they "agree" or "strongly agree" that the "guide was useful in ordering the electrolyte bolus." After using at least one of the four EB ordering guides in clinical practice, all seven APPs indicated they would want to use the EB guide again.

Discussion

Summary

This quality improvement initiative significantly increased the proportion of EBs administered at the ordered rate, from a baseline of 15% to 85%, surpassing the aim of achieving 60% compliance by March 1, 2024. The first three PDSA cycles yielded modest improvement but were important in gaining the confidence of key nurse leaders on the units and sharing messaging across the frontline nurse team. The most effective interventions included publishing the four RN job aids and changing formulary guidance.

Figure 2. Electrolyte Bolus Administration on Inpatient Oncology Units

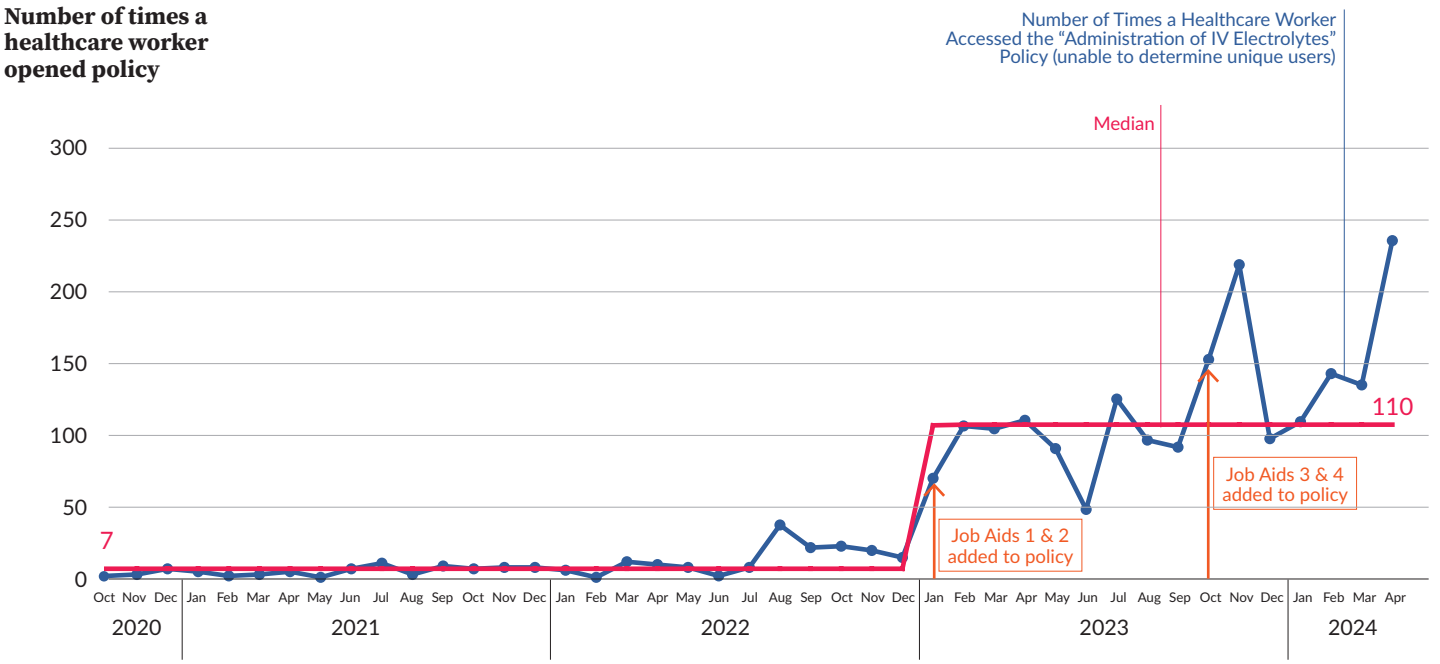


PDSA Cycles:

1. Administered 15 EBs at the ordered rate without hazardous drug IV tubing
2. RN huddle and email message to administer EB at ordered rate or request order change
3. Posted the "What/Why" document on the units guiding large volume pump administration steps
4. Modified the IV calcium gluconate formulary monograph
5. Published IV calcium gluconate and IV potassium chloride RN job aids as policy
6. Linked IV calcium gluconate and potassium chloride RN job aids in formulary
7. Shared ordering provider guides for each EB with APPs on units
8. Published IV magnesium sulfate and IV potassium phosphate RN job aids as policy
9. Changed IV magnesium sulfate formulary monitoring parameters to eliminate required vital sign monitoring for infusions of one hour duration or greater
10. Linked IV magnesium sulfate and IV potassium phosphate RN job aids in formulary

	Number of Boluses				
	2020	2021	2022	2023	2024
January		58	41	53	63
February		31	62	70	73
March		34	38	92	39
April		21	50	101	40
May		33	123	89	54
June		37	69	79	39
July		30	46	73	67
August		42	24	94	54
September		50	47	36	45
October	46	84	17	76	88
November	63	42	42	81	77
December	28	24	52	71	44

Figure 3. Number of Times a Heathcare Worker Opened the "Administration of IV Electrolytes" Policy per Month



Interpretation

The addition of one job aid for each of the four EBs into the policy was the driving force of this project, as the job aids created a clear, standard approach to verification of the duration and infusion rate. The job aids addressed previously challenging scenarios in a stepwise approach, such as concurrent infusion of TPN. The updated policy also stated that the infusion set is to be primed with the large-volume electrolyte, which was a previously missing step that caused confusion among nurses.

While policy revisions do not always translate to a change in practice, this project was successful in changing the RN administration process because the step-by-step guidance in the job aids made it easier for RNs to complete all necessary steps in the administration process. This team attributes the success of the RN job aids to the expertise of our clinical pharmacist in developing the content, seeking frontline RN feedback, and incorporating suggested changes into the published policy. Five of the improvement team members are clinicians who practice in the inpatient oncology clinical setting. This subject matter expertise allowed the team to understand the processes we aimed to change. Further, by implementing changes into existing electronic systems such as the hospital formulary and adding hyperlinks from the formulary to policy, the frontline clinicians found this information to be readily accessible. In a large, complex healthcare environment, our interventions needed to reach individuals regardless of their awareness of our improvement team or project. We anticipate that these interventions will increase the ability to teach new APPs and RNs who join the care team in inpatient oncology the ordering and administration steps for each EB.

The team attributes the sustainability of the project's outcomes to the time spent understanding the problem before developing interventions.[21] This interprofessional improvement team integrated sustainable interventions into existing systems of care, "hardwiring" interventions into practice using existing workflows including policy and the hospital's medication formulary.[21]

Limitations

There were several limitations of the project due to context and measures. In the inpatient oncology units, the influence of hyper-priming and IV hazardous chemotherapy rate recalculation was a primary driver of nursing practice. The variability in medication administration practices the team observed may be less prevalent in less-acute settings or inpatient care settings without frequent infusion rate recalculation of high-risk medication categories.

The outcome measure did not account for the degree of variability between the ordered and administered infusion rate. The infusion rate was used as a proxy for the infusion duration. However, when the administered infusion rate varied slightly, the impact to the infusion duration was not likely to be clinically significant. The outcome measure did not differentiate, for example, between an EB administered too quickly in half of the intended duration and an EB administered too slowly for five minutes longer than the intended duration.

This institution uses an electronic policy manager system which cannot differentiate between categories of healthcare workers or count unique users. Therefore, we could not measure the number of inpatient oncology RNs who opened the "Administration of IV Electrolytes" policy. The team inferred that an increase in healthcare workers opening the policy represented an increase in oncology RN use, as RNs are the primary users of policies published in our policy manager.

Conclusions

The team successfully used a quality improvement framework to implement interventions and improve the proportion of EBs administered at the ordered rate. The team found the gap between the medication order and RN action was an opportunity to explore practice and reduce complexity of care delivery. Reaching 85% compliance in the 11 months after our last PDSA cycles were complete indicates the project's sustainability over time. Our institution has the potential to spread standardization of medication delivery to other drug categories, such as IV hazardous chemotherapies. Clinical teams outside of inpatient oncology are interested in creating additional job aids to guide the administration of additional high-alert medications such as IV hypertonic saline solution. The team anticipates sustained success in the outcome measure, as interventions were implemented into the organization's policy and formulary.

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Wrong Drug Events Across Pennsylvania Healthcare Facilities:

A Systematic Analysis of Medication Pairs, Class Patterns, and Clinical Safety Implications

Keywords: medication error, medication safety, patient safety, confused drug names, look-alike sound-alike, high-alert medication

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Abstract

Background: Medication errors represent a significant challenge to patient safety. Wrong drug events (WDEs), which occur when a patient receives a medication different from the one intended, can cause serious patient harm.

Methods: We queried the Pennsylvania Patient Safety Reporting System (PA-PSRS) database for wrong drug medication error reports submitted in calendar year 2023 to identify WDEs that reached the patient in which one medication was inadvertently ordered, dispensed, or administered in place of another medication that contained a different active ingredient.

Results: We identified and analyzed 450 WDE reports from 127 different healthcare facilities. Insulin was the most frequently reported medication class, comprising 10.3% (93 of 900) of all reported medications involved in a WDE, followed by antibacterial for systemic use (n=90), electrolyte solution (n=62), and opioid (n=51). Many WDEs occurred within the same medication class, highlighting their shared stem names.

Conclusion: WDEs can cause serious patient harm resulting from omission or delay of a necessary medication, administration of an unintended and/or contraindicated medication, or other deviation due to confusion between two medications. Medications belonging to the same class, as well as those sharing similar names, require heightened attention. Additional research regarding the contributing factors to WDEs could provide a more complete understanding of these events and facilitate further development of evidence-based, targeted prevention strategies.

Introduction

Medication errors represent a significant challenge to patient safety. They have been suggested as the most common type of preventable error,[1,2] with hospitalized patients potentially experiencing at least one medication error every day.[3] The magnitude and severity of this problem is reflected in data from the Pennsylvania Patient Safety Reporting System (PA-PSRS)[a], which received 40,680 reports of medication errors in 2023 alone, 294 of which reporters classified as a serious event that resulted in patient injury or death.[4,5]

Among these medication errors are wrong drug events (WDEs), which occur when a patient receives a medication different from the one intended. The case of RaDonda Vaught serves as a reminder of the potentially fatal consequences of WDEs, especially when they involve high-alert medications.[6] In this instance, the accidental administration of vecuronium, a paralytic agent, instead of the intended sedative, midazolam, resulted in the patient's death.[7] Vecuronium was accidentally dispensed after "VE" was typed into the automated dispensing cabinet (ADC) in an attempt to locate "Versed," a discontinued brand name of midazolam.[7]

Previous literature has identified numerous factors contributing to WDEs, including similarities in names, packaging, and tablet/capsule appearance, as well as human factors such as limited knowledge, inattention, haste, communication failure, and fatigue.[8-18] A major focus within this body of research has been placed on the issue of confused medication names,[9-16] which are medications with similarities in phonology (the spoken forms) or orthography (the written forms) in generic names, brand names, abbreviations, or any combination thereof.[9-11] Often referred to as "look-alike, sound-alike" medications, these can lead to errors throughout all stages of the medication-use process.[10,11]

In this study, we examine the current state of WDEs through an analysis of patient safety event reports. Based on reports submitted to PA-PSRS in 2023, we identify the specific medications most frequently involved in WDEs and summarize events resulting in patient harm. By understanding the medications involved in WDEs, healthcare facilities can prioritize focused internal reviews, development of proactive risk assessments, and strategies to minimize the occurrence of WDEs.

Methods

We used data from PA-PSRS, a repository containing over 5 million event reports from healthcare facilities across Pennsylvania.[19]

We queried PA-PSRS for reports submitted between January 1, 2023, and December 31, 2023, under the "Wrong Drug" subtype of the "Medication Error" event type category with a harm score of C or higher to focus on events that reached the patient.[5] Each report was then manually reviewed and the following inclusion criteria were applied:

- The report described a WDE, which we defined as "an event in which one medication was inadvertently ordered, dispensed, or administered in place of another medication that contained a different active ingredient."
- The report identified the names of both medications involved.
- Both medications involved in the event are approved by the Food and Drug Administration (FDA).[20,21]

Reports were excluded if they described the following:

- Two medications that share the same active ingredient(s) but differ in dose, concentration, rate of administration, route (e.g., bisacodyl enema and suppository), or formulation (e.g., bupropion immediate release and sustained release).
- Two vaccines that treat the same organism(s) but differ in antigen serotype or intended age group (e.g., Menveo and Bexsero, Tdap and DTaP).
- Both medications involved in the event were maintenance intravenous (IV) fluids, irrigation fluids, or dialysates. (The following hypertonic solutions were not excluded, as they are considered high-alert medications:[6] sodium chloride with a concentration greater than 0.9% and dextrose with a concentration of 20% or greater).

Coding and Data Analysis

We reviewed and analyzed structured variables that are coded by the reporter at the time of submission, including facility type, care area[b], event classification (incident[c] or serious event[d]), and details related to the medication prescribed and medication administered, such as medication name, dose, and route. The pharmacist researcher manually reviewed and standardized the medications to generic names for consistency, while also maintaining the brand name(s), and acknowledged medication pairs in cases where the medications had phonetic or orthographic similarities and/or the confused medication names were reported as a contributing factor to the WDE. The researcher also categorized the medications by applying the Anatomical Therapeutic Chemical (ATC) classification system by the World Health Organization (WHO).[22] Similarly, high-alert medications were initially coded by the reporter during submission; however, to ensure accuracy and consistency, the

[a]PA-PSRS is a secure, web-based system through which Pennsylvania hospitals, ambulatory surgical facilities, abortion facilities, and birthing centers submit reports of patient safety–related incidents and serious events in accordance with mandatory reporting laws outlined in the Medical Care Availability and Reduction of Error (MCARE) Act (Act 13 of 2002).[4] All reports submitted through PA-PSRS are confidential and no information about individual facilities or providers is made public.

[b]Within the PA-PSRS acute care database, there are 168 care areas for facilities to use to identify where events occur. Each of these care areas is then placed into one of 23 higher level care area groups.

[c]An incident is defined as "[a]n event, occurrence or situation involving the clinical care of a patient in a medical facility which could have injured the patient but did not either cause an unanticipated injury or require the delivery of additional health care services to the patient."[4]

[d]A serious event is defined as "[a]n event, occurrence or situation involving the clinical care of a patient in a medical facility that results in death or compromises patient safety and results in an unanticipated injury requiring the delivery of additional health care services to the patient."[4]

researcher made adjustments as needed based on the Institute for Safe Medication Practice (ISMP) List of High-Alert Medications.[6] To gather additional contextual information about the WDEs, the researcher also reviewed the unstructured free-text data fields of the PA-PSRS reports, primarily focusing on the Event Description.

We performed a descriptive analysis to summarize and describe the data in a meaningful way and to identify any previously undocumented phenomena or patterns within the literature.[23] A variety of techniques, including frequency tables, cross tabulations, and bar charts, were used to provide a high-level overview of the data.

Results

Healthcare Facility Demographics

Our query of the "Wrong Drug" subtype in PA-PSRS produced 1,192 reports, 450 of which met criteria for inclusion in the study. These events occurred across 127 different healthcare facilities, representing 10 distinct facility types as shown in **Figure 1**. More than half of the events (56.4%, 254 of 450) were associated with four care area groups: medical/surgical unit (19.6%, 88 of 450), intensive care unit (12.7%, 57 of 450), emergency department (12.4%, 56 of 450), and surgical services (11.8%, 53 of 450).

Medication Classes, Individual Medications, and Pairs Involved in WDEs

Figure 2 shows the most frequently reported medication classes based on ATC categorization.[22] Insulin was reported most frequently, comprising more than one-tenth (10.3%; 93 of 900) of all reported medications. Other medication classes that were frequently reported include antibacterial for systemic use, electrolyte solution, opioid, and cardiac stimulant.

Table 1 shows the most frequently reported individual medications involved in WDEs and the medications with which they were erroneously interchanged most frequently.

The medication pairs listed in **Table 1** demonstrate that WDEs frequently occur within the same class. For example, insulins were commonly confused with other forms of insulin. Similarly, epinephrine and norepinephrine were mistaken for one another, and hydromorphone was interchanged with other opioid medications. This pattern was also evident with antibiotics, as cefazolin was often confused with other antibiotics, particularly those within the same cephalosporin subclass.

While many of the medications in **Table 1** involve confusion within the same medication class, some exceptions exist. For example, normal saline solution (NSS) and heparin were confused with a wide range of medications across numerous classes. In contrast, hydroxyzine demonstrated a different pattern of confusion, being mistaken for hydralazine and hydrochlorothiazide (HCT or HCTZ), as an example of confused medication names contributing to WDEs.

Table 2 provides a list of the most frequent medication pairs involved in WDEs, all of which follow the pattern of belonging to the same class and/or having similar phonetic and/or orthographic features in their generic or brand names. This similarity is often evident in shared stems within a drug class, such as "cef" for cephalosporin antibiotics or "phrine" for vasopressors (e.g., epinephrine and norepinephrine). Additionally, confusion can arise from similar brand names, such as Solu-Cortef (hydrocortisone) and Solu-Medrol (methylprednisolone succinate), or within various insulin types (e.g., Humalog and Humulin).

Furthermore, **Table 2** includes combination products that contain two active ingredients. Medications with two active ingredients can be confused with a single-entity medication containing only one of two active ingredients (e.g., oxycodone and oxycodone/acetaminophen, ampicillin and ampicillin/sulbactam). While not shown in **Table 2**, this issue extends to other medication pairs such as albuterol and albuterol/ipratropium and amoxicillin and amoxicillin/clavulanate, which were also identified in the analysis.

Table 3 lists additional medication pairs that share similar names but were reported less frequently than those identified in **Table 2**.

High-Alert Medications

Our analysis revealed the involvement of 312 high-alert medications across 197 event reports. More than half of the reports (57.4%, 113 of 197) involved confusion between two high-alert medications. **Figure 3**[e], which displays the most frequently reported classes of high-alert medications, shows that insulin comprised 29.8% (93 of 312) of all reported high-alert medications.

Of the 13 neuromuscular blocking agents (NMBs) that were identified across 11 event reports, seven were rocuronium, four were succinylcholine, and two were vecuronium. As a result of these 11 events, five patients did not achieve necessary muscle paralysis, four patients received unnecessary paralysis, and two patients received incorrect NMBs.

Intravenous oxytocin, which comprises its own high-alert medication class, was reported in six events. Four of these events occurred in the Labor & Delivery and Postpartum Recovery units and involved confusion with fluids or magnesium sulfate.

Furthermore, one of the events involving an antithrombotic agent described a WDE that resulted in accidental administration by the wrong route. Heparin, which was intended by the subcutaneous route, was administered IV due to confusion with IV famotidine.

We also identified WDEs involving high-alert medications and their reversal agents that led to an unintended therapeutic effect. For example, naloxone, an opioid antagonist, was administered in cases where fentanyl or hydromorphone were intended. In another case, succinylcholine, a depolarizing NMB, was administered instead of sugammadex, a reversal agent for non-depolarizing NMBs. Although the actual impact on patients was not described in these reports, we can theorize that the WDEs led to a delay, failure to produce the intended effect, or exacerbation of the adverse effect the providers were attempting to mitigate.

[e]Due to the use of a different system to classify high-alert medications, the frequency of some high-alert medication classes shown in **Figure 3** do not exactly match the classes shown in **Figure 2**. For example, there is a lower frequency for "Antithrombotic agent" in **Figure 3** compared to **Figure 2** because subcutaneous heparin is not considered a high-alert medication.

Figure 1. Frequency of Event Reports by Facility Type (n=450 reports)

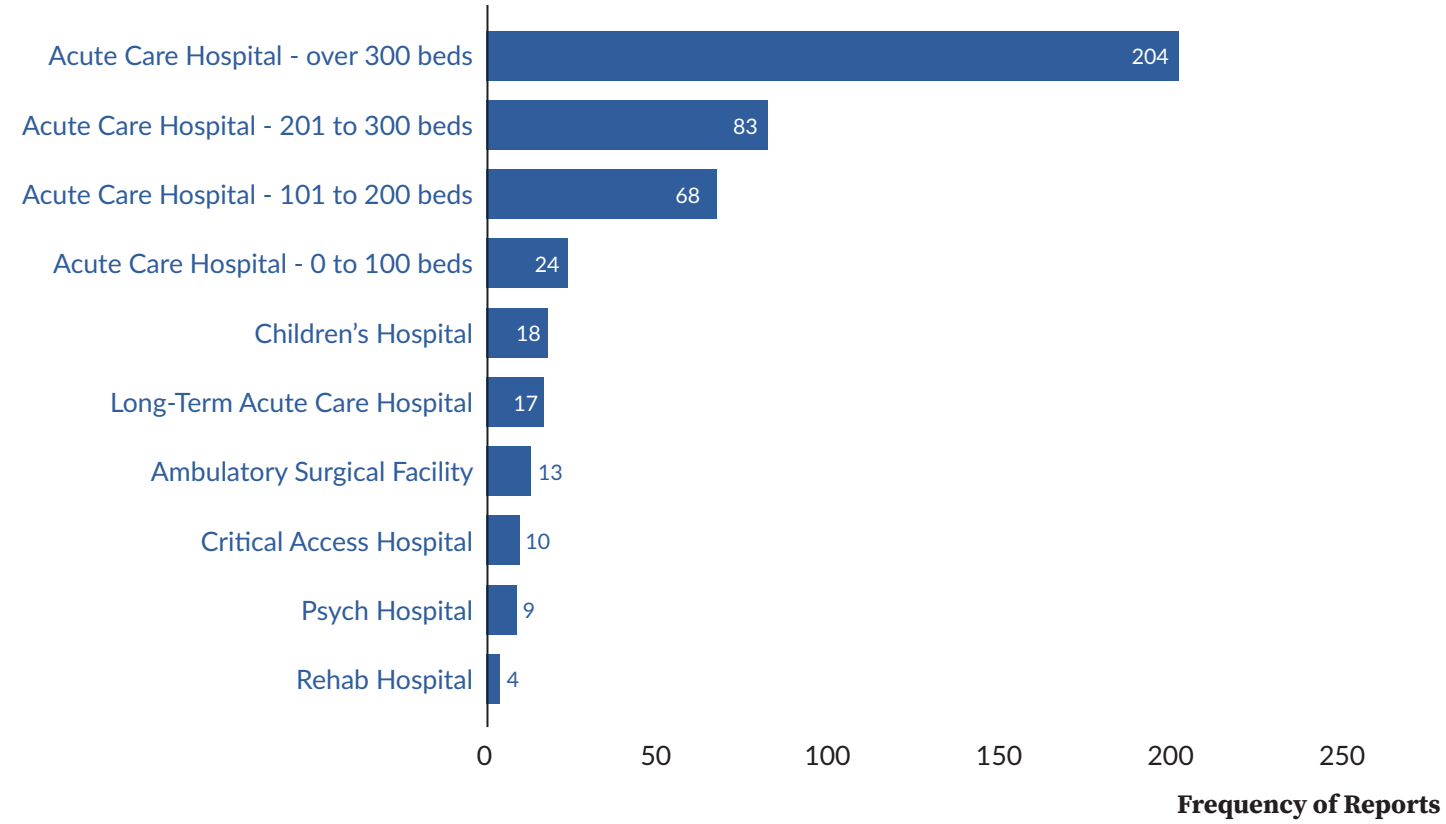
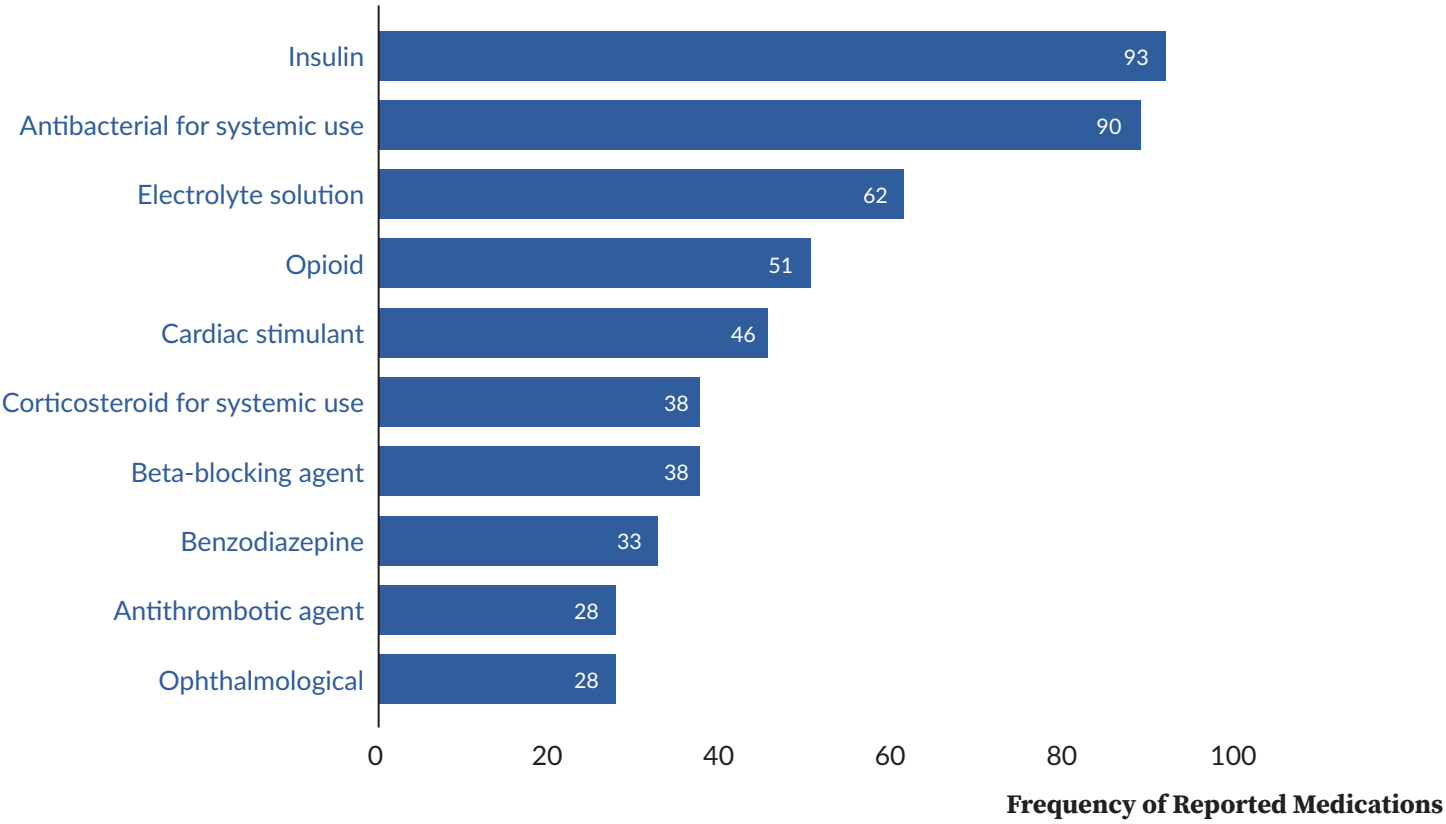


Figure 2. Most Frequently Reported Medications by Class (n=507 of 900 total medications)



Note: The figure shows the medication classes most frequently involved based on ATC categorization[22] along with their frequencies. Figure does not show classes representing 393 medications due to their low frequency.

Table 1. Most Frequently Reported Individual Medications and Their Pairs

Medication 1	Frequency of reports	Medication 2	Frequency of medication pair
Insulin lispro	27	Insulin glargine	12
		Insulin regular	8
		Heparin	2
		Insulin NPH	2
Insulin regular	23	Insulin lispro	8
		Insulin glargine	3
		Insulin aspart	2
Insulin glargine	21	Insulin lispro	12
		Insulin aspart	3
		Insulin regular	3
Normal saline solution (NSS)	18	Heparin	3
		NaCl 3%	2
Epinephrine	16	Norepinephrine	5
Heparin	16	NSS	3
		Insulin lispro	2
Hydromorphone	16	Morphine	7
		Fentanyl	2
Metoprolol tartrate	15	Metoprolol succinate	9
Norepinephrine	14	Epinephrine	5
		Phenylephrine	3
Cefazolin	13	Ceftriaxone	5
		Cefepime	3
		Clindamycin	2
Metoprolol succinate	12	Metoprolol tartrate	9
Midazolam	12	Diazepam	4
		Lorazepam	2
		Fentanyl	2
Hydroxyzine	12	Hydralazine	6
		Hydrochlorothiazide	3

Note: The labels Medication 1 and Medication 2 do not indicate directionality (i.e., medications listed under both columns may represent medications prescribed or administered). Medications with a frequency of 1 were not included in the table.

Table 2. Most Frequently Reported Medication Pairs

Medication 1	Medication 2	Frequency of Reports
Insulin glargine	Insulin lispro	12
Metoprolol succinate	Metoprolol tartrate	9
Insulin lispro	Insulin regular	8
Hydromorphone	Morphine	7
Hydralazine	Hydroxyzine	6
Hydrocortisone	Methylprednisolone succinate	6
Epinephrine	Norepinephrine	5
Cefazolin	Ceftriaxone	5
Oxycodone	Oxycodone/Acetaminophen	4
Diazepam	Midazolam	4
Prednisolone	Prednisone	4
Ampicillin	Ampicillin/Sulbactam	4

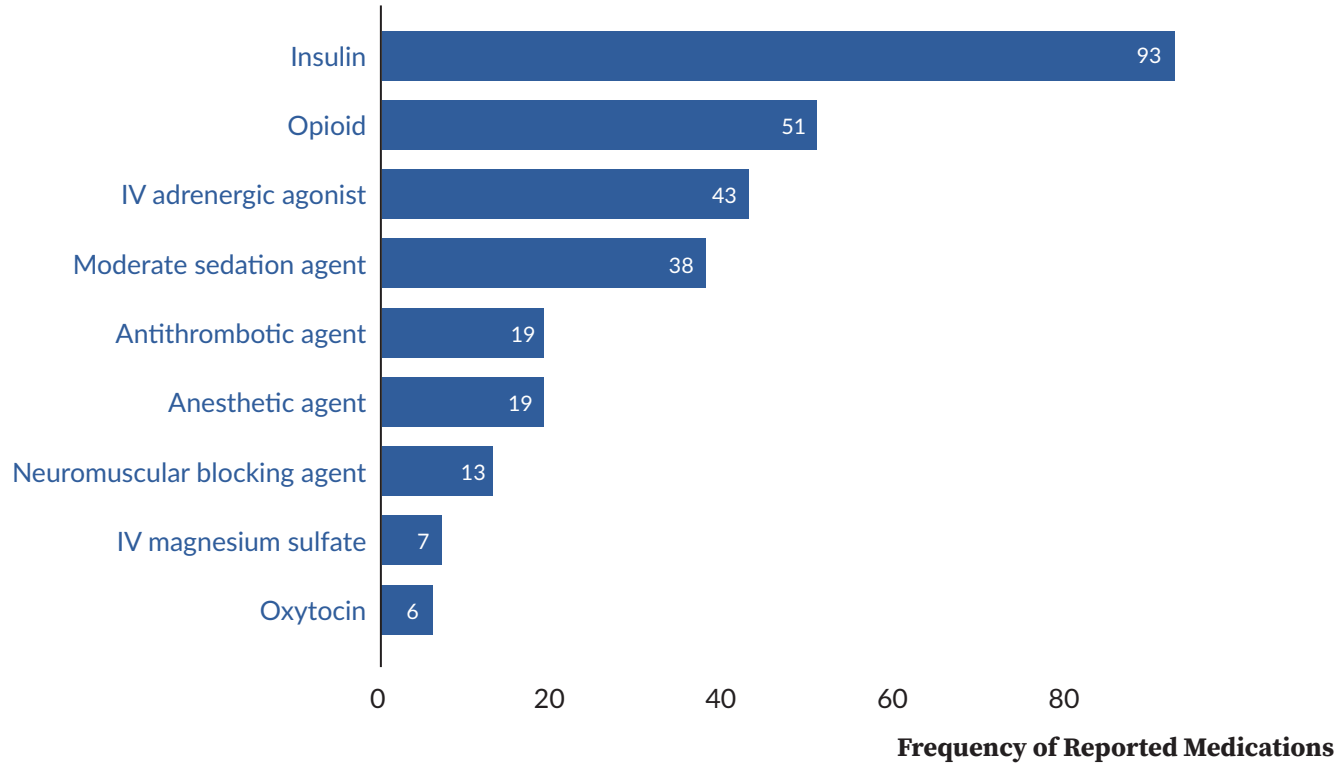
Note: The labels Medication 1 and Medication 2 do not indicate directionality (i.e., medications listed under both columns may represent medications prescribed or administered). "/" denotes a combination product containing two active ingredients.

Table 3. Other Reported Medication Pairs

Medication 1	Medication 2
Alteplase	Tenecteplase
Amlodipine	Amiloride
Cardene*	Cardizem*
Diltiazem	Diazepam
Fioricet*	Percocet*
Fluorouracil	Fluocinonide
Glucagon	Geodon*
	Calcium gluconate
Lactulose	Lactase
	Lactose
Methylnaltrexone	Naltrexone
Milk of Magnesia (MOM)*	Maalox*
Neo-Synephrine*	Neostigmine
Nitroglycerin	Nitroprusside
Phenobarbital	Phentermine
Premarin*	Permethrin
Pyridostigmine	Pyridoxine
Rifampin	Rifabutin
	Rifaximin
Suggamadex	Succinylcholine
Subutex*	Suboxone*
Tobrex*	Tobradex*
	Ciprodex*
Valacyclovir	Valganciclovir

Note: The labels Medication 1 and Medication 2 do not indicate directionality (i.e., medications listed under both columns may represent medications prescribed or administered). "*" denotes a brand name. Cardene = nicardipine. Cardizem = diltiazem. Ciprodex = ciprofloxacin/dexamethasone. Fioricet = acetaminophen/butalbital/caffeine. Geodon = ziprasidone. Maalox = aluminum hydroxide/magnesium hydroxide. Milk of Magnesia (MOM) = magnesium hydroxide. Neo-Synephrine = phenylephrine. Percocet = acetaminophen/oxycodone. Premarin = conjugated estrogens. Subutex = buprenorphine. Suboxone = buprenorphine/naloxone. Tobrex = tobramycin. Tobradex = tobramycin/dexamethasone.

Figure 3. Most Frequently Reported High-Alert Medications by Class (n=289 of 312 high-alert medications)



Note: The figure shows the high-alert medications classes most frequently involved and their frequency based on the ISMP categorization.[6] Figure does not show classes representing 23 medications due to their low frequency.

Serious Events

The majority of reports (97.3%, 438 of 450) were classified as incidents. Of the 12 reports that were classified as serious events, more than half (58.3%, 7 of 12) involved one or more high-alert medications. Insulin was involved in four of the serious events and an NMB was involved in two events. All of the serious events involving insulin described insulin that was unintentionally administered to a patient, which led to hypoglycemia and required immediate medical intervention.

Two of the serious events described carvedilol being inadvertently administered at high doses, leading to a decrease in blood pressure and requiring immediate medical intervention and an increased length of stay. Another serious event report described a patient who developed hemolytic anemia, requiring a blood transfusion and readmission to the hospital following accidental administration of an antibiotic to which the patient had a previously documented allergy.

Discussion

Impact of WDEs on Patients

The administration of incorrect medication and deviation from the intended treatment can impact patients in several different ways. The omission of a necessary dose intended to treat or manage a medical condition can have adverse effects. Patients may also experience adverse effects if given unnecessary medication due to a WDE. For example, our analysis revealed instances where NMBs were mistakenly administered to several patients. This is particularly concerning given NMBs' ability to induce paralysis and potential to cause serious injuries or death when used in error.[7,24]

Moreover, the inadvertent administration of a medication presents additional risk because the medication is not evaluated against the patient's medical history or allergies. Such was the case involving the administration of an antibiotic to a patient despite the patient's documented allergy, which resulted in a reaction and readmission to the hospital.

An additional risk associated with WDEs is the potential for other medication errors, such as errors in dose, route, rate, and time. Two serious events in our study involved the incorrect administration of carvedilol to patients who had not previously received the medication. The recommended initial dose of carvedilol, depending on the indication, is 3.125 milligrams or 6.25 mg twice daily, with titrations to the desired maintenance dose occurring gradually over several days or weeks with careful monitoring for adverse effects.[25] Consequently, unintentionally initiating treatment with an inappropriately high dose can result in serious patient harm, as seen in our analysis.

In the events involving the inappropriate administration of reversal agents, the administration of unintended medications not only delayed or failed to provide the intended therapeutic effect, but also potentially exacerbated the adverse effects that the providers attempted to mitigate.

WDEs and Medication Classes

By examining WDEs in the context of medication classes, our study builds on previous research that focused primarily on medication pairs.[9-14] Our findings revealed a pattern of medication confusion within drug classes, with insulins, vasopressors, antibiotics, opioids, and benzodiazepines frequently being mistaken for similar medications within their respective groups. A plausible explanation for this phenomenon is the similarity in nomenclature within these classes, in which many medications share common stems[26] that contribute to confusion. Additionally, medications within the same therapeutic class often share similar indications and are used to treat patients with comparable medical conditions.

A notable finding from our study is the high frequency in which insulin was involved in WDEs. The three most frequently reported individual medications in our analysis were all insulins (lispro, regular, and glargine). This observation contrasts with previous literature from approximately two decades ago, which identified opioids as among the most frequently reported,[13,14] although it is important to acknowledge methodological differences between the studies.

Confused Medication Names

Naming conventions of medications face the challenge of balancing two competing goals: minimizing the risk of confusion and ensuring that names are readily identifiable and understood in relation to chemical composition, pharmacological action, and/or therapeutic use.[10] While the use of similar names for medications within the same class can facilitate identification, it can also increase the risk of WDEs. For example, cephalosporin antibiotics are characterized by their shared "cef" stem; according to the FDA's list of approved drugs as of January 2025,[20] there are 17 commercially available cephalosporin antibiotics containing "cef" within their names. This pattern of similar nomenclature within subclasses extends to other antibiotic classes, including aminoglycosides (e.g., gentamicin, streptomycin, tobramycin), carbapenems (e.g., ertapenem, imipenem, meropenem), fluoroquinolones (e.g., ciprofloxacin, levofloxacin, moxifloxacin, ofloxacin), glycopeptides and lipoglycopeptides (e.g., dalbavancin, oritavancin, telavancin, vancomycin), macrolides (e.g., azithromycin, clarithromycin, erythromycin), rifamycins (e.g., rifabutin, rifampin, rifaximin), and tetracyclines (e.g., doxycycline, minocycline, tetracycline), among others.[27]

In addition to shared stems, and other name components, certain medications within the same class may also be referred to by similar abbreviations. For example, alteplase and tenecteplase are sometimes abbreviated by "TPA" and "TNK," respectively.[28-30] Alteplase presents a unique case where "TPA" not only refers to the individual medication but also to the broader class of tissue plasminogen activators, to which both alteplase and tenecteplase belong.[29-31] This overlap in abbreviation further contributes to the potential for confusion and medication errors.

Multiple organizations have endeavored to mitigate WDEs arising from medication name confusion. These efforts include the Phonetic and Orthographic Computer Analysis program by the FDA, which assesses the similarity of names based on a computer algorithm and assigns a percent similarity score to a given name pair.[32] ISMP maintains the List of Confused Drug Names[11] and the Lists of Look-Alike Drug Names With Recommended Tall Man (Mixed Case) Letters.[33] However, it is crucial to acknowledge that these lists cannot encompass all possible medication combinations involved in WDEs, and confused medication names represent only one facet of a broader, complex issue.

Future Research

While we have identified key insights regarding the medications and medication pairs commonly involved in WDEs, additional investigation may provide a deeper understanding of the factors that contribute to these events. Such insights could enable further development and prioritization of targeted prevention strategies for WDEs.

Limitations

Several limitations inherent to this study warrant careful consideration when interpreting the findings. Despite Pennsylvania's mandatory reporting laws, PA-PSRS data fundamentally reflect the complexities of staff-driven identification and reporting processes. Also, the reporter's interpretation of an event can introduce bias in the classification of event types. For example, a WDE involving medication administration to the wrong patient may be reported under the "Wrong Patient" subtype rather than the "Wrong Drug" subtype. Since our study focused exclusively on reports categorized as "Wrong Drug" events, relevant WDEs classified under other Medication Error subtypes may have been inadvertently excluded.

Despite these limitations, this study provides valuable insights into the medications involved in WDEs and their impact on patients.

Conclusion

WDEs can cause serious patient harm resulting from the omission or delay of a necessary medication, administration of an unintended and/or contraindicated medication, or other deviation such as administration via the incorrect route due to confusion between two medications. Our findings highlight insulin as the medication class most frequently involved in WDEs. Additionally, our study underscores the need for heightened attention to medications with similar names, including those with shared stems. Additional research regarding the contributing factors to WDEs could provide a more complete understanding of these events and facilitate further development of evidence-based, targeted prevention strategies.

Note

This analysis was exempted from review by the Advarra Institutional Review Board.

Data used in this study cannot be made public due to their confidential nature, as outlined in the Medical Care Availability and Reduction of Error (MCARE) Act (Pennsylvania Act 13 of 2002).

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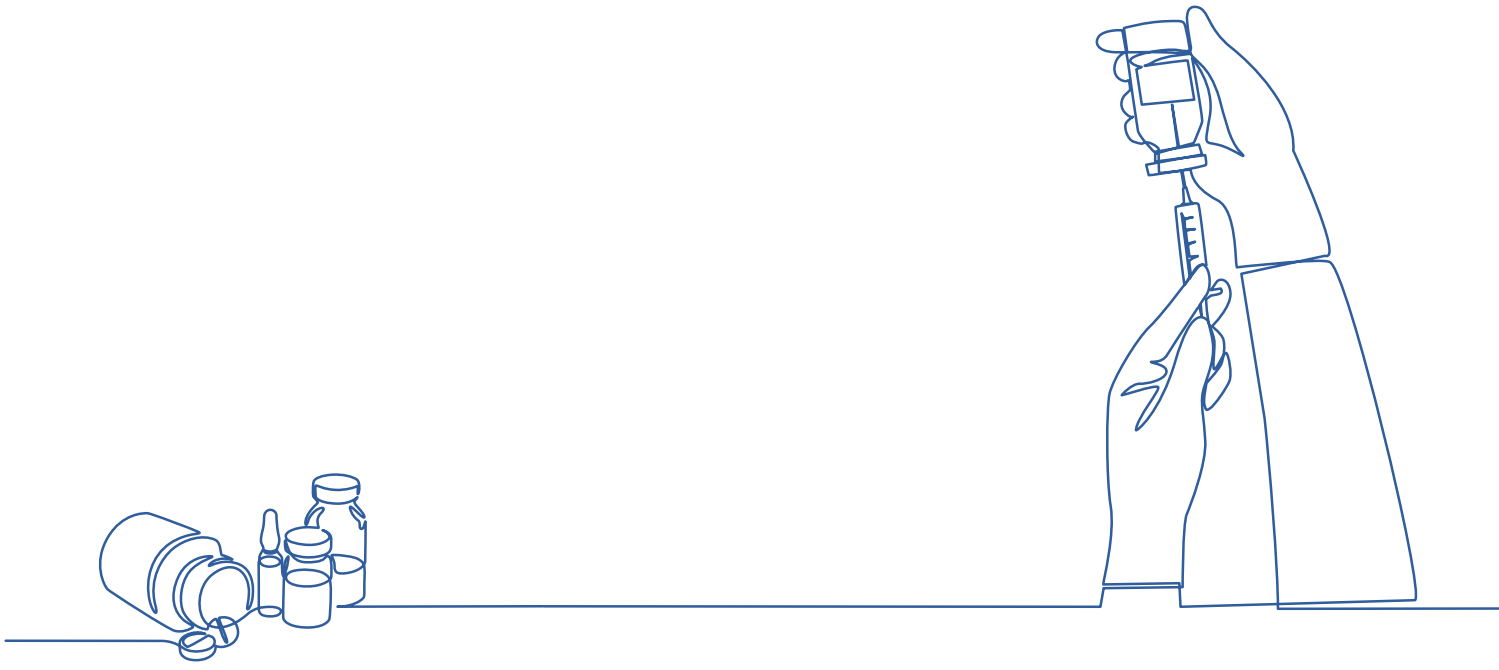

The Overlooked Threat of Hospital Falls During the Discharge Period:

A Statewide Retrospective Analysis of Patient Safety Event Reports

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Keywords: injurious falls, fall-related serious events, hospital discharge, fall prevention, inpatient falls, discharge planning

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Abstract

Background: Inpatient falls continue to be a patient safety challenge, with 35,450 falls reported to the Pennsylvania Patient Safety Reporting System (PA-PSRS) in 2024. While previous research has primarily focused on inpatient or post-discharge falls, the transitional period surrounding discharge has been understudied.

Methods: We queried the PA-PSRS database for fall reports submitted between July 1, 2023, and June 30, 2024. Using a stepwise refinement process, we identified a subset of falls that occurred around the time of discharge for inclusion in the falls surrounding discharge group. We used a two-proportion z-test to compare the proportion of serious events between the discharge group and the broader comparison group. We further analyzed and coded reports from the falls surrounding discharge group to identify fall type, discharge phase, injury type, discharge plan outcome, and staff presence/assistance.

Results: A total of 253 falls surrounding discharge were identified for analysis. The proportion of serious events in this group (7.5%; 19 of 253) was significantly greater than in the comparison group (2.9%; 749 of 25,701; $p<0.0001$). Among the 11 identified fall types, *ambulating* was the most common (33.2%; 84 of 253). Over one-quarter of patients (28.5%; 72 of 253) were in the *discharge complete* phase when their fall occurred. Injury details were available in 185 reports, with the most common injury types being *superficial skin injury* (15.1%; 28 of 185), *soft tissue injury* (5.9%; 11 of 185), and *musculoskeletal injury* (5.4%; 10 of 185). Discharge plan outcome was determined in 141 reports, with the majority (80.9%; 114 of 141) indicating the discharge proceeded as planned. Information about staff presence/assistance was available in 206 reports, with over two-thirds (71.8%; 148 of 206) indicating that *staff was not present* when the fall occurred. Four discharge-related activities were identified and associated with falls: *dressing*, *packing/gathering belongings*, *showering/washing up*, and *entering a vehicle*.

Conclusion: This study identifies the time frame surrounding discharge as a critical and high-risk period for falls, representing a greater threat to patient safety than previously recognized. The significantly greater proportion of serious events in the falls surrounding discharge group compared to the broader comparison group highlights the elevated patient safety risk during this transitional period. By identifying specific discharge-related activities associated with falls, this study offers actionable insights for targeted interventions. Implementing focused strategies and integrating fall prevention into discharge planning and patient education may enhance safety and reduce the risk of serious fall-related events during this vulnerable period.

Introduction

Inpatient falls are a continuing patient safety issue nationwide.[1-4] In Pennsylvania alone, 35,450 falls were reported to the Pennsylvania Patient Safety Reporting System (PA-PSRS)[a] in 2024, with 3.2% classified as a serious event that resulted in either death or an unanticipated injury requiring the delivery of additional healthcare services.[5] A breadth of previous work has investigated inpatient falls, leading to the development and implementation of numerous prevention strategies.[6-9] For example, previous studies have found that universal fall precautions should be in place regardless of a patient's fall risk to reduce the risk of falls.[10] Implementing the use of personalized risk assessment and care plans,[1,3,6-8,11] staff and patient education,[7] and patient safety technology (e.g., bed and chair alarms)[7,9] can also help with fall prevention. Falls after hospital discharge (e.g., those that occur within three months following discharge) have also been studied previously.[12-17] Fall prevention strategies for the post-discharge destination[15] are similar to those targeting prevention of inpatient falls and include hand-off communication,[18] patient education,[14,15,19] and environmental safety measures (e.g., clearing the floor of clutter).[20]

While inpatient falls and falls after the patient leaves hospital grounds are well researched, falls that occur during the time frame surrounding discharge have yet to be fully investigated in the literature. This transitional period may present a unique set of conditions that enhance patients' perceived independence and inadvertently reduce vigilance toward fall prevention. Although medically stable for discharge, these patients may still be at risk of falling. Maintaining appropriate precautions throughout the discharge period is vital to patient safety. In this study, we aim to examine the characteristics, contextual factors, and impact of falls that occur during the period surrounding discharge, while the patient was still in the hospital or on hospital grounds, to better understand how the events affect patient safety.

Methods

We defined a fall surrounding discharge as any unintentional fall that occurred after the patient had been formally discharged (e.g., while waiting for transport or exiting the facility) or on the same day the patient was scheduled for discharge.

Data Query

Data for this study were collected from event reports in the PA-PSRS acute care database. PA-PSRS reports contain responses to structured fields (e.g., event date, event type, harm score, patient age, patient sex at birth) and free-text narrative fields that allow reporters to describe event details in their own words. We queried PA-PSRS for reports submitted between July 1, 2023, and June 30, 2024, under the event type Falls. To focus our analysis on inpatient hospital events, we limited the facility types to include only acute care hospitals and 10 care area groups[b] (intensive care unit, intermediate unit, medical-surgical unit, labor and delivery, obstetrics and gynecology unit, pediatric unit, pediatric intensive care unit, psychiatric unit, rehabilitation unit, and specialty unit). This initial search produced 25,954 reports.

To target falls surrounding discharge, we applied a search of the free-text fields for at least one of the following keywords potentially indicating the patient's discharge status or intended post-discharge destination: "discharg,"[c] "d/c," "DC," "home," "SNF," and "skilled nursing." This keyword search yielded 1,086 reports which were then manually reviewed to identify those that met our definition of a fall surrounding discharge. Reports that did not meet the definition remained in the group of reports identified through our initial search, which was used as a comparison group for statistical analysis. **Figure 1** illustrates the stepwise process of identifying and refining the search for inpatient falls surrounding discharge. The comparison group was not analyzed beyond statistical comparison to the falls surrounding discharge group.

Variables Coded

We analyzed the falls surrounding discharge using data entered by the reporter in both structured and unstructured (free-text) fields of the reports. We analyzed patient demographics (age and sex) and event classification (incident and serious event), which are provided in the structured fields. The terms "incident" and "serious event" are defined in the Medical Care Availability and Reduction of Error (MCARE) Act (Act 13 of 2002)[21] as follows:

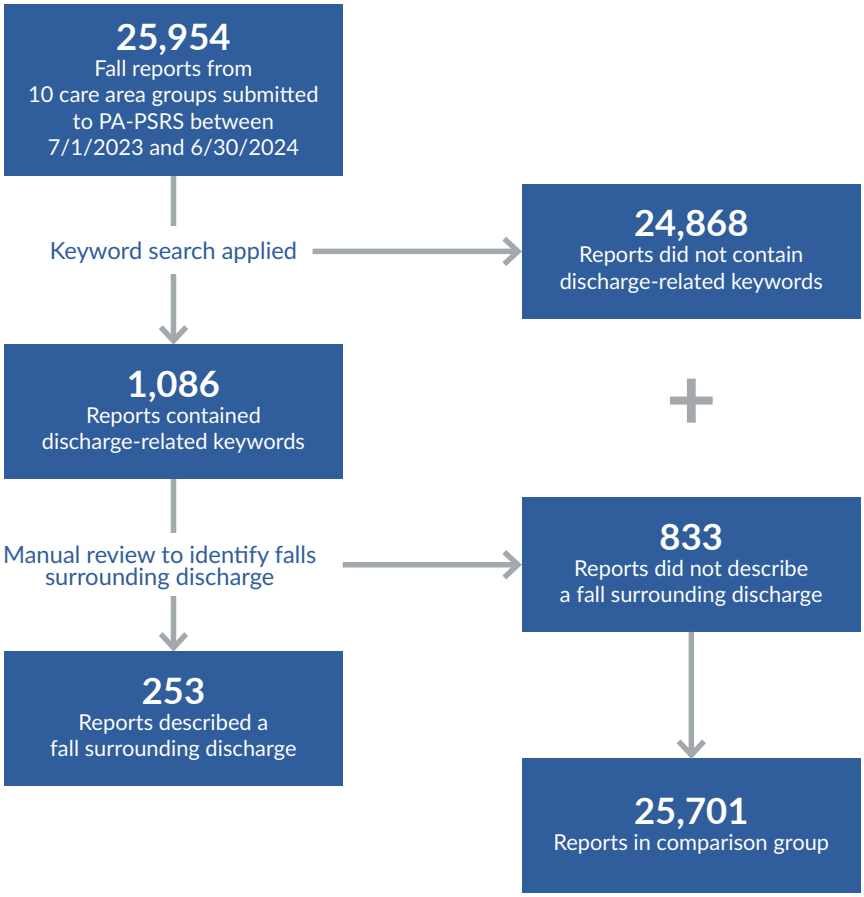
- Incident: "An event, occurrence, or situation involving the clinical care of a patient in a medical facility which could have injured the patient but did not either cause an unanticipated injury or require the delivery of additional healthcare services to the patient."
- Serious Event: "An event, occurrence, or situation involving the clinical care of a patient in a medical facility that results in death or compromises patient safety and results in an unanticipated injury requiring the delivery of additional healthcare services to the patient."

[a]PA-PSRS is a secure, web-based system through which Pennsylvania hospitals, ambulatory surgical facilities, abortion facilities, and birthing centers submit reports of patient safety–related incidents and serious events in accordance with mandatory reporting laws outlined in the Medical Care Availability and Reduction of Error (MCARE) Act (Act 13 of 2002). All reports submitted through PA-PSRS are confidential and no information about individual facilities or providers is made public.

[b]Within PA-PSRS, the event reporter chooses among 168 care areas to indicate the location where an event occurred. To simplify our analysis, we sorted each of the care areas into 23 higher-level care area groups, 10 of which were relevant for this study.

[c]"Discharg" was used to search for discharge, discharged, discharging, and any other conjugation of the word that may have been included in the free-text fields of the event report.

Figure 1. Stepwise Process of Identifying and Refining Inpatient Falls Surrounding Discharge



Fall risk[d] and fall history[e] for each patient were coded using information from the structured fields, as well as details from the free-text fields. Additionally, the information in the free-text fields underwent a rigorous two-stage coding process. In the first stage, one researcher identified and coded the variables listed below. If a report lacked clarity or presented ambiguities, a second researcher reviewed the report and engaged in discussion until consensus was reached.

Fall Type. We analyzed the reports to identify the type of fall that occurred using the PA-PSRS Falls Event Type Decision Tree for Hospital Users.[22] This decision tree was developed by the Patient Safety Authority to help facilities systematically evaluate patient falls and consistently identify specific fall event types. Additional relevant details for certain fall types were identified and coded, and these will be further explored in the Results.

The following fall types are specified in the Falls Event Type Decision Tree: lying in bed, assisted, sitting at side of bed, sitting in chair/wheelchair, transferring, ambulating, toileting, in the exam room/exam table, hallways of facility, grounds of facility, from stretcher, found on floor, and other[f].

Discharge Phase. We evaluated the reports to determine the patient's phase of discharge at the time the fall occurred.

- *Discharge Complete*: The report described a patient who had already been discharged at the time the fall occurred.
- *Discharge Pending*: The report described a patient who was scheduled to be discharged on the same day the fall occurred.

Injury Type[g]. We reviewed the report details to identify the type of injury, if any, the patient sustained as a result of the fall.

- *No Injury*: The event details explicitly indicated there was no injury to the patient.
- *Superficial Skin Injury*: Patient experienced an abrasion, reddened skin, skin tear, or laceration.

[d]Fall risk was determined based on responses to the optional Fall Event Detail Question in PA-PSRS: "At the time of last assessment, was patient determined at risk?" When this question was not answered by the reporter, but event details indicated the patient was at risk for falls, the researcher coded the reports accordingly.

[e]Fall history was determined based on responses to the optional Fall Event Detail Question in PA-PSRS "Does patient have prior history of falls in the past 12 months?" When this question was not answered by the reporter, but the event details indicated the patient had a history of falls, the researcher coded the reports accordingly.

[f]In the Falls Event Type Decision Tree, the other category includes a range of fall types, some of which are more specific. One such type, unanticipated physiological fall ("physiological"), was pertinent to the reports in our study and was therefore treated as distinct from the broader other fall type. Falls categorized under the more general "specify the reason" subtype remained within the other fall type category.

[g]Serious events were identified using the structured event classification field assigned by the reporting facility, while injuries were manually coded based on details provided in the unstructured free-text event descriptions. Although there is a natural overlap between serious events and injuries, not all injuries were classified as serious events, as some may not have required the delivery of additional healthcare services.

- *Musculoskeletal Injury*: Patient experienced a fracture or tendon injury.
- *Soft Tissue Injury*: Patient experienced swelling, bruising, superficial hematoma, or surgical wound bleeding and/or dehiscence.
- *Brain Injury*: Patient experienced a hemorrhagic contusion or subdural hematoma.

Discharge Plan Outcome. We examined the outcome of the planned discharge following the fall to determine whether the patient was discharged as intended or the fall resulted in a delay or change to the discharge plan.

- *Discharged as Planned*: The patient's discharge plan was unchanged due to the fall.
- *Not Discharged as Planned*: The patient was unable to be discharged at the time intended or needed to be readmitted due to the fall.

Staff Presence/Assistance. We analyzed the report details to determine whether a staff member was present and/or assisting the patient when the fall occurred.

- *Staff Was Present and Actively Assisting the Patient*: A staff member was providing hands-on assistance to the patient when the fall occurred (e.g., assisting with ambulating or transferring).
- *Staff Was Present but Not Actively Assisting the Patient*: A staff member was with the patient but was not providing hands-on assistance (e.g., staff member was in the room, but not helping the patient ambulate) when the fall occurred.
- *Staff Was Not Present*: A staff member was not with the patient at the time the fall occurred.

Descriptive Data Analysis

We used a retrospective, mixed-methods design with an exploratory sequential approach,[23] starting with a focus on the qualitative data, which was then quantified for further analysis. The variables were measured by frequency and assessed using a descriptive data analysis. Descriptive analysis is a quantitative method where phenomena are explored and patterns are identified with the purpose of better understanding and explaining the occurrence of the phenomena.[24] This type of analysis is not used to identify causal relationships but is used to characterize the context of the phenomena, point toward possible causal mechanisms, and generate hypotheses.

Statistical Analysis

We used a two-proportion z-test to compare the proportion of serious events in the group of falls surrounding discharge to the proportion in the comparison group. The statistical test was used to determine whether the proportion of serious events in the falls surrounding discharge group was significantly greater than that in the comparison group using a 0.05 level of significance.

Results

Event Classification

In the falls surrounding discharge group, 7.5% (19 of 253) of the reports were classified as serious events. This was significantly greater than the comparison group, in which only 2.9% (749 of 25,701; $p<0.0001$) were serious events.

This quantitative analysis revealed a significantly greater proportion of serious events among falls occurring around the time of discharge compared to those in the broader comparison group. The sections that follow describe the characteristics and contextual factors of the falls surrounding discharge group in greater detail.

Patient Characteristics

Among patients who experienced a fall surrounding discharge, sex was reported in 232 reports. Of these, 53% (123 of 232) were female and 47% (109 of 232) were male. Age was provided in all but one report, with a mean age of 68.4 years and a median of 73 (range=1–105 years; 25th percentile=59 years; 75th percentile=81 years). Over two-thirds of patients (69.4%; 175 of 252) were 65 years or older. Among patients age 65 and older, 8.6% (15 of 175) of falls were reported as serious events, compared to 5.2% (4 of 77) in patients under 65 years of age.

Fall risk status was able to be determined in 151 reports, with over three-quarters (76.8%; 116 of 151) indicating that the patient was at risk for falls. Fall history information was available in 115 reports, with approximately half (50.4%; 58 of 115) reflecting a prior history of falls.

Fall Type

All reports provided sufficient detail to identify the fall type. Falls occurring while *ambulating* were most common (33.2%; 84 of 253). **Figure 2** illustrates the frequency of each identified fall type.

We also investigated the relationship between fall type and event classification. As shown in **Table 1**, seven of the 11 fall types identified in this study resulted in at least one serious event.

Further analysis of fall types revealed that 20.6% (52 of 253) of falls were associated with activities more closely related to the discharge process than to routine patient care. These activities included *dressing*, *packing/gathering belongings*, *showering/washing up*, and *entering a vehicle*. Among these discharge-related activities, *dressing* was the most frequently identified, accounting for 10.3% (26 of 253) of all falls. One notable report highlighted the patient's perception of risk: After falling, the patient stated they believed they could dress independently because of their imminent discharge.

Footwear also emerged as a contributing factor to falls around the time of discharge. Five falls were associated with footwear issues: two while *ambulating*, two in the *hallways of facility*, and one on the *grounds of facility*. Issues related to footwear included patients tripping over their shoes, wearing less supportive footwear (i.e., flip-flops), and wearing an ill-fitting surgical shoe.

Discharge Phase

All reports contained sufficient detail to determine the patient's discharge phase at the time of the fall. More than one-quarter of patients (28.5%; 72 of 253) were in the *discharge complete* phase when their fall occurred, as shown in **Figure 3.**

Injury Type

A total of 185 reports contained sufficient information to determine whether an injury occurred (see **Figure 4**). Among these, 15.1% (28 of 185) described a *superficial skin injury*, such as skin tears and lacerations; 5.9% (11 of 185) involved a *soft tissue injury*, including superficial hematoma and surgical wound bleeding or dehiscence; 5.4% (10 of 185) reported a *musculoskeletal injury*, including various types of fractures; and 1.1% (2 of 185) resulted in a *brain injury*, including one patient who was diagnosed with a hemorrhagic contusion and another with multiple subdural hematomas. The remaining 134 reports indicated that no injury occurred.

Figure 2. Frequency of Fall Type, N=253 PA-PSRS Reports

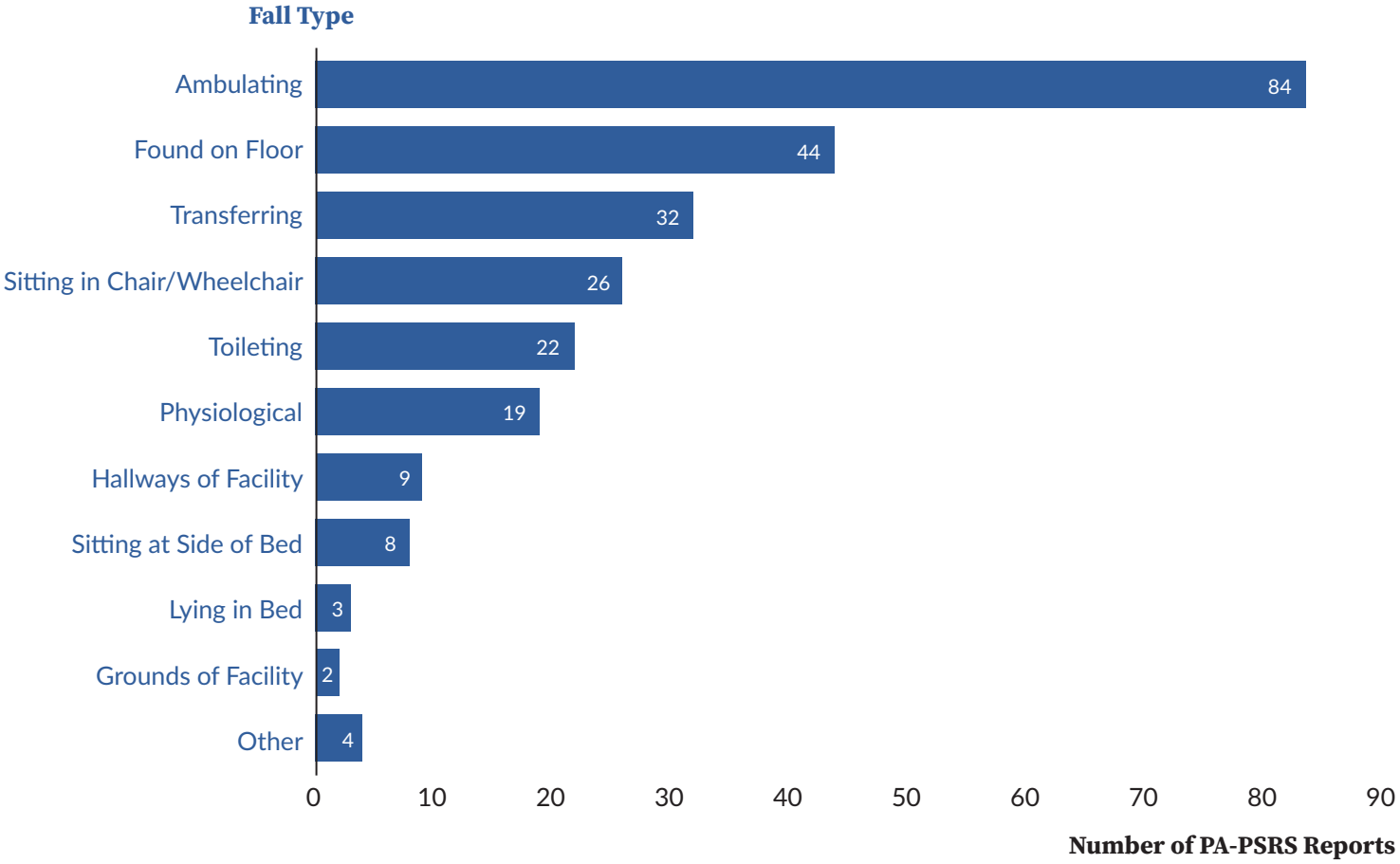


Table 1. Frequency and Relationship Between Fall Type and Event Classification, N=253 PA-PSRS Reports

	Event Classification		
Fall Type	**Incident**	**Serious Event**	**Total**
Ambulating	75	9	84
Found on Floor	42	2	44
Transferring	31	1	32
Sitting in Chair/Wheelchair	24	2	26
Toileting	20	2	22
Physiological	18	1	19
Hallways of Facility	9	-	9
Sitting at Side of Bed	6	2	8
Lying in Bed	3	-	3
Grounds of Facility	2	-	2
Other	4	-	4
Total	**234**	**19**	**253**

Note: Cells with a "-" represent a zero frequency per combination of categories.

Figure 3. Discharge Phase at the Time the Fall Occurred, N=253 PA-PSRS Reports

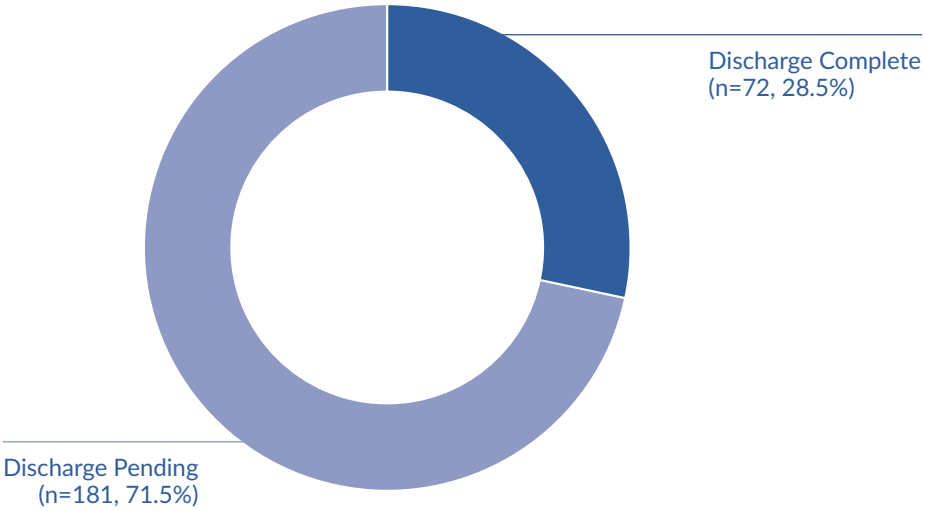
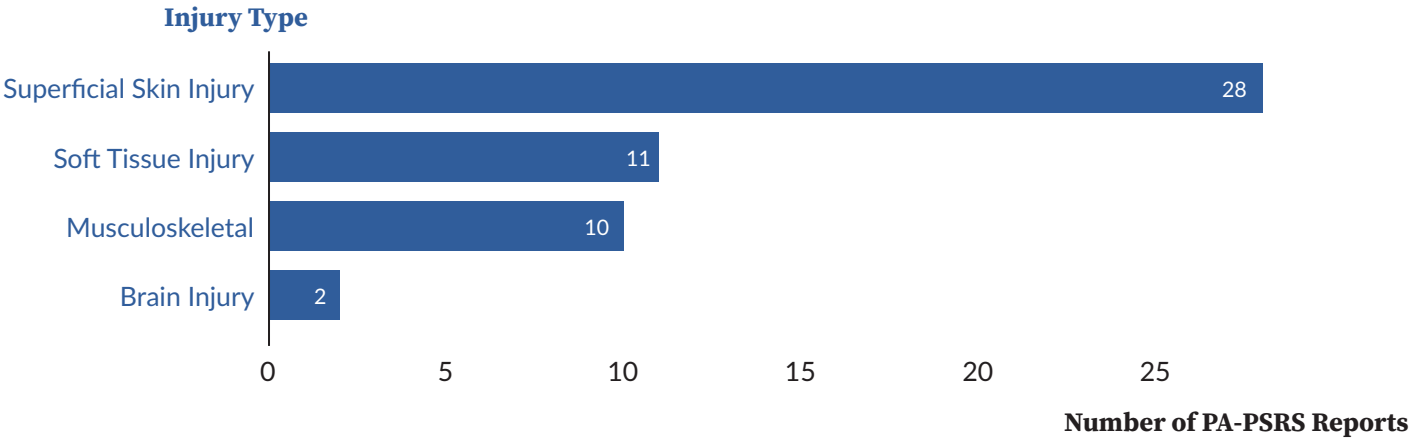


Figure 4. Frequency of Injury Type for Reports Describing an Injury, N=51 PA-PSRS Reports



Note: Of the 185 reports that contained sufficient information to determine whether an injury occurred, 51 described an injury. Each of the 51 reports was coded as having only one injury type. The remaining 134 reports indicated that no injury occurred.

Discharge Plan Outcome

Information about the discharge plan outcome was available in 141 reports. The majority (80.9%; 114 of 141) of these indicated that the patient was *discharged as planned*, while 19.1% (27 of 141) of patients were *not discharged as planned*.

Staff Presence/Assistance

Information regarding staff presence and assistance at the time of the fall was included in 206 reports. Among these, 71.8% (148 of 206) indicated *staff was not present* at the time the fall occurred. In 18.4% (38 of 206), *staff was present but not actively assisting the patient*, while in 9.7% (20 of 206), *staff was present and actively assisting the patient*.

Discussion

Implications of Findings

Consistent with prior research,[25-28] our findings confirm that inpatient falls can lead to patient injury. Our study builds upon existing literature by highlighting the period surrounding hospital discharge as a critical transitional phase for fall and injury prevention. We identified a statistically significant difference in the proportion of serious events between falls surrounding discharge and those in the comparison group. Notably, serious events occurred in 7.5% of falls surrounding discharge, more than double the proportion in the comparison group (2.9%). Additionally, we identified discharge-related activities, including *dressing*, *packing/gathering belongings*, *showering/washing up*, and *entering a vehicle*, which could be potential targets for prevention strategies during this critical period. Taken together, these findings suggest that the discharge transition period warrants the same level of attention—if not greater—as any other phase of hospitalization to prevent falls and mitigate the risk of serious injury when falls do occur.

The data from this study suggest that patients may underestimate their risk of falling during the time surrounding discharge. Patients may feel that because they are being discharged, they are no longer at the same risk as they were during their hospital stay. This is supported by the example in our dataset of a patient who did not ask for help getting dressed, believing they were independent due to their imminent discharge. While hospital discharge indicates clinical stability sufficient to leave inpatient care, patients may not be fully recovered or at their baseline level of functioning and may remain at risk for falling during this transitional period.[16,17,29] Additionally, time in the hospital and recovering from injury and/or illness can leave patients weaker than they were prior to hospitalization,[16,17,29] but patients may not perceive this weakened state.[30] Patients should be informed that, although they no longer require inpatient hospital care, they may still be at risk of falling.

The results of this study underscore the importance of integrating fall prevention into discharge planning and instructions. Discharge planning, which should begin early in a patient's hospital stay, is primarily intended to determine the type of care a patient will need after they leave the hospital and to ensure safe patient transfer to their discharge destination (e.g., home, skilled nursing facility).[19,31] This includes medication reconciliation,[32,33] necessary health resources (e.g., home health, physical therapy, medical equipment),[19,31] and patient[33] and caregiver education[19] about fall prevention at their post-discharge destination. Notably, more than one-quarter of patients in our study had technically been discharged at the time their fall occurred. These patients would have already received their discharge information and instructions, highlighting an opportunity to remind patients to keep inpatient fall prevention strategies in place until they leave hospital grounds. Embedding fall prevention into both the discharge plan and discharge instructions may help bridge the gap between inpatient and post-discharge fall prevention efforts.

Potential Safety Strategies

Table 2 outlines evidence-based fall prevention strategies identified in the literature. These interventions are applicable throughout the hospital stay and should be consistently maintained through the discharge period until the patient has left hospital grounds. The third column illustrates how existing evidence-based fall prevention strategies can be adapted to target the time frame surrounding discharge.

Future Directions

Future research should explore both patient and staff awareness and perceptions during the time frame surrounding discharge, as well as implementation and evaluation of targeted fall prevention strategies during this transitional period. Safety strategies should be assessed for feasibility (e.g., time and resources required to implement and maintain), potential unintended consequences, and effectiveness in reducing falls surrounding discharge.

Limitations

The quality of information provided in the free-text fields of PA-PSRS reports varies, with some reports containing more detailed information than others. This reduced the full scope of certain variables in our study. When using the PA-PSRS Falls Event Type Decision Tree to code fall type, we were also limited by the algorithm's linear design and dichotomized (yes/no) options. Fall types positioned earlier in the decision tree are more likely to be selected than types that may also be relevant but do not appear until further along in the coding sequence. Additionally, the number of falls that occurred during the discharge period may be underrepresented in this study, as some reports may not have included keywords or sufficient detail in the free-text fields to determine that the fall occurred on the day of discharge. As a result, relevant cases may have been missed during data extraction and manual review. Due to the large volume of reports in the comparison group, manual review for additional discharge-related indicators was not feasible. Finally, the fall prevention strategies provided in **Table 2** are not exhaustive, as we did not intend to provide a full review of all fall prevention strategies and their effectiveness.

Conclusion

This study highlights the time frame surrounding discharge as a critical and high-risk period for falls, representing a greater threat to patient safety than previously recognized. Our analysis revealed that a significantly greater proportion of serious events resulted from falls during this period, with falls surrounding discharge involving more than double the proportion of serious events compared to the broader comparison group. We also identified discharge-related activities that can serve as focus points for interventions targeting this critical phase of care.

These findings underscore the importance of maintaining vigilant fall prevention efforts throughout the discharge process, up to and including the patient's departure from hospital grounds. By addressing the vulnerabilities identified in this study, healthcare facilities can enhance patient safety and reduce the risk of serious fall-related events during the discharge period.

Notes

This analysis was exempted from review by the Advarra Institutional Review Board.

Data used in this study cannot be made public due to their confidential nature, as outlined in the Medical Care Availability and Reduction of Error (MCARE) Act (Pennsylvania Act 13 of 2002).

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Table 2. Evidence-Based Fall Prevention Strategies and Targeted Interventions for the Time Frame Surrounding Discharge

Category	Fall Prevention Strategies	Targeted Interventions for the Time Frame Surrounding Discharge
Environment	• Maintain call bell within patient's reach[2] • Keep patient's personal belongings within reach[2] • Ensure handrails are securely in place where appropriate (bathroom, room, hallway)[2] • Use nightlights or supplemental lighting[2] • Keep floors clean and dry and promptly clean up spills[2] • Keep patient care areas (bathroom, room, hallway) uncluttered[2] • Place mobility aids (e.g., walker, cane) within safe reach • Keep nonslip, well-fitting footwear on the patient[6,34]	• Place clothing and patient belongings within safe reach of the patient to minimize patient ambulation while dressing and packing/gathering belongings • Ensure the floor stays dry when patient is showering/washing up before leaving the hospital
Medical Equipment and Technology	• Ensure hospital bed and wheelchair locks are on when stationary[2] • Place hospital bed in low position at all times, unless staff needs to raise the bed for clinical care[2,6] • Raise hospital bed to a comfortable height when patient is transferring out of bed[2] • Encourage use of mobility aids (e.g., walker, cane) early and often[3,6] • Use bed and/or chair alarms[6,35-37] • Use video monitoring[3,38,39]	• Encourage use of mobility aids to ambulate around the room when dressing, packing/gathering belongings, and to ambulate to and from the bathroom when showering/washing up • Encourage use of shower chair when showering/washing up • Keep bed or chair alarms active until the patient leaves their room
Clinical and Care Process	• Use a standardized risk assessment tool[8,40] to determine individual patient fall risk[6,7,11, 35-37] • Complete a review of medications associated with increased fall risk for each patient[6] • Establish and follow an individualized plan of care to decrease the risk of falls for each patient[6] • Follow safe patient handling practices, such as using mechanical lifts instead of manual lifts for patient transfers[41,42] • Foster an understanding that fall prevention is a multidisciplinary responsibility[6] • Provide early and frequent access to physical and/or occupational therapy, when appropriate[6]	• Assist patients with dressing, packing/gathering belongings, and showering/washing up • Determine whether patients will require extra help when entering a vehicle • Include vehicle transfers as a component of physical therapy, if appropriate
Patient Education	Educate patients and family members about fall risk and individualized interventions to prevent falls (e.g., bed alarm, mobility aid, utilizing staff assistance when ambulating or toileting)[6,7,35-37,43,44]	• Incorporate patient and family education about fall risk into discharge planning and discharge instructions • Include information about current fall prevention strategies in patient discharge instructions • Remind patients and family members to keep inpatient fall precautions in place until they have left hospital grounds • Educate patients regarding appropriate footwear to choose when dressing for discharge • Incorporate vehicle transfer education into discharge planning (e.g., encourage family to bring a vehicle that is easier to get into, such as a sedan)

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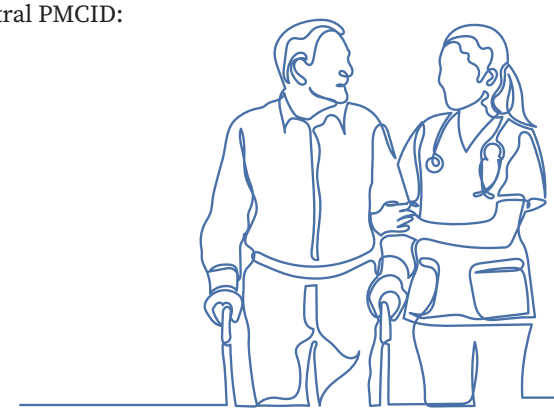

A Physics Tribute to James Reason

Creator of the Swiss Cheese Model

By **Mohammad Bakhtiari**, PhD[1]

Keywords: Swiss cheese model, safety

[1]WellSpan Health

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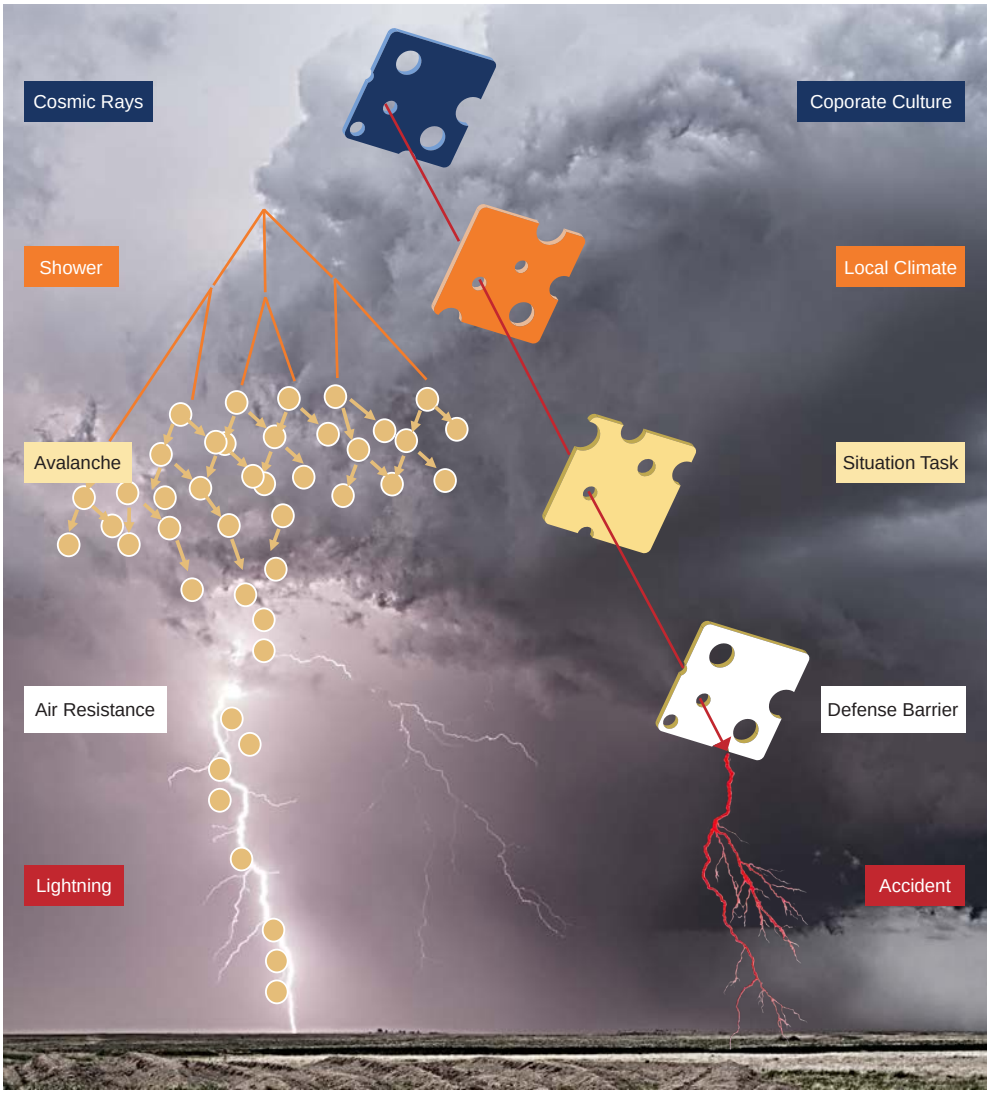
In memory of James Reason (1938–2025), the influential psychologist behind the Swiss cheese model (SCM),[1-3] who passed away on February 5, 2025, we honor his legacy by acknowledging how his work has shaped patient safety. Reason's pioneering insights have profoundly advanced our understanding of human error and systemic safety management across high-risk domains,[2-5] including radiation therapy.[6] This brief tribute highlights the continued relevance and application of Reason's concepts by examining their critical role in analyzing radiation therapy incidents.[6]

The SCM is a conceptual framework illustrating how accidents and errors occur in complex systems.[3] The model uses the metaphor of slices of Swiss cheese, each standing for a layer of defense against errors. The holes in the cheese slices symbolize weaknesses or vulnerabilities within each layer. When these holes align across multiple layers, they create a pathway for errors to reach the patient, resulting in events. In Reason's memory, we dedicate an exploration of the physics behind lightning formation as an analogy to illuminate and honor his pioneering development of the SCM (**Figure 1**).

Despite the electric field during thunderstorms being insufficient alone to ionize the air for initiating a breakdown, recent theories suggest a more complex mechanism.[7] The process begins invisibly, hundreds of miles above the ground, with cosmic rays triggering cascades of energetic electrons. Cosmic rays constantly hit the Earth's atmosphere at a rate of about one particle per square centimeter per second. The resistance of air prevents the electrons from creating an avalanche. However, the cascades, combined with environmental conditions, such as electric fields, can evolve into electron avalanches, ultimately creating conductive channels through the resisting air that lead to lightning.

Figure 1. Swiss Cheese Model From a Physicist Perspective



James Reason's 12 Principles of Error Management

1. Human error is both universal and inevitable.
2. Errors are not intrinsically bad.
3. You cannot change the human condition, but you can change the conditions in which humans work.
4. The best people can make the worst mistakes: No one is immune!
5. People cannot easily avoid those actions they did not intend to commit.
6. Errors are consequences, not causes.
7. Many errors fall into recurrent patterns.
8. Safety significant errors can occur at all levels of the system.
9. Error management is about managing the manageable.
10. Error management is about making good people excellent.
11. There is no one best way.
12. Effective error management aims as continuous reform not local fixes.

Reason J, Hobbs A. Chapter 7: Principles of Error Management. In: *Managing Maintenance Error: A Practical Guide*. CRC Press; 2017:95-101.

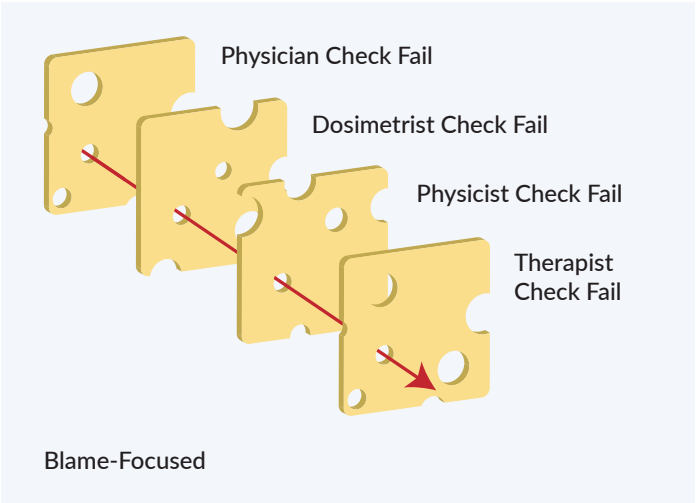
Similarly, organizational influences act like invisible cosmic rays, subtly initiating changes high in the hierarchy (Reason calls them latent errors). These influences cascade downward through supervisory layers, analogous to generating and multiplying high-energy electrons. Preconditions for unsafe acts quietly build up beneath the surface, like an electron avalanche, intensifying vulnerabilities. Like air resistance, employees' resilience and adaptability constantly absorb imperfection and error cascades in the environment and resist the errors' propagation. However, when environmental conditions, akin to an electric field reaching a critical threshold, overwhelm the front line, latent errors push active errors to manifest, leading to visible incidents. This analogy highlights James Reason's fundamental insight: incidents rarely stem from isolated mistakes but arise from complex interactions between latent conditions and triggering events.

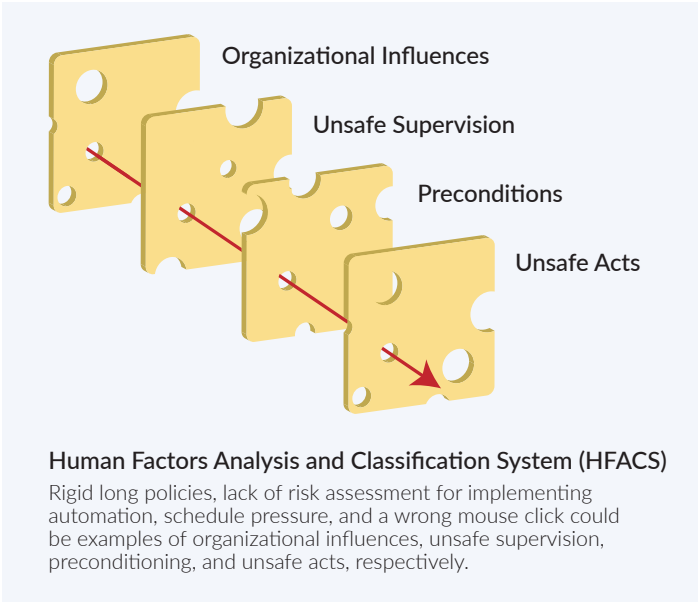
According to Reason's model, the chain of events leading to an incident starts long before a patient arrives for consultation. An active error occurring at the front line is insufficient to cause events; instead, multiple latent conditions, such as corporate culture, local climate, and situational factors, set the stage.[5] For example, an extended rigid policy, inappropriate purchases, schedule pressure, a noisy environment, implementing automation without proper assessment, etc., are preconditions. The latent weaknesses, represented as holes in layers of defense, are dynamic, continuously appearing and disappearing as the front line detects and corrects errors throughout daily operations autonomously and adaptively.

Furthermore, Reason recognized that defenses evolve due to organizational changes, technological advancements, and change management practices' effectiveness (or ineffectiveness). Continuous monitoring and adaptation of these defenses are thus essential.[3] Additionally, these latent conditions interact in various manners: a single vulnerability at one organizational level can trigger multiple failures elsewhere ("one-to-many" mapping), or several small factors can converge to form a single critical vulnerability ("many-to-one" mapping).[5,8]

People utilize the SCM differently. **Figure 2** illustrates two distinct ways of using the SCM to analyze an incident: a superficial approach, where blame is placed primarily on individuals, and a deeper, systemic approach, aligned with James Reason's original intention, which considers the broader organizational context and underlying systemic vulnerabilities.[8,9]

Figure 2. Contrasting Ways of Using the SCM for the Same Problem





Finally, among many lessons we can learn from Reason, I summarize a few:

1. **The absence of accidents is not necessarily a sign of safety.**[5]
2. **The best people can make the worst mistakes.**[4]
3. **Errors are not causes; they are consequences.**[4]
4. **Errors are not intrinsically bad.**[4] He emphasizes that errors are a natural part of human behavior and can offer valuable insights into the functioning of systems and the cognitive processes of individuals. A learning culture needs errors to learn from them.
5. **Effective error management aims at continuous reform rather than local fixes.**[4] Solutions depend on time and space. Today's solution could be tomorrow's problem.
6. **Automation can increase the probability of certain kinds of mistakes** by making the system and its current state opaque to the people who run it.[6] He called this "clumsy automation," where the automation and "defense in depth" make the workings of the system more mysterious to its human controllers and allow the subtle buildup of latent failures hidden behind high-technology interfaces and within the interdepartmental interstices of complex organizations. Automation can hide latent failures within the system, which may accumulate over time and lead to catastrophic outcomes when combined with other factors. Effective use of artificial intelligence (AI) requires healthcare professionals to train and understand the technology properly. There is a risk of overreliance on AI, where healthcare professionals might trust the system too much and not cross-check its outputs.

James Reason left a valuable legacy for understanding and managing risks in complex systems. Organizations can better use his ideas to enhance risk management strategies and improve patient safety by addressing common misconceptions and incorporating modern interpretations. As we remember James Reason and his contributions, we continue to build on his legacy to create safer healthcare environments for all.

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Doing Their Best to Prepare for the Worst:

How the Cooper-Rowan Simulation Center Builds Teamwork From OR to Bedside

By **Amanda Burden**, MD[1,2], **Caitlyn Allen**, MPH[*3] & **Eugene Myers**, BA[3]

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In the fast-paced, often chaotic, and ever-changing environment of medicine, we know how important it is to keep people at the heart of healthcare—but that may be easier said than done. Dr. Amanda Burden, professor of Anesthesiology and assistant dean for Clinical Skills and Simulation Education at Cooper Medical School of Rowan University, sat down with Patient Safety *managing editor, Caitlyn Allen, to share how they put people first and collaborate to be ready for anything.*

Caitlyn Allen: How does anesthesia work?

Dr. Amanda Burden: Anesthetic medications work by blocking signals from nerves to the brain to prevent the feeling of pain. They also act on different centers in the brain to change our level of consciousness to allow people to undergo significant surgeries and procedures that would otherwise be very painful and stressful in a safe, manageable way. Anesthesiology involves more than just helping patients be asleep or not feel pain. It also involves keeping people safe throughout whatever procedure or surgery they are having.

Patients have reported waking up during surgery. Is there any way to predict when this might happen?

Unintentional awareness is a very rare event in modern day anesthesia care. We monitor our patients and their physiological responses continuously throughout the procedure or surgery. We also monitor a patient's brain activity in real time so we can identify that they are unconscious.

There are many procedures, even surgeries, that can be performed comfortably and safely under deep sedation instead of general anesthesia. This is like being in a deep sleep but is not fully a general anesthetic. Many colonoscopies are performed in this manner, for example. What is most important is to make sure that the patient understands the planned anesthesia technique and that they are not surprised. Also, patients who are undergoing general anesthesia are not fully unconscious in the operating or procedure room right before and after the procedure and may remember this period. This is very different than intraoperative "awareness."

If you've never had surgery and have only seen it on TV, you'd expect to be completely asleep. But that's not always what is best for the patient for the situation.

Being completely asleep with general anesthesia is not always the best or safest option for a particular operation or procedure. It may expose the patients to the risks associated with general anesthesia when the procedure could be accomplished safely and comfortably under light or deep sedation instead. There are many different approaches that can be employed: We can use sedation with a local anesthetic or use a peripheral nerve block or something like a spinal or epidural. What the anesthesiologist will do is determine what is safest and most appropriate for each patient in light of their preexisting medical conditions and the type of procedure that is planned.

You're board certified in anesthesiology and pediatric anesthesiology. How does working with kids differ from adults?

Kids are always a little trickier. Their bodies and brains are still developing; there are significant differences between children and adults in terms of their anatomy and physiology—as well as their ability to understand what is happening. All these factors have a considerable impact on anesthetic management. Their heart and lungs may be working harder than an adult's. They need and use more oxygen and are different from adults in how they navigate oxygen supply and demand. Obviously, nobody wants their child to need surgery, and this is very stressful for the parents and family. Even if the kids don't fully understand what's happening to them, they do usually sense that everyone around them is terrified, especially their parents. That makes taking care of kids an especially anxiety-provoking circumstance for everyone involved. It can also be harder to communicate with children. So, we need to be mindful of those points when we're working with kids.

I had no idea just how nuanced and complex anesthesia is.

It's an amazing gift to be able to render people unconscious to the point where they really don't feel something that is incredibly painful, because it's obviously not normal sleep. If someone decided to take out your gallbladder while you were napping, you would wake up and have a big discussion with them. This is a significant change in your consciousness and in how your body reacts to pain.

It's truly amazing that we're able to do that. It's also a tremendous responsibility. Our field has come a long way in understanding that responsibility, both of improved outcomes and of helping patients to better comprehend what's happening.

> "I fully believe that every person who went into healthcare did so because they want to use their skills to take care of people. Every single person shows up every day hoping to make things better.

What is one of your most unusual patient experiences?

I feel fortunate to have been a part of each of my patients' care. They have all been very interesting. I participated in one of the very early living unrelated lung donor transplants. I took care of the donor patient. She and the recipient patient were church members, and this woman decided to give part of one of her lungs to her close friend. I still get chills thinking about it.

The recipient needed this lung, or they wouldn't live. The donor subjected herself to very significant risk to give this amazing gift to somebody with friendship as the only benefit, and everyone in the room felt it, everyone who took care of her felt it. And I still can't believe that I was part of it. Thankfully, everyone did well. It was an amazing experience.

How can you create a team environment in the operating suite when working with new colleagues?

The World Health Organization created a great tool: a preop checklist that gets everyone on the same page. At the beginning of the procedure, before the patient is asleep, the full team reviews key points: What's the patient's name, medical record number, date of birth? What procedure are we doing? Who's here? What is some of the basic equipment we have? Do we think this procedure is likely to cause blood loss? Will that be significant? What else is going on with the patient?

The checklist process includes gathering the team together at the beginning to introduce ourselves, even if we all know each other. The overall process has proven to be very helpful. We all introduce ourselves: "Hi, I'm Amanda. I'm the anesthesiologist." Everyone says their names and their roles. It reminds us that we're all there together for the patient. My institutions, Cooper University Health Care and Cooper Medical School of Rowan University, have made this a priority. There is tremendous support for this at every level, from leadership through to every person working in the health system.

I fully believe that every person who went into healthcare did so because they want to use their skills to take care of people, they want to make things better. Every single person shows up every day hoping to make things better. So, I try to meet people in that place and assume that the whole team is working to do their best.

That's always helpful for me. If we're in a rough patient situation just saying, "Hey, I'm concerned about this. Here are the vital signs I see. Here's what I think's going on, and here's what I think we should do. I'm going to start doing this. Please tell me what different ideas you have. Is there something I'm not seeing?" We refer to those sorts of things as human factors issues, and they are very helpful. Anesthesiology has borrowed this approach to patient safety from other high-hazard fields. They've been super helpful in those fields and they're super helpful for us as well.

What are some of the things that you borrowed in anesthesiology?

From aviation, probably the biggest thing is "crew resource management," which we call crisis management in anesthesiology. David Gaba, MD, an anesthesiologist, engineer, and pilot, first identified the similarities between challenges in aviation and anesthesiology and created this approach [crisis management in anesthesia (CMA)] to thinking about a crisis and to organizing and leading the team. It's a system that uses these advances from aviation in anesthesiology practice and has been adopted by other healthcare domains as well. CMA provides a guide for how to organize the team. It's an understanding that there needs to be a leader. That leader obviously needs to have excellent medical knowledge and skills; they also need to have humility about the potential scope of the situation and to be open to information and ideas that they have not considered.

The other people on the team have a responsibility to help the leader. That includes telling the leader if they think the leader is wrong, obviously in a reasonable, respectful way. "Hey, did you happen to see this is going on? I'm confused about this point; I'm concerned about that." Assuming that everyone is there to make patients feel more comfortable and to do what is best as a starting point is very helpful for this.

It's also an understanding of the importance of assessing what resources we have, of the importance of calling for help early, and of the different roles that people have: who can help and how. There's more involved in crisis management, but those are some key elements that are very useful. They are useful for anything you do that involves other people. Literally anything. Does not have to be a crisis, does not have to be a medical situation. Those elements are incredibly helpful anytime you're trying to get other people to do something together.

It's hard to have a successful encounter when everybody's a captain or nobody's a captain.

Right. Often, it's a nobody's a captain situation, but either one is a problem. Studies show that teams that work together often have a rhythm and do better. Most of those studies are from the other high-hazard fields. It's a little harder to study that kind of thing in healthcare.

Cooper-Rowan[a] has one of the most impressive simulation training labs in the region, if not the country, of which you are the director. Tell me about your approach to educating your fellow clinicians.

Thank you for your kind words! We are very fortunate at Cooper-Rowan to have a wonderful team and faculty of people who recognize the importance of education in healthcare—for all levels of experience in our SimLab. Cooper-Rowan was one of the first in this area to understand how simulation could help teach people how to provide better care for patients.

Around 2004, Cooper purchased a simulation mannequin and began developing a curriculum. I was fortunate to be part of that early process to help shape some of the earliest education that we accomplished here and then just move forward with it. When Cooper Medical School of Rowan University [CMSRU] was started in 2012, the medical school leadership immediately identified simulation education as an essential element for medical student education. Working with learners at every level of the healthcare and medical education continuum has allowed our simulation center to study and develop more robust and meaningful educational programs.

How do you progress from a single mannequin to becoming one of the premier sim centers?

We have a very dedicated group of people in the sim center and leadership at Cooper and CMSRU who understood how simulation can help with medical education and patient safety. We have been able to work with many different departments, along with Risk Management, to best identify what's going on and the different areas of concern in healthcare across the country. Two early projects for us were managing a difficult airway and helping more-novice workers to recognize when a patient is in distress. We were able to meet with stakeholders to involve them in addressing those concerns. We identified different challenges and created a program around those.

It was a success in a lot of different ways. People really enjoyed it. They felt that the simulation training helped them overcome their anxiety of working through these stressful situations and better understand how to marshal resources when you're new in a new place, in a new setting with new people. And they felt that it helped them

[a]Cooper University Health Care and Cooper Medical School of Rowan University

The Closed Claims Program: Reviewing Malpractice Insurance Cases to Improve Anesthesia Safety

Sharing and studying stories about what went wrong in patient safety is an effective way of preventing errors from happening again. Recognizing this powerful opportunity to identify safety concerns and trends relating to anesthesia, in 1984 the American Society of Anesthesiologists (ASA) and the University of Washington at Seattle turned to an unusual source of information on safety events: insurance malpractice cases.

The **Closed Claims Program in Anesthesiology**—which began in 1984 and moved under the auspices of the Anesthesia Quality Institute in 2019—studies closed malpractice claims to identify anesthesia-related major safety concerns, patterns of injury, and prevention strategies in areas where anesthesiologists provide care. Board-certified anesthesiologists collect and analyze quantitative and qualitative data from participating malpractice insurance organizations and derive a narrative summary of care, which is reviewed by legal experts associated with the cases. These analyses of rare and serious events are available for use in publications, presentations, and research studies.

For more than 35 years, the work of the Closed Claims Program has helped advance understanding of the hazards of anesthesia and support for standards of practice, such as the use of pulse oximetry for all anesthetics and in the post-anesthesia care unit (PACU), as well as encouraged further research to improve patient safety.

Learn more at asahq.org/aqi/registries/closed-claims.

make the transition from student to healthcare professional.

We were also able to demonstrate during some subsequent encounters that things improved after taking our course. That set us off on a good path. The people who took the course liked it, the patients they took care of did better, and we were off to the races after that.

How do you come up with realistic scenarios on which people can train?

Whenever we can, we use actual encounters, because one of the first things people will say is, "This could never happen." But we are able to counter with, "I wish you were right, but it did." Typically, we'll use cases we have read about in the literature, particularly those that present meaningful opportunities for us to learn and discuss what happened. We often use cases from the Closed Claims Program in Anesthesiology for scenarios so we can learn as much as possible from these issues. (See sidebar on **page 3**.)

Some studies have looked at how to make simulation feel more realistic, and the best thing is to create a realistic sense of the emotion involved in the situation, to replicate the sights and smells and sounds and people in the real setting for the simulated event to make the learners feel as though they are in a real situation.

Everyone in healthcare has stories. Everyone in healthcare knows how incredible the work is and that taking care of patients requires the effort of so many people working together, of so many different interacting procedures and equipment, and circumstances. So, it doesn't take much to get people back into the setting. It doesn't require an expensive piece of equipment, mainly just bringing in some people to play the different roles and bringing in some of the real feel of the people and the actual setting.

If a facility wants to implement simulation training, but lacks access to something like Cooper-Rowan SimLab, where would you recommend they start?

The most important thing and the most expensive thing are the people: the clinical educators who make the sessions work. The simulators are really tools to get the learners and the clinical educators together around something that's important to both groups, something relevant to their practice. Good sim training also recognizes how adults learn. That it's much more of an opportunity for people to reflect on what they do and how they might do it differently instead of me saying, "Hi, here's how you need to do it, and here's the best way to do it, and here's what you're doing wrong. Just stop doing all that." Studies have repeatedly shown that approach doesn't work.

It's best to present circumstances where people can reflect about what happened and discuss it. And that's the real power of what simulation education can do. It does not take much equipment. It takes people to investigate where there is a need for more education who can create a scenario that captures those points and that provides an opportunity to think through what happened that worked and where there's room for improvement.

> "I certainly appreciate innovation and new technology, but people talking to each other, people trusting each other, people working well together is still such an essential part of healthcare.

What type of scenarios do you use?

We use many different sorts of scenarios. We use some scenarios to teach people a new technique or procedure and some to teach people how to recognize and manage a crisis. We'll turn off the power in a hospital room and the hallways and call people to take care of a patient. Suddenly, they must navigate where they're going and how they're getting there. Our goal is for people to say, "You know what? I need to go look at our disaster preparedness plan. Where exactly would I go and how would I get the patient wherever I need them to go?"

It's to make people think about things like, "Hey, where is a flashlight? Oh, I have a phone that has a flashlight. Yes, that is helpful." We do run scenarios around surgical fires. Unfortunately, it can happen, and people often don't think about it. But it's absolutely one of those things that you have to anticipate and plan to address, or you just will not be ready. You will waste precious time and too many people will be harmed. So that's something we run through in a sim center in an effort to prevent it from happening, and to make sure people are prepared.

We provide education for every possible learner in healthcare, from prehospital through board-certified attending physicians. We cover everything from introducing a very novice learner to how to talk to a patient all the way up through really complex and dynamic scenarios for long-standing professionals to figure out how to manage those better.

If you're going to invest so much time and energy into creating scenarios, it makes sense that you'd want them to be things that people are likely to encounter. Something as simple as the power going out could very well happen, especially with all the fierce storms that we're increasingly getting. It would be better if the first time someone has to deal with a disaster scenario is in the sim center.

Absolutely. I've been at places where the power has gone out. When the weather is extreme, or there are outside physical events that are catastrophic, it is important to have a framework to think about how to manage that crisis. In the case of the power going out, a generator will typically turn on quickly, but it's not perfect. You still need to think about it.

Are there particular topics that don't lend themselves as well to sim training?

I used to think that, but increasingly less so. There are many different tools for simulation. There are people who pretend to be patients, we call those people "standardized patients" (SPs). They are useful for pretty much any field. Those SPs allow students or learners of any level to examine them, to talk to them, to better learn how to take care of someone.

They also are instrumental for issues of professionalism and communication, including between colleagues. It's helpful to teach people about breaking bad news or error disclosure, God forbid, or any adverse event disclosure. Any conversation that is challenging presents an opportunity to learn what it feels like to be the patient

or their family who's hearing that sort of information and to better understand how to present difficult information to patients.

We use sim to teach many elements around adverse events: how to avoid errors and how to have tough conversations, because unfortunately, that is part of medicine. Even if everything goes perfectly, sometimes you have tough information to give people that you'd obviously much rather not. And you have to learn how to do that in a way that's most helpful for the patient.

We also want to be mindful of the emotional well-being of healthcare workers, because it is a rough place to work sometimes. There is so much emotion in addition to the complex illnesses or procedures involved. We want to help physicians, nurses, and all healthcare workers develop the skills they need to do the best job they can for their patients.

Absolutely. As you said, you go into healthcare because you want to help people. So, when things go wrong, it can be devastating: You woke up this morning hoping to make things better, but sometimes things just don't go that way.

It is brutal for people. There have been many studies of healthcare workers who have committed errors and how they've coped with it. It's obviously most brutal for the patient and the patient's family. But it is also very brutal for the people in the healthcare system.

What do you see as the next generation of sim training?

There's obviously a lot of work in virtual reality and artificial intelligence [AI], I'm sure that will create many opportunities to help people better understand anatomy, physiology, and how to accomplish certain procedures. As long as we are going to be taking care of patients and working with other people, we are going to need to keep improving how we do that. We need to best understand how we create a great team that works well together, that feels comfortable questioning each other, making decisions, and then accepting new information and changing those decisions based on new information.

There may be a role for virtual reality and artificial intelligence in that, but we'll still need to get people together and talking to each other.

Absolutely. And at the end of the day, if you or a loved one is sick or needs a procedure, you want to talk to a human, you don't want to talk to a robot.

I agree. I'm hoping that it can help us learn how to work better together. I certainly appreciate innovation and new technology, but people talking to each other, people trusting each other, people working well together is still such an essential part of healthcare.

We've done a few programs for students to work with standardized patients who are demonstrating different challenges, whether it's vision loss or hearing loss or memory loss. And it's very powerful. It's helpful for them to train in a setting where it's not an actual patient. Students can see what they know, but more importantly, what they don't know. Where they've misunderstood something, where they've been just guessing about something, but they really don't have it solidified in their head.

Nobody can know everything. Let's figure out how we can work together to fill in the gaps, whatever the gaps are. That's tremendously powerful.

About the Authors

Amanda Burden is vice chair of Faculty Affairs, professor of Anesthesiology, and assistant dean for Clinical Skills and Simulation Education at Cooper Medical School of Rowan University and Cooper University Healthcare in Camden, New Jersey. She is an active member of the medical education research and patient safety communities. Her research and publications address the use of simulation to explore a range of physician education and patient safety issues, particularly involving critical thinking and decision-making during crises. Dr. Burden is a recipient of an Anesthesia Patient Safety Foundation Safety Scientist Career Development Award and funding from the Agency for Healthcare Research and Quality. She has been an invited speaker at national and international anesthesiology, surgery, and simulation meetings, as well as at the United States Department of Education and the White House Office of Science and Technology Policy, to discuss the use of simulation education to improve patient safety.

Working with a diverse team, Dr. Burden built and directs a successful multidisciplinary interprofessional simulation program that is nationally recognized. She serves as vice chair for the Closed Claims Committee for the American Society of Anesthesiologists (ASA) and Anesthesia Quality Institute, editor-in-chief of the ASA Simulation-Based Education Editorial Board, and as an associate editor of the ASA Editorial Board for Interactive Computer-Based Education.

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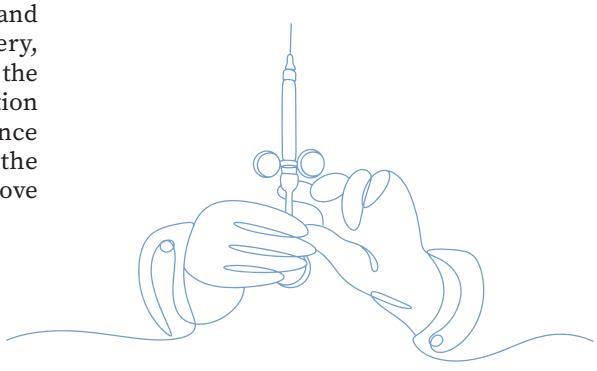

Beware of the **Forgotten Tourniquet** During Phlebotomy and IV Insertion

Keywords: patient safety, blood flow, IV catheter, retention, vigilance, medical error, iatrogenic injury

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Over the past several years more than a thousand event reports of staff forgetting to remove tourniquets from patients following intravenous (IV) insertion or phlebotomy were submitted to the Pennsylvania Patient Safety Reporting System (PA-PSRS). Unfortunately, this issue persists despite being identified 20 years ago in a study with PA-PSRS data.[1]

Impact of Forgotten Tourniquet on the Patient. A prior study of reports submitted to PA-PSRS found that when accidental retention of a tourniquet occurred, patients often had one or more of the following symptoms: pain; numbness; tingling; skin tear; IV infiltration; delay of capillary refill; and extremity edema, temperature change, and color change.[1] An extended delay in the removal of a tourniquet can cause neurological, muscular, circulatory, and/or vascular injury.[1-3] Additionally, prolonged retention of a tourniquet can result in inaccurate laboratory test results (e.g., potassium level or blood count), which could lead to errors in patient care and treatment.[1]

Circumstances of the Events and Why Staff Forget to Remove a Tourniquet. Previous research revealed that in more than 30% of events the tourniquet was applied for more than two hours and up to as many as 24 hours.[1,4] When the forgotten tourniquet was detected, it was most often identified by staff other than the person who applied the tourniquet[1] and in 5%–10% of the events it was recognized by the patient or family.[1,4] According to prior studies,[1,2,4] the forgotten tourniquet was attributed to one or more of the following factors: tourniquet was short in length, similar to skin color, and/or it was covered by other items (e.g., gown, drapes, blood pressure cuff, restraints, patient's fatty tissue); staff were distracted and/or inexperienced; communication breakdown between staff; patient had a condition or state that hindered meaningful

communication (e.g., dementia, unconscious, non-English speaking, or nonverbal); a less common access site was used (e.g., foot, ankle); an alternative material was used as the tourniquet (e.g., blood pressure cuff, glove); and low lighting limited visibility.

Strategies to Reduce Risk of Staff Forgetting to Remove a Tourniquet.[1,2,5,6]

- Implement consistent IV insertion and phlebotomy collection processes across departments.
- Use staff who have completed training and have been verified competent for collections. Staff training should be robust, address policies, and include competency verification. Consider the following when developing training and competencies:
    - Raise the bed during the procedure to increase visibility of the patient's extremity and site.
    - Ensure visibility of the tourniquet by placing it close to the insertion site.
    - Place the tourniquet in a location where it will not become hidden (e.g., covered by clothing or folds of skin). The tourniquet should go over a shirt or hospital gown sleeve whenever possible. If the tourniquet cannot be placed over a shirt sleeve, the sleeve should be rolled up, not pushed up.
    - To improve visibility, use a wide, long, and brightly colored tourniquet.
    - Release the tourniquet promptly when blood flows into the tube, following advancement of the IV catheter or removal of the needle.
    - If patient care is interrupted or if staff need to leave the bedside, remove the tourniquet.
    - If there is persistent bleeding from a puncture site, then inspect for tourniquet retention.
    - Complete the procedure, including tourniquet removal, prior to documentation.
    - Verify that the tourniquet has been removed before leaving the patient.
    - During routine patient assessments staff should inspect for tourniquet retention.

Recovery From a Forgotten Tourniquet.[6]

- Remove the tourniquet right away.
- Evaluate for neurological, muscular, circulatory, and/or vascular injury.
- Evaluate for infiltration and extravasation. If indicated, treat based on best practices.
- Notify the provider and document as appropriate.

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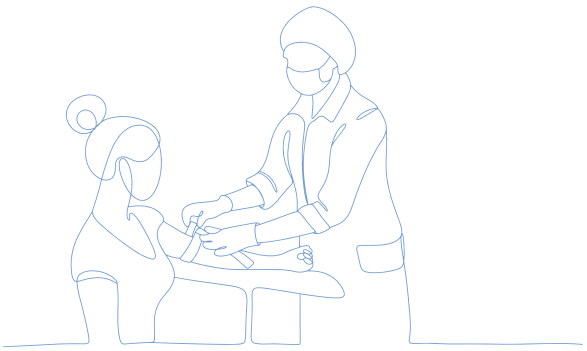

Enhancing Patient Safety Surrounding **Colonoscopy** Procedures

Keywords: colonoscopy complications, colonoscopy perforation, post-colonoscopy bleeding, patient safety, patient education

[1]Patient Safety Authority

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Sanchez CE. Enhancing Patient Safety Surrounding Colonoscopy Procedures. *Patient Safety.* 2025;7(2):129611. doi.:10.33940/001c.129611

By **Christine E. Sanchez**, MPH[1]

Colonoscopies are performed for screening, therapeutic, and diagnostic reasons, with over 15 million being performed every year in the United States.[1] Screening colonoscopies play an integral part in the diagnosis and treatment of colorectal cancer and are estimated to decrease the risk of death from colorectal cancer by 60%.[1] While providing essential healthcare services to patients, this routine procedure comes with risks such as post-procedure bleeding and perforations of the intestinal tract.[2] Post-procedure bleeding can occur when polyps are removed for testing during the procedure. Employing techniques to prevent complications and enhancing patient awareness of what to look for while recovering are essential to increase patient safety during and after these procedures.

Reports recently submitted to the Pennsylvania Patient Safety Reporting System (PA-PSRS) describe patient safety events that involved patients experiencing bleeding and/or a perforated bowel following a colonoscopy. In some of these reports, patients required hospitalization to control post-procedure bleeding, while others described a return to the operating room and/or death due to a perforation.[1,3] Strategies to reduce the risk of bleeding include using evidence-based techniques when removing polyps based on their size and managing a patient's use of anticoagulants or daily aspirin. Polyps less than one centimeter are recommended to be removed using a cold polypectomy technique (i.e., using a snare or forceps that do not require electrocautery).

The risk of bleeding with removal of larger polyps can be decreased by using endoscopic clips, nylon loops, or injecting epinephrine. Generally, patients who chronically use anticoagulants will require cessation of these medications before their procedure or other management to decrease bleeding risks.[4] Techniques to decrease the risk of perforation during a colonoscopy include injecting fluid under large or flat polyps before removal and avoiding dilation in areas with significant inflammation.[3]

Patient education plays a key role in managing post-procedure recovery. To prepare patients to manage possible post-procedure complications, patients should be educated on the signs and symptoms to look for during recovery. Patients should be informed that while a small amount of bleeding may occur with their first bowel movement after the procedure, persistent bleeding or passing of blood clots is a concern, and they should seek medical attention if it occurs. Patients should also look out for persistent abdominal pain and fevers in the days and up to two weeks after a colonoscopy.[5] To ensure effective communication, the timing of when this information is provided should be considered. Providers should avoid explaining these signs and symptoms during the immediate post-procedure time frame, as patients may still be feeling the effects of anesthesia. Instead, this conversation with the patient should occur during a preprocedure appointment or before anesthesia is administered preprocedure, and this information can also be communicated to a family member to ensure understanding.

Combining evidence-based techniques to minimize the risk of complications with clear patient education regarding signs and symptoms that require further medical attention can result in increased patient safety for routine colonoscopies.

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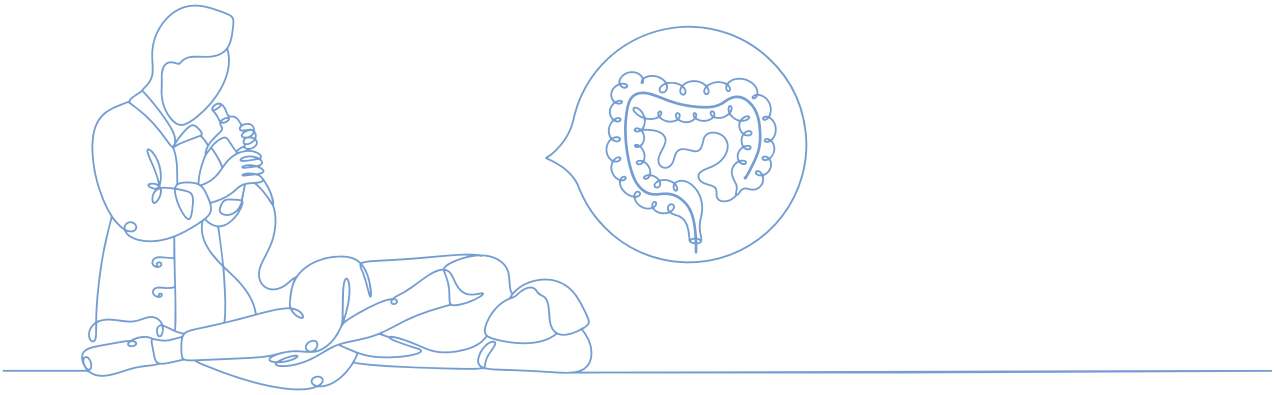
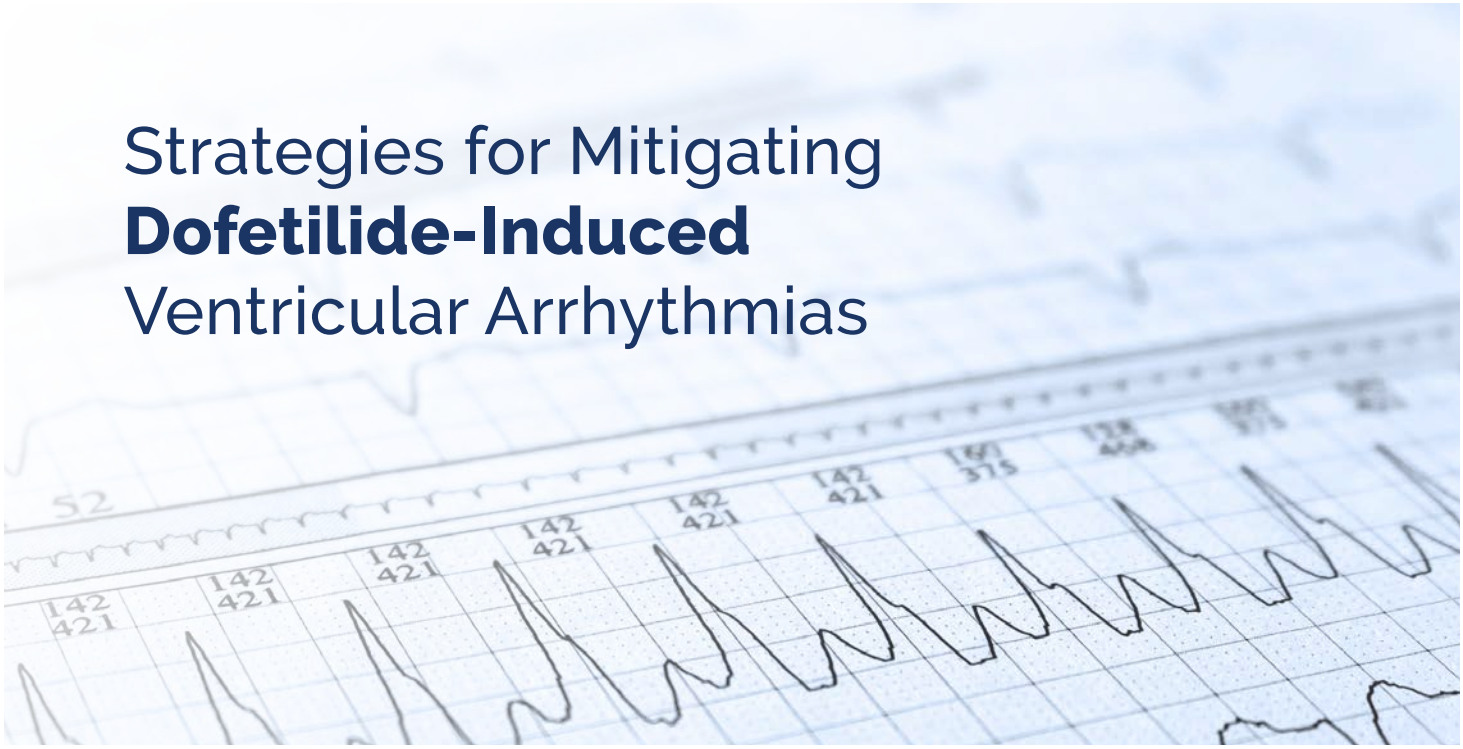


Strategies for Mitigating **Dofetilide-Induced** Ventricular Arrhythmias



Keywords: torsades de pointes, Tikosyn, medication error, medication safety, patient safety, antiarrhythmic

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Ro M. Strategies for Mitigating Dofetilide-Induced Ventricular Arrhythmias. *Patient Safety*. 2025;7(2):131808. doi:10.33940/001c.131808

By **Myungsun Ro**, PharmD, MS[1]

In recent years, the Patient Safety Authority has received several reports of QT prolongation in patients receiving dofetilide. Approximately half of these reports were associated with serious adverse events, including torsades de pointes and other types of ventricular arrhythmias and cardiac arrest, some requiring a transfer to a higher level of care and at least one resulting in death. Some of these reports described a failure to adequately monitor electrocardiograms (EKGs) and adjust therapy in a timely manner. Others indicated concomitant use of medications contraindicated with dofetilide[1] and/or those known to prolong the QT interval,[2] such as azithromycin, fluconazole, hydrochlorothiazide, indapamide, levofloxacin, ondansetron, promethazine, and sulfamethoxazole/trimethoprim.

Dofetilide, also marketed under the brand name Tikosyn, is a class III antiarrhythmic agent used to treat irregular heartbeat in certain patients with atrial fibrillation or atrial flutter.[1] Due to the linear relationship between QTc interval and serum dofetilide concentrations, and its potential to induce life-threatening ventricular arrhythmias, the black box warning recommends starting or restarting dofetilide therapy in a facility that provides continuous EKG monitoring, serum creatinine monitoring, and access to cardiac resuscitation for a minimum of three days.[1] Contraindications include preexisting prolonged QTc interval, renal impairment, and concomitant medications or disease states that may further prolong the QTc interval or elevate serum dofetilide levels.[1]

Until 2016, the U.S. Food and Drug Administration's Risk Evaluation and Mitigation Strategy (REMS)[a] program mandated certification of prescribers, pharmacies, and healthcare facilities in a national registry to ensure safe prescribing and dispensing of dofetilide.[4] Although the dofetilide REMS program no longer exists, we strongly encourage healthcare facilities and providers to reevaluate their current protocols for dofetilide and ensure that they align with the information provided in the package insert[1] and documented in literature,[5,6] including dosage calculations, documented and potential drug interactions, patient-specific risk factors, and instructions for monitoring EKG and lab values, to ensure its safe and effective use.

To enhance the safety of dofetilide administration and mitigate the risk of ventricular arrhythmias, healthcare facilities are advised to consider implementing the action items below.

- Accurate medication reconciliation
    - Conduct a thorough medication reconciliation process to verify the correct dofetilide dose for newly admitted patients who are continuing their chronic therapy from home.
- Engagement of specialized practitioners
    - Restrict the prescribing of dofetilide (re) initiation therapy to cardiology.
    - Engage the clinical pharmacists (e.g., in pharmacy-driven protocol) to monitor, evaluate, and adjust therapy based on risk factors and patient response to dose.[7]
- Optimization of electronic health records (EHR) and computerized provider order entry (CPOE)
    - Incorporate clear and specific ordering instructions and monitoring parameters for EKG. If applicable, preselect within CPOE order panel by default to ensure timely EKG acquisition. For (re)initiation of therapy, EKG should be obtained at baseline and two to three hours after administration of each of the first five doses.[1]
    - Include instructions for dose modifications per package insert: dose should be decreased if increase in QTc or QT is >15% or >500 milliseconds after the first dose, and the therapy should be discontinued if at any time after the second dose QTc or QT increases >500 msec.[1] Refer to the package insert for detailed instructions on dose modifications and therapy adjustments.
    - Activate interaction alerts for dofetilide within CPOE and EHR to notify healthcare providers of potential risks when dofetilide is ordered concurrently with medications known to prolong the QT interval or alter potassium levels. Employ a risk stratification strategy for these alerts to minimize alert fatigue and prioritize interactions with the greatest potential for adverse effects. Ensure that these alerts are prominently displayed for the prescribing and verifying providers.
    - Integrate prompts and reminders for nurses to alert prescribers if magnesium, potassium, and serum creatinine levels deviate from their normal range.[1,5-7]
- Additional instructions for monitoring
    - Emphasize the importance of communicating the need for EKG monitoring, changes in lab values, and vigilance for potential arrhythmias during hand-offs.
- Competency training
    - Provide competency training to all healthcare providers involved in the medication-use process, encompassing prescribing, verification, dispensing, administration, and monitoring of dofetilide.
- Patient education
    - Empower patients to actively participate in their care by advising them to thoroughly review the dofetilide Medication Guide.[1] Emphasize the importance of correct administration, adherence to the dosing schedule, and recognition of potential adverse effects. Stress the need to maintain an accurate and accessible medication list. Furthermore, educate the patients on the requirement for readmission if they miss more than two consecutive doses of dofetilide.[8]

[a]REMS is a national program designed to prevent, monitor, and/or manage a specific serious risk associated with certain medications that have significant safety concerns. A primary goal of REMS is to ensure that the benefits of the medication outweigh its potential risks.[3]

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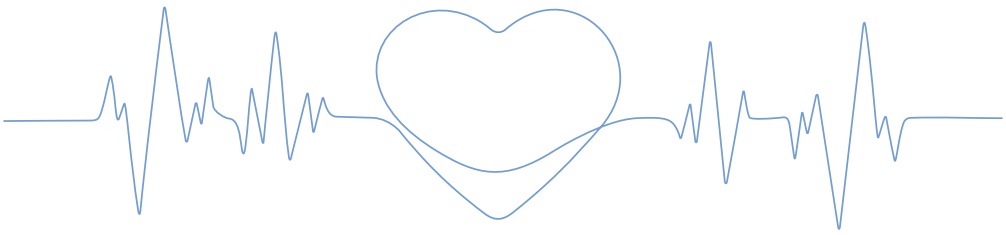

Overcoming Communication Barriers to Improve Patient Safety for American Sign Language Users Who Are Deaf or Hard of Hearing

Keywords: patient safety, ASL, health communication

[1]Patient Safety Authority

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Sanchez CE. Overcoming Communication Barriers to Improve Patient Safety for American Sign Language Users Who Are Deaf or Hard of Hearing. *Patient Safety*. 2025;7(2):138084. doi:10.33940/001c.138084

By **Christine E. Sanchez**, MPH[1]

In the United States, approximately 3.6% of the population—about 11 million individuals—are deaf or hard of hearing[1] and about 1 million adults who are deaf or hard of hearing use American Sign Language (ASL) to communicate.[2] Patients who use ASL can encounter communication-related patient safety challenges in various healthcare settings.[3-6] While some of these patients can use alternatives to ASL to communicate, such as lipreading or written communication methods,[3,7] these are considered inferior to using ASL interpreters.[7,8] For example, lip-readers may only understand part of a conversation[7,9] and written communication could be limited by other factors, such as education and literacy challenges.[10] Addressing these communication challenges can improve confidence in care provided, patient understanding, and—ultimately—patient safety.

Reports recently submitted to the Pennsylvania Patient Safety Reporting System (PA-PSRS) highlight communication challenges faced by deaf or hard-of-hearing patients and the healthcare workers serving them, emphasizing that inadequate or delayed interpreter availability could lead to serious patient safety events. For example, one report described a delay in emergency department triage due to an inability to obtain an ASL interpreter and having to resort to written communication to triage a patient who was deaf. Another report described a patient who was restrained due to movement during necessary scans that resulted in the patient becoming agitated and experiencing a skin tear trying to remove the straps; this patient was deaf and

may have been unable to communicate while restrained. Additionally, a patient who had limited eyesight in addition to being deaf required an in-person ASL interpreter, but only video remote interpretation (VRI) was available.

While in-person interpretation and VRI services can mitigate the communication challenges that patients who are deaf and hard of hearing can encounter, it is important to understand the limitations of these services. For example, in-person interpreters may not be available at all facilities or at all times.[5] VRI services are preferred over lipreading or written communication,[3,7,8,10] but technology or equipment failures may impact their availability.[3,5]

Patients who are deaf or hard of hearing may feel frustrated, overwhelmed, and frightened when experiencing communication challenges with their providers.[5] To improve patient safety and communication, healthcare providers should consider the following practices identified through research, legislation, and advocacy groups:

- Provide an ASL interpreter to patients who are deaf or hard of hearing, as mandated by the Americans with Disabilities Act[11] and Affordable Care Act.[5,12]
- Encourage patients to communicate their deaf or hard-of-hearing status to every healthcare team member.[13]
- Use of VRI services may be adequate for some patients; however, in-person interpreters are preferred[3] and may be necessary, for example, for patients who also have vision loss.[13]
- Use qualified[14] interpreters[5] (i.e., certified through the Certification Commission for Healthcare Interpreters[15] or another certification agency).
- Use the teach-back method[16] when giving instructions to ensure patient understanding.[3,13]
- Provide and use visual aids, such as written instructions or explanations of procedures, anatomical models, and posters to enhance patient understanding.[3,13]
- When possible, arrange ASL interpreters ahead of time to be available to communicate with patients who are deaf or hard of hearing.[4]
- Write in large, bold letters that can be read from several feet away if written communication is necessary.[13]
- Allow extra time for communication[13] and verification of patient understanding.
- Involve patient family members to support communication and advocate for the patient. However, family members should be used *in addition to* and not in place of qualified interpreters.[13]

It is important to address communication barriers for patients who are deaf or hard of hearing and communicate via ASL. Providing access to qualified ASL interpreters, using visual aids, and other evidence-based practices are essential to foster an inclusive environment and improve patient safety.

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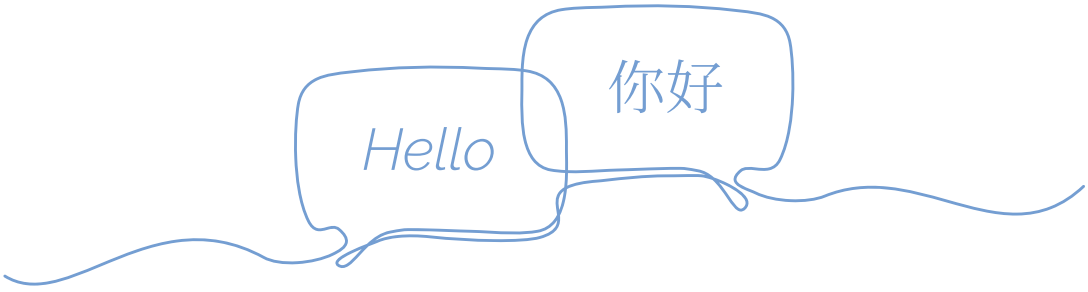

Improving Surgical Outcomes Through Frailty Screening: **An Overview of the Risk Analysis Index**

Keywords: RAI, surgical pause, mFI-5, morbidity, mortality, prehabilitation, screening tool

By **Matthew A. Taylor**, PhD*[1] and **Daniel E. Hall**, MD, MDiv, MHSc*[2,3]

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Reports of Complications Related to Surgery or Invasive Procedures

More than 31,000 events involving complications related to a surgery or invasive procedure were reported to the Pennsylvania Patient Safety Reporting System (PA-PSRS) in the five-year period between January 1, 2020, and December 31, 2024[a]. Of those events, more than 15,000 resulted in serious patient harm or death.

Patient Frailty and Preoperative Use of the Risk Analysis Index Tool

Patient frailty is a significant predictor of postoperative morbidity and mortality.[1-5] The collective body of research over recent years has made a strong argument for preoperative use of a Risk Analysis Index (RAI) tool to evaluate the patients for frailty, as a proxy for physiologic reserve.[3,5,6] The RAI tool can be completed by the patient/representative or staff and the scores are then tallied to estimate the degree of patient frailty. Higher RAI scores indicate that a patient would have greater frailty-associated risks. For ease of interpretation, the RAI scores are often grouped into the following four categories of patient status: robust, normal, frail, or very frail.

This tool is intended to be used with patients who are potential candidates for nonemergent or elective surgeries. Use of the RAI to identify patients who are frail or very frail may guide the surgeon and patient to consider preoperative rehabilitation (i.e., prehabilitation) or to not have surgery (i.e., opting for nonoperative treatments for symptom management, sometimes including palliative care).[3-5,7-10]

[a]The frequency of reports is based on the following category of the PA-PSRS taxonomy: Event Type of "Complication of Procedure/Treatment/Test" and Subtype of "Complication following surgery or invasive procedure."

This decision among frail patients could reduce the likelihood of a morbidity and premature mortality.[3,4,7-10] Overall, the use of RAI and related interventions have been associated with improved long-term outcomes for frail patients.[9,11]

Background and Considerations for Use of the Risk Analysis Index

Validity and Predictive Ability of RAI

- The RAI tool has been validated for point-of-care use for clinicians to screen patients for frailty.[4,6,8,11,12] Readers should note that numerous other frailty indices exist, but some are not suitable for point-of-care use (e.g., other frailty indices use dynamometers and walking tracks, were designed to be used retrospectively, or impose excessive respondent burden).[4,6,13,14]
- The RAI tool is effective for identifying approximately the 10% of patients that are at greatest risk for postoperative morbidity and mortality, due to their extent of frailty.[15,16]
- The RAI has been validated to predict postoperative mortality[13] across 30-,[10] 90-,[3] 180-,[8,10] and 365-day[3] time frames.
- Studies demonstrated the predictive ability of the RAI across a range of clinical context,[4,8,9] including the following surgical specialties: oncology,[16] spine,[3,5] cardiovascular,[17] urology,[18] neurology,[10,19] plastic,[10] otolaryngology,[10] orthopedic,[10] gynecology,[10] vascular,[10] and thoracic.[10]
- Research indicates that the RAI can and should be used with patients of all ages[17] and across the full range of surgical procedures, including procedures of low physiological stress (i.e., operative stress scores).[10,20,21]
- In a study of both young and old patients, those with higher preoperative RAI scores (i.e., greater frailty) were associated with significantly more postoperative days away from home (e.g., rehabilitation, skilled nursing facilities) and a higher likelihood of losing independence after surgery.[22]
- The RAI demonstrates greater predictive ability for both morbidity and mortality when compared with the five-factor modified frailty index[b] (mFI-5)[5,24] and has similar predictive ability when compared to the other indices;[13] Fried frailty phenotype (FFP),[25] Edmonton Frail Scale (EFS),[26] and the Canadian Study of Health and Aging.[27]

Versions and Access to RAI

- There are several similar versions of the RAI tool (e.g., RAI-A, RAI-C, RAI-ICD, and RAI-VQI) and the primary differences are the data sources used to estimate patient frailty.[4,12,28]
- For most clinical applications, we suggest using the RAI-C version, based on its ease of use at the point-of-care.
- The RAI-C is available as a printable version and to users of Epic (through EpicShare),[29] Cerner, REDCap, Microsoft's PowerApp, and Veteran Affairs' Computerized Patient Record System (CPRS).[12,15,28]
- To access the RAI-C and for information about the other RAI versions, see reference 28.

Implementation and Features of RAI-C

- For a user guide and supporting materials, see references 12 and 28.
- The RAI-C is intended to be used preoperatively within the existing workflow to estimate patient frailty.[12]
- The tool targets the following five domains of health: physical, functional, social, nutritional, and cognitive.[4,6]
- The RAI-C consists of 14 questions[3,6,9,28] and is available in English, Spanish, Portuguese, and Chinese languages.[28]
- The questions on the tool can be completed by staff, but are most often completed by the patient/representative, which will take them less than two minutes.[12]
- The score from a completed tool can be quickly tallied manually or with an online calculator (available at efrailty.hsl.harvard.edu/ToolRiskAnalysisIndex.html) by a range of staff, including medical assistants and nurses.[6,8,12,15] Staff have reported calculating the RAI-C score in a median of less than 40 seconds per patient.[8,13]
- The cutoff scores used to classify frailty can be adjusted to fit the setting and available resources.[4]
- The RAI-C score, ranging from 0 to 81, will categorize the patient as being robust (≤29), normal (30–36), frail (37–44), or very frail (≥45).[12]

[b]The modified frailty index (mFI)[23] was developed before the RAI, based on 11 variables in the American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) dataset, but has never been widely validated for prospective survey-based administration. A shortened version (mFI-5) became necessary when the ACS eliminated six of the original 11 variables, degrading its predictive power and construct validity as a frailty measure, and for these reasons it should be considered obsolete.[12]

Treatment Decisions and Clinical Actions

- Patients identified through the RAI as being frail or very frail should then participate in a more thorough assessment that would be used to further inform patient and provider decisions.[6,15] The follow-up could target multiple areas of frailty through various tests, such as geriatric assessment, serological biomarkers, and functional performance (e.g., gait speed, grip strength).[6,15]
- Patients and providers engage in shared decision-making based on the predicted trajectory of frailty-associated risks[4,6,9,11,22] and the patient's health-related goals.[15]
- Depending on the degree of patient frailty and their goals, the patient may choose not to proceed with the surgery and instead opt for medical symptom management, sometimes including palliative care. Other patients may choose to prepare for surgery with preoperative rehabilitation (i.e., prehabilitation).[9,13] Use of preoperative rehabilitation may increase the odds of postoperative recovery at home, as opposed to being postoperatively placed in a rehabilitation facility.[15]
- Frailty-associated risks can be reduced through optimized care and prehabilitation,[3,7,9,11,15] which may include glycemic control, anemia management, adjustment of medication, multimodal anesthesia, nutritional supplementation, evaluation of home support, care coordination, respiratory muscular training, balance and strength training, cardiovascular exercise, and use of upper body ergometers.

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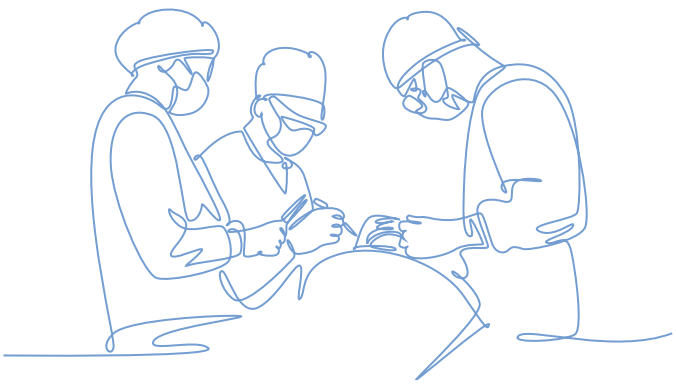

Preventing Patient Burns and Skin Tears When Using Electrosurgical Units

Keywords: patient safety, surgery, Bovie, skin integrity, ESU

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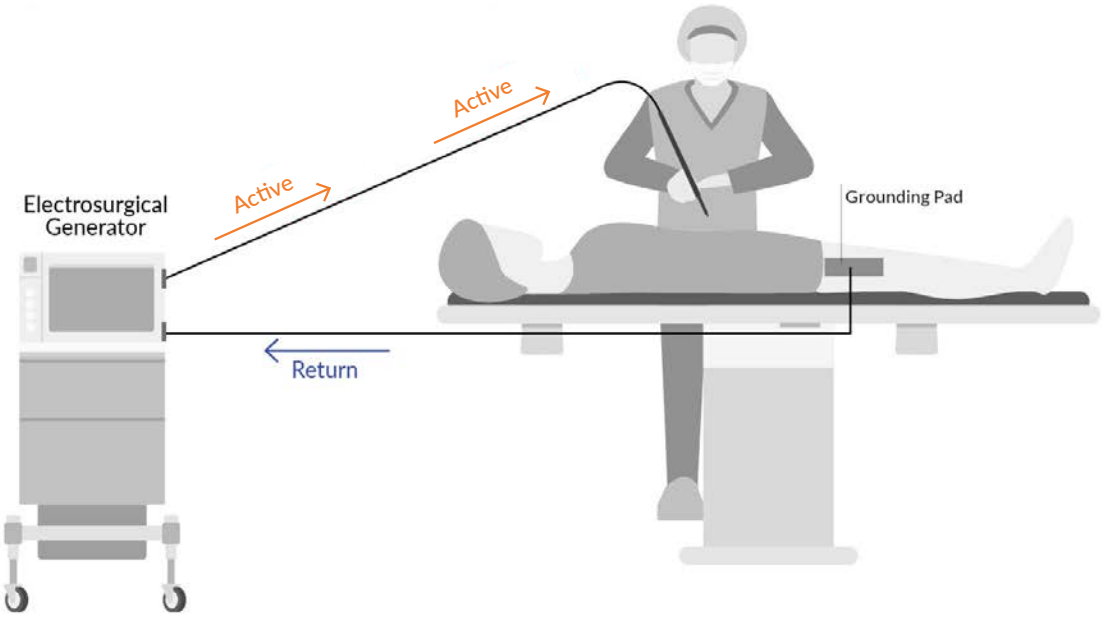
Sanchez CE. Preventing Patient Burns and Skin Tears When Using Electrosurgical Units. *Patient Safety*. 2025;7(2):142254. doi:10.33940/001c.142254

By **Christine E. Sanchez**, MPH[1]

Electrosurgery is used to rapidly cut soft tissue and control bleeding during a variety of surgical procedures.[1-3] Some commonly reported complications from electrosurgery include electrical burns,[1,4,5] surgical fires,[1,5,6] electric shock,[4] and malfunction of implanted medical devices such as pacemakers.[4] A review of event reports recently submitted to the Pennsylvania Patient Safety Reporting System (PA-PSRS) identified complications that were less commonly referenced when reviewing the literature about electrosurgery complications: burns from a metal instrument that was in contact with the electrosurgical unit (ESU) and skin injuries from the ESU grounding pad. Knowledge about the principles of electrosurgery[2] and how ESUs work[2,7] can help prevent complications that may pose a risk to patient safety.

An electrosurgery generator unit powers an electrical current that flows through the cutting and/or coagulation instrument. There are two electrosurgery modalities, monopolar and bipolar.[2,4] Monopolar electrosurgery (**Figure 1**) is the most common modality used in surgical procedures. In monopolar electrosurgery, the handheld device (the device used by the surgeon) is pencil shaped, with a single tip. The current flows from the generator to tip and then into the patient's tissue. The current then exits the patient via a grounding pad that is adhered to the patient's body to complete the electrical circuit and flows back to the generator.[2,4,8]

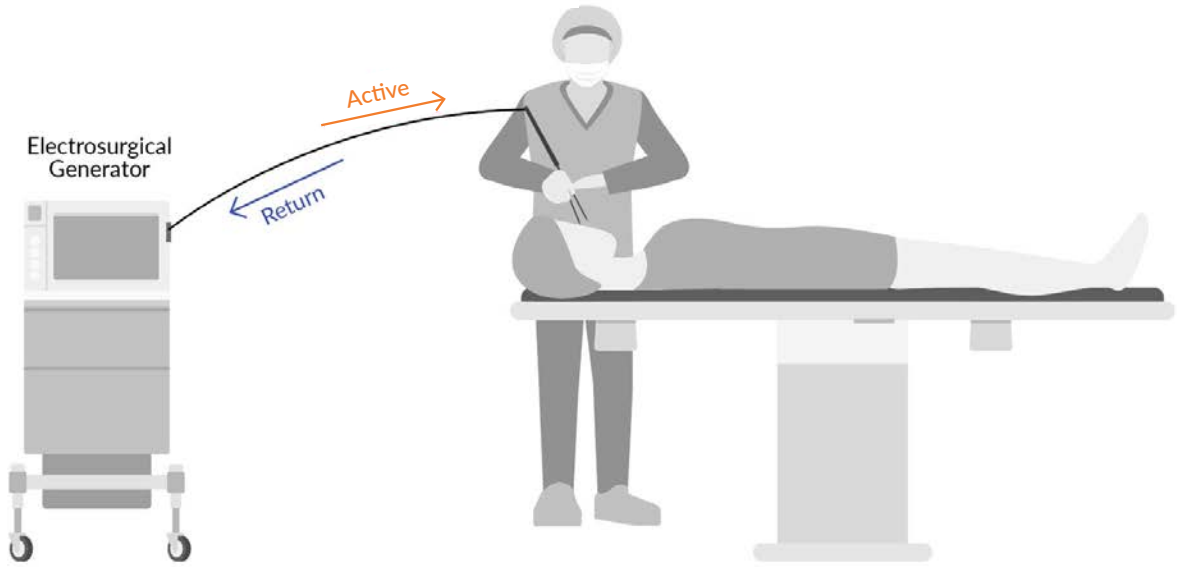
Figure 1. Illustration of Monopolar Electrosurgery



Bipolar electrosurgery (**Figure 2**) is most commonly used in neurosurgery and surgeries involving the eyes and eyelids.[8] In bipolar electrosurgery, the handheld device is designed similar to tweezers. The electrical current travels from the generator to one prong of the handheld device, across the patient's tissue surface to the prong on the other side of the handheld device, and then back to the generator.[2,4,8] An electrical current does not pass through the patient, so a grounding pad is not needed.

Two reports submitted to PA-PSRS described burns to the patient from another metal surgical instrument. One burn resulted from the ESU electrical wire that was clamped down using a metal clamp. The energy running through the wire likely caused the clamp to heat up. This clamp was then inadvertently leaned on, causing it to touch the patient's skin and subsequently leave a burn mark on the patient that required topical treatment. Another example described the ESU coming into contact with a metal retractor, which caused the retractor to become hot, subsequently burning the patient at the point of contact between the patient's skin and the retractor.

Figure 2. Illustration of Bipolar Electrosurgery



The heat transfer to the metal clamp and/or retractor that resulted in a burn could have been due to faulty ESU instrument insulation.[2] One previous study cited that skin contact with metals, such as body piercings, can cause burns from the metal jewelry coming in contact with ESUs with compromised insulation,[9] allowing the electrical current to transfer from the surgical instrument to the metal object.[2] It is important to note, however, that the integrity of the instrument insulation was not included in the event reports.

Another complication in recent PA-PSRS reports included burns and skin tears from the adhesive return electrode (i.e., grounding pad). Burns from the grounding pad can occur when the pad becomes partially detached from the patient, and skin tears were reported to occur when the grounding pad was removed after the procedure was complete.

Burns from the grounding pad can be prevented by using a return electrode monitoring system. In addition, placing the grounding pad on a well-perfused, dry, hairless area of the body that is over a large muscle and as far away from metallic implants as possible can decrease the risk of burns and skin tears when the pad is removed.[2] There is also an option to use a full-body return electrode that reduces the risk of burns and skin tears because it is not adhered to the patient's skin. These full-body return electrodes are not suitable for all patients, as they can cause inadvertent discharge of an implantable electronic device, such as an implantable cardioverter-defibrillator.[10] With that caveat in mind, if a patient is at an increased risk of a skin tear when a grounding pad is removed (e.g., thin skin), or is otherwise generally a good candidate for a full-body return electrode pad, using one during their procedure can increase patient safety.

To minimize the likelihood of the complications discussed above, surgeons and other surgical staff can:

1. Understand how ESUs transfer heat and energy.
2. Inspect ESUs for faulty insulation, both visually and with the use of a testing wand.[2]
3. Avoid ESU contact with any metals during the procedure[2] to prevent burns to the patient from those metal objects.[8]
4. Be aware of their surroundings and body positioning throughout a procedure.
5. Understand proper use and placement of the grounding pad.
6. Consider whether a patient would be a good candidate for a full-body return electrode instead of a grounding pad.

Implementing the risk mitigation strategies described above can increase patient safety and reduce harm during procedures in which ESUs are used.

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Christine E. Sanchez (chrsanchez@pa.gov) is a research scientist on the Data Science & Research team at the Patient Safety Authority. She is responsible for utilizing patient safety data, combined with relevant literature, to develop strategies aimed at improving patient safety in Pennsylvania.

A **Fatal Medication Error** Involving Neuromuscular Blocking Agent and Insights From Wrong Drug Events in Pennsylvania

Keywords: paralytic, medication safety, patient safety, pharmacy, override

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Ro M. A Fatal Medication Error Involving Neuromuscular Blocking Agent and Insights From Wrong Drug Events in Pennsylvania. *Patient Safety*. 2025;7(2):143958. doi:10.33940/001c.143958

By **Myungsun Ro**, PharmD, MS[1]

The Patient Safety Authority (PSA) recently received a report describing a fatal medication error that highlights persistent risks involving wrong drug events. In this event, a patient who was prescribed a medication typically used to treat high blood calcium levels inadvertently received a fatal dose of a neuromuscular blocking agent (NMB) instead.

Investigation into this event revealed a series of system vulnerabilities that contributed to it. The initial error occurred when the wrong medication, which was stocked next to the intended medication, was selected from the refrigerated dispensing area in the pharmacy. A wrong drug alert was generated during the dispensing process but was overridden. Subsequently, the pharmacist performing the final verification missed the error.

To prevent such an error, facilities are encouraged to reevaluate their current processes for handling NMBs and implement proactive actions such as a force stop "wrong medication" alert in the pharmacy and the sequestration of all paralytic agents in appropriately labeled bins.

This event aligns with findings from a recently published manuscript on wrong drug events, "Wrong Drug Events Across Pennsylvania Healthcare Facilities: A Systematic Analysis of Medication Pairs, Class Patterns, and Clinical Safety Implications," which identified NMBs as among those implicated in wrong drug events reported to the Pennsylvania Patient Safety Reporting System (PA-PSRS).

For full details and study findings, we recommend facilities and providers review that article in PSA's journal *Patient Safety* at doi.org/10.33940/001c.134046.

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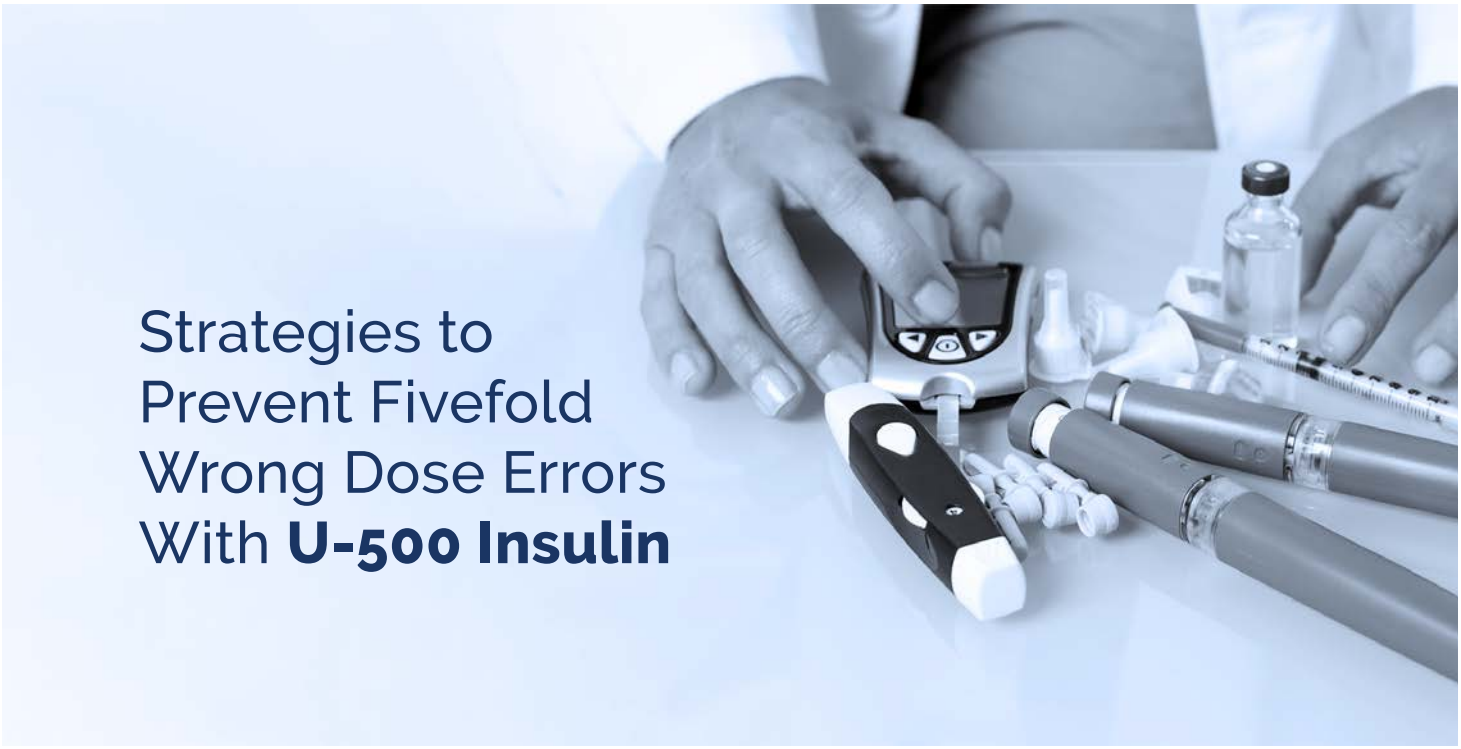
Strategies to Prevent Fivefold Wrong Dose Errors With **U-500 Insulin**



Keywords: medication error, medication safety, patient safety, concentrated insulin, insulin overdose, insulin underdose, Humulin R U-500

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Ro M. Strategies to Prevent Fivefold Wrong Dose Errors With U-500 Insulin. *Patient Safety*. 2025;7(2):144287. doi:10.33940/001c.144287

By **Myungsun Ro**, PharmD, MS[1]

Over the years, the Patient Safety Authority (PSA) has highlighted numerous errors involving insulin.[1-5] Recently, PSA has received several reports via the Pennsylvania Patient Safety Reporting System (PA-PSRS) describing errors with U-500 insulin that led to patients receiving either five times less or five times more insulin than intended. Humulin R U-500, a type of insulin that is five times more concentrated than U-100 insulin, is used to manage blood glucose levels in individuals with diabetes mellitus requiring more than 200 units of insulin per day.[6,7] As a high-alert medication,[8] U-500 insulin has been associated with dose errors that can lead to life-threatening hypoglycemia or hyperglycemia.[6]

There are many ways in which wrong dose errors can occur with insulin. The unique measurement system of insulin using "units" instead of the conventional milliliter (e.g., 1 mL=100 units) inherently complicates its dosing.[2,3,5] The potential for errors is further amplified by the availability of various formulations, concentrations, and delivery devices.[1,2,7,9-14] In the recent PA-PSRS reports, fivefold wrong dose errors with U-500 insulin occurred after the patients' home dose of insulin was incorrectly reconciled during admission to facilities that use 1 mL tuberculin or U-100 syringes to administer U-500 insulin. Presently, the U.S. Food and Drug Administration advises that U-500 insulin should only be administered using specifically designed U-500 syringes.[15]

Example of Underdose Reported to PA-PSRS

Some patients use 1 mL tuberculin or regular U-100 syringes to measure their U-500 insulin at home. Because U-500 is five times more concentrated than U-100 insulin, the prescribed dose needs to be divided by five to be measured correctly with a U-100 syringe.[13] However, in some cases, when patients were admitted the markings on the syringe, which reflect the volume administered at home, were documented and ordered rather than the actual number of units prescribed. For example, a patient who takes 200 units/0.4 mL of U-500 insulin at home was ordered 40 units at the hospital. This resulted in a fivefold underdose.

Example of Overdose Reported to PA-PSRS

Other patients use U-500 pens or U-500 syringes at home, which do not require the dose conversion. When these patients were admitted, the patients' home dose in units was inadvertently documented as volume to be administered using the U-100 syringe. For example, a patient taking 75 units via U-500 pen at home was administered 0.75 mL (375 units) rather than 75 units (0.15 mL). This resulted in a fivefold overdose.

To prevent wrong dose errors with U-500 insulin, healthcare facilities should consider implementing the action items below.

- During medication reconciliation, confirm the type(s) of insulin, the concentration(s), the dose(s) in terms of units, and the delivery method used at home. Ask the patient to bring in the medication if possible and demonstrate their self-administration technique of insulin.[1,9,16]
- Reevaluate the facility's formulary[2] and evaluate the feasibility of using pens to administer U-500 insulin.[9,11]
- If the facility uses U-500 insulin vials instead of pens,
    - Use only U-500 syringes to measure U-500 insulin.[6,15]
    - Store U-500 vials at the pharmacy in a location separate from other insulins.[1,2,10,12,17]
    - Require both the units AND the volume (milliliters) in the medication order.[2,10,12]
    - Provide a prescription for U-500 syringes upon discharge to patients who were previously using a U-100 or tuberculin syringe.[13]
- Implement a prominent alert within the computerized provider order entry system to notify healthcare providers of the high-alert classification[1,8] of U-500 insulin (e.g., "Concentrated regular insulin U-500 provides 500 units per mL, which is 5 times the concentration of regular insulin U-100.")
- Require barcoded medication administration and documentation of an independent double check prior to administration.[1,2,10]
- Dispense patient-specific doses from the pharmacy with a barcoded label.[2,10-12,17]
- Consult an endocrinologist or other specialist trained in glycemic management for prescribing and adjusting therapy with U-500 insulin as determined by the organization.[10,17]
- Incorporate other members of the interdisciplinary team, such as certified diabetes educators, to provide comprehensive patient education on U-500 insulin safety and injection technique.[10,12,17]
- Provide ongoing education to both providers and patients regarding insulin products and related safety events.[1,2,9,12,17] Maintain up-to-date and comprehensive drug information resources relating to insulin within the facility.

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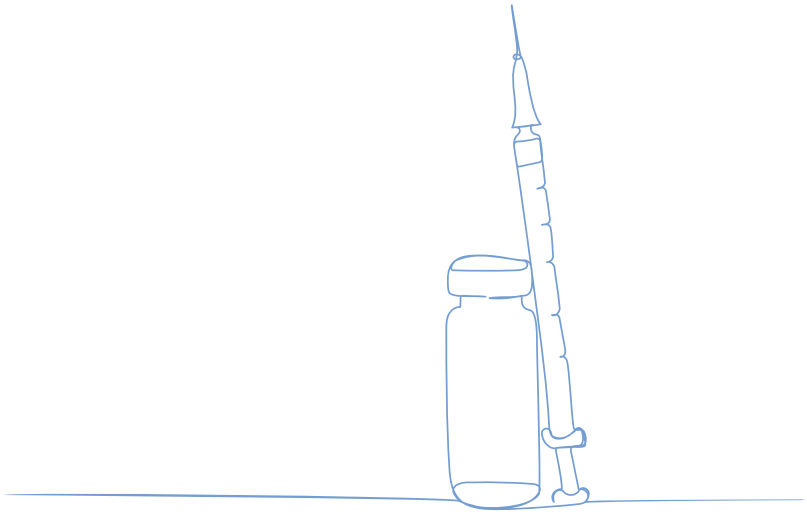
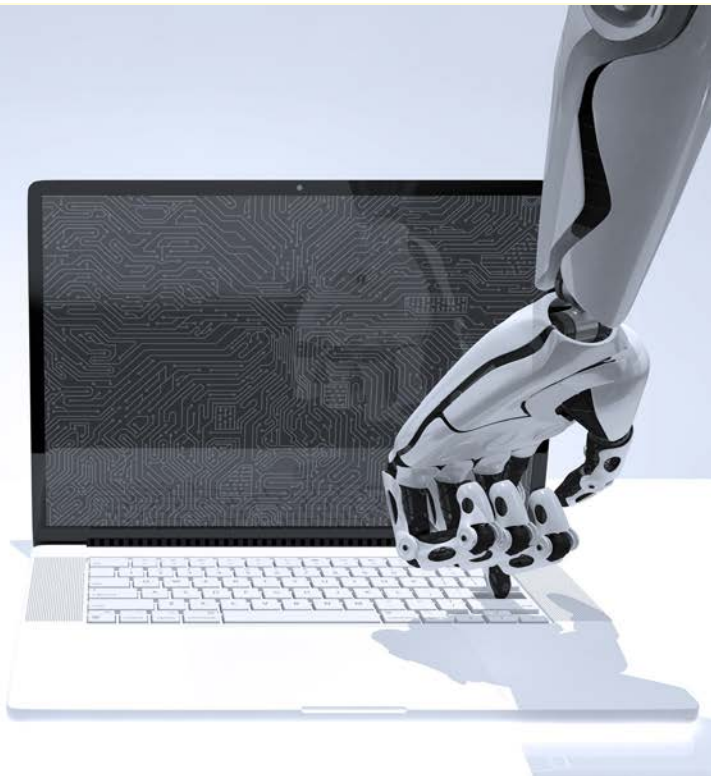


Impact of Artificial Intelligence on Patient Safety Events: Preliminary Exploration of Events Reported to the PA-PSRS Database



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Taylor MA. Impact of Artificial Intelligence on Patient Safety Events: Preliminary Exploration of Events Reported to the PA-PSRS Database. *Patient Safety*. 2025;7(2):146252. doi:10.33940/001c.146252

By **Matthew A. Taylor**, PhD[1]

Artificial intelligence (AI) is reshaping healthcare and expected to have a dramatic impact on patient safety as AI is further developed and refined.[1-7] AI is expected to improve patient safety in key areas, such as by increasing efficiency of clinical decisions and care,[2,4,6] reducing human error,[2,3,6] offering risk prediction and early detection of change in patients' condition,[2-4] supporting system-level safety,[2,4] and offering insights by aggregating many data sources.[2,4] Despite the optimism surrounding AI, the following patient safety concerns have been raised: AI models that are trained on biased or incomplete data,[1,2,4,6-8] staff become overly reliant on and biased toward the recommendations provided by AI,[1,6,8] staff not trusting the "black box,"[2,6,7] AI has given erroneous recommendations for individual patients with incomplete and/or inaccurate records,[6,8] staff are overwhelmed by being given too much information/notifications,[2] and AI-based tools that are implemented prior to sufficient testing and validation.[4,6-8]

PA-PSRS Reports of Events Involving AI

Given the concerns about AI and patient safety, we conducted a preliminary exploration of the Pennsylvania Patient Safety Reporting System (PA-PSRS) for events that involve AI, either *causing* the event or *preventing/detecting* the event. Based on a limited sample of event reports, we found that AI was primarily involved in monitoring of patients for exiting their bed, interpretation of data collected from patient monitoring devices, reading of images (e.g., X-ray, CT), and note dictation. We found that events were occurring at both small and large hospitals, and across a range of care areas (e.g., cardiovascular unit, emergency department, general medicine, imaging, orthopedic, surgical unit).

In most of the event reports within our sample, AI was used to prevent/detect issues. For example, AI was involved in numerous events where a human failed to detect a significant image finding (i.e., false-negative), but AI detected the misread. In other instances, AI analyzed patient behavior to predict/detect a patient exiting their bed, out of staff's concern for them being at risk for either a fall or disorientation (the AI technology is more advanced than a traditional bed alarm). In these bed-related events, the reports frequently described scenarios where the AI technology alerted staff to a prediction that the patient was planning to exit their bed, but staff were still unable to reach the patient before their fall. Among the instances where AI was used to prevent/detect issues, a majority of the event reports described AI as being proactively implemented, but in some events it was described as being reactively implemented with the goal of preventing the same issue from occurring again.

We also identified limited instances where AI caused or contributed to the events by either misreading an image or a monitoring device where a new AI program began producing a much greater quantity of information that caused staff to be overwhelmed with notifications and this reportedly delayed their identification of an urgent finding.

Future Directions and Conclusion

Numerous sources have warned the healthcare community that, despite the intended benefits of AI, it could create a broad range of risks to patient safety.[1,2,6,7,9] Despite the potential risks, we have identified very few PA-PSRS reports that describe AI as a cause or contributing factor to patient safety events. However, AI-related events may be underdetected and their true frequency could be higher than what is reflected in our current data. For example, AI involvement may not be recognized during monitoring and analysis of PA-PSRS reports if reporters do not mention "artificial intelligence," "AI," or the name of an AI-enabled software/device.[10] Similarly, reporters may not always recognize when AI is involved, such as when staff use an AI-enabled software/device but are unaware that AI was being used or that the design of AI was somehow contributing to the event.[9] Lack of understanding how AI contributed to an event likely will result in important information being absent from the patient safety event report. Finally, events involving AI might also be underreported in more nuanced circumstances, such as when AI-enabled technology (i.e., clinical decision support, CDS) provides a nonoptimal recommendation or an erroneous recommendation that the clinician follows, but is not identified until a much later date.

Leaders and staff at healthcare facilities need to be vigilant in detecting and reporting patient safety events involving AI.[9,11] The reporting of events will enable the Patient Safety Authority to identify statewide patterns and share lessons learned across Pennsylvania.

Call to Action

Report AI-Involved Events to PA-PSRS

When submitting a report to PA-PSRS, include "artificial intelligence" or "AI" in the event narrative, along with the name of the software and/or device, and describe the full context of the event. Ensure that the report identifies the contributing factor(s) and outcome. This information is vital for the Patient Safety Authority to monitor how AI is impacting patient safety and to deliver actionable insights back to facilities.

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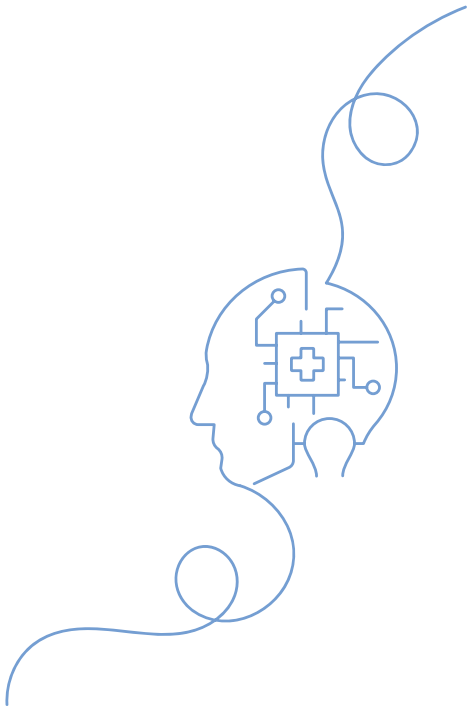
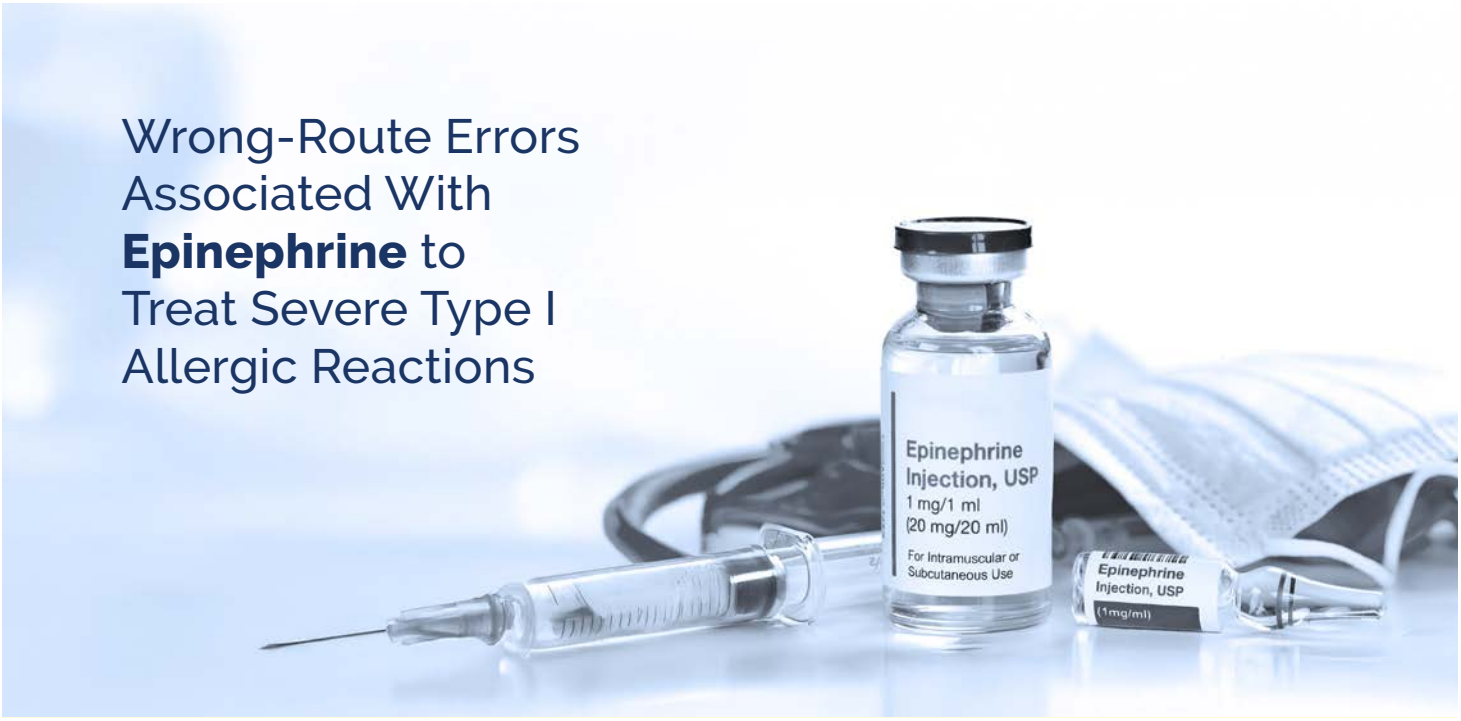


Wrong-Route Errors Associated With **Epinephrine** to Treat Severe Type I Allergic Reactions



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Ro M. Wrong-Route Errors Associated With Epinephrine to Treat Severe Type I Allergic Reactions. *Patient Safety*. 2025;7(2): 146867. doi:10.33940/001c.146867

By **Myungsun Ro**, PharmD, MS[1]

The Patient Safety Authority has received multiple reports to the Pennsylvania Patient Safety Reporting System (PA-PSRS) describing wrong-route errors with epinephrine intended to treat anaphylaxis and other severe type I allergic reactions, in which epinephrine was incorrectly ordered and/or administered by the intravenous route instead of the intended intramuscular route. We previously identified wrong-route errors as the most frequent error type involving epinephrine.[1,2] Despite our published analyses and mitigation strategies,[1-3] we continue to receive PA-PSRS reports describing wrong-route errors with epinephrine to treat severe type I allergic reactions.

Epinephrine is a nonselective alpha- and beta-adrenergic agonist with various indications and routes of administration.[4,5] One of the indications for the use of epinephrine is the treatment of severe type I allergic reactions, including anaphylaxis. Administration of epinephrine for this indication is typically given by the intramuscular or subcutaneous route,[4] with the intramuscular administration in the thigh preferred and shown to provide the highest peak blood levels.[6,7] Intravenous bolus administrations of epinephrine are generally reserved for life-threatening situations such as cardiac arrest due to asystole or pulseless electrical activity.[5,8] According to PA-PSRS reports, patients have experienced several adverse effects following erroneous intravenous administrations of epinephrine to treat type I allergic reactions, including sudden rise in blood pressure, electrocardiogram (EKG) changes such as ventricular tachycardia and atrial fibrillation with rapid ventricular response, "excruciating pain" and feeling of "going to die," as well as transfer to a higher level of care.

Erroneously administered intravenous doses of epinephrine have been associated with several factors based on PA-PSRS reports, including verbal orders, lack of scanning prior to medication administration, rapid response situations, formulary change from the use of autoinjectors to the use of vials, and confusing electronic orders that lack clear and simple instructions for the route of administration. Another noteworthy aspect identified in the PA-PSRS reports is that several medications used to treat allergic reactions, such as steroids, diphenhydramine, and even famotidine, are typically administered intravenously and at the same time as epinephrine.

Facilities can mitigate the risk of wrong-route epinephrine errors by implementing the following safety strategies.

- Use autoinjectors, which are designed to deliver premeasured single doses of epinephrine by the intramuscular or subcutaneous route.[2,3,9-11]
- If not using autoinjectors, create an anaphylaxis kit that contains the vials or ampules of epinephrine, needles intended for intramuscular administration, auxiliary labels, clear instructions, and other necessary supplies.[9,11]
- Store epinephrine products used to treat anaphylaxis separately from those intended for resuscitation carts.[10]
- Ensure that the order is clear, concise, and easy to understand. Do not refer to epinephrine concentrations using ratios. The U.S. Food and Drug Administration (FDA) currently requires the labeling of epinephrine strengths in amount per volume (e.g., milligrams per milliliter [mg/mL]) instead of ratio expressions (e.g., 1:1000).[12]
- Distinguish the separate epinephrine orders for different indications, and ensure that the routes of administration are clearly visible.[13]
- Create a warning in the automated dispensing cabinet to remind the user of the intended route of administration, and, if applicable, consider affixing auxiliary labels on the top of the cubby.[13]
- Limit the use of verbal orders to urgent situations. Create and reevaluate facility guidelines to establish standardized processes for verbal orders, such as the readback method, to confirm the route of administration.[9,10]
- Follow proper protocol in labeling and scanning the medication prior to administration.[13]

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Myungsun (Sunny) Ro (mro@pa.gov) is a research scientist on the Data Science & Research team at the Patient Safety Authority (PSA). Her responsibilities include analyzing and synthesizing data from various sources to identify opportunities to improve patient safety, as well as writing scientific articles for publication in the PSA's peer-reviewed journal, *Patient Safety*.

2025 I AM PATIENT SAFETY ANNUAL ACHIEVEMENT AWARDS

By **Eugene Myers**, BS[1]

[1]Patient Safety Authority

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The Patient Safety Authority (PSA) established the I AM Patient Safety Achievement Awards[1] to recognize that everyone in healthcare has a role in patient safety: admission registrars, nurses, physicians, pharmacists, environmental staff, and more. The annual IAPS contest is an opportunity for healthcare staff to celebrate and share the inspiring stories of peers who go above and beyond to ensure safe care for their patients.

This year, PSA introduced several new award categories to highlight champions for their commitment to safety, solutions to address healthcare disparity, improving the medication administration process, and educating and engaging patients as partners in their own care. Although only one person or team can win the award in each category, every nominee deserves congratulations for their extraordinary efforts, accomplishments, and contributions to patient safety. Many of their successes will be published on the PSA's website as examples of how event reporting catalyzes change that improves care within a facility, a health system, or even nationwide.[2]

The 2025 IAPS awards were judged by patient safety advocates; government, university, and patient representatives; and healthcare executives, who carefully evaluated 147 nominations from 50 healthcare facilities for innovation, impact, sustainability, and scalability. In addition to the nine juried awards, PSA Executive Director Regina Hoffman, MBA, RN, selected a Choice Award winner for special recognition.

Executive Director's Choice Award

Fernanda Basso Alcoforado
Main Line Health

While doing her 15-minute safety rounds, mental health technician Fernanda Basso Alcoforado observed a patient on the Inpatient Psychiatric Unit for depression and suicidal ideation who appeared superficial and preoccupied. The patient denied any need for help, but on the next set of rounding, Alcoforado broke from her routine and returned early to the patient's room. The patient was in the bathroom, denied any issues, and said they would be out soon. Out of continued concern for the patient, Alcoforado entered the bathroom—to find the patient with a shirt tied around their neck. Alcoforado hit their alarm button and untied the shirt. She then stayed with the patient and took them to the nurse's station for further assistance.

Individual Impact Award

Andrea Colfer
Children's Hospital of Philadelphia

Despite working in patient safety at Children's Hospital of Philadelphia (CHOP) for many years, Andrea Colfer continues to propose innovative ways for patient safety staff to best approach their work. Last year alone, she organized and facilitated working sessions and presented to leadership a total refresh to CHOP's major event analysis that will include a huge culture shift to allow for better reflection on why an error may have occurred and how the team can best add system solutions. This refresh moves away from focusing on deviations, allowing review teams to engage in open dialogue and increase psychological safety.

Colfer is constantly pushing CHOP staff to think through their processes to better themselves for both the employees they interact with and the patients their teams care for. She does this in addition to her daily work because she is passionate about patient safety. For example, Colfer created a patient safety book club that has cultivated amazing conversation amongst the patient safety team members about their goals and how to reflect on their purpose and mission.

In true passion for promoting patient safety, she is also creating a curriculum for a patient safety certificate program. Colfer is consistently adding the voice of the patient or family as the team considers any harm, and she gives every event review careful thought and attention.

Medication Safety Award

Christine Zdaniewski
UPMC Hamot

Christine Zdaniewski serves as the lead pharmacist for decentralized patient care services, a critical care clinical pharmacy specialist, and the postgraduate year 1 (PGY-1) pharmacy residency program director at UPMC Hamot. In 2024, she reported 16 medication-related events, of which 10 were good catches or pharmacy interventions that had significant patient impact. Through chart reviews and rounding on her units, she detected and prevented multiple severe drug-drug interactions, optimized drug therapy with appropriate dosing, and prevented significant harm by escalating inappropriate drug therapies.

The most important aspects of her work are her dedication to education and her commitment to driving positive change. She does not just find and report issues but follows up with the entire team caring for the patient and provides education to prevent future errors. She educates the care team, unit directors, nurses, providers, and the pharmacy team as needed. She partners with other departments to ensure clear and concise communication and escalates issues to local committees, as well as to system-level service line leaders to ensure appropriate interventions are implemented across the system. She ensures that the pharmacy residency program attracts the most qualified candidates, provides the best training, and instills in them a commitment to patient safety and pharmacy involvement in the care team.

One example of Zdaniewski's contributions is her reporting of a medication event involving low-dose ketamine administration for pain, a therapy that was new to the facility at the time. She not only reported the event but also partnered with the ordering physician and his team to develop educational materials for pharmacy and nursing. She ensured that the associated policies were updated and continues to communicate with the morning safety huddles and pharmacy team to ensure medication availability for patients scheduled for procedures requiring this therapy.

Another example is her discovery of multiple instances of orders approved with a severe drug-drug interaction between carbapenems and valproic acid. She intervened to prevent additional administration to the patients, and she prepared and provided education to the pharmacy team to help prevent future orders from being approved. She provided the background information, explained the "why" behind the concern, outlined the potential risks, and explained the appropriate procedures to prevent the error in the future.

Safety Story Award

Women and Children Team and Pulmonary Services Team
WellSpan York Hospital

An unexpected issue occurred during a scheduled medical gas shutdown, impacting a critical care unit. The clinical coordinator and charge nurse of the affected unit immediately began communicating with other charge nurses, respiratory therapists, and the house supervisor. They acted swiftly and effectively, ensuring the safety and well-being of the patients.

The charge nurse contacted administration at home to bring awareness to the situation, and nurse leadership promptly came in to assist. The house supervisor was kept informed of the critical nature of the issue. Teams rallied to provide necessary resources, and an additional unit charge nurse mobilized the team to be ready for any potential evacuations.

The pulmonary team also went above and beyond, ensuring that all ventilators had the necessary air to function. Due to the resiliency and teamwork of all involved, all patients received appropriate care throughout the event and were able to remain on the unit until the medical gas was restored.

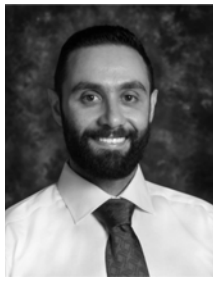
Following the event, efforts have been ongoing to identify opportunities for improvement, including evaluating the unit's evacuation plan and enhancing communication processes.

Improving Diagnosis Award

Penn Medicine Enterprise High Sensitivity Troponin Implementation Team

Penn Medicine





Per the 2021 American Heart Association and American College of Cardiology guidelines, high-sensitivity cardiac troponin assays (hs-cTn) are the preferred standard for establishing a biomarker diagnosis of acute myocardial infarction, allowing for more accurate detection and exclusion of myocardial injury in the evaluation and diagnosis of chest pain or anginal equivalents. Transitioning from conventional cardiac troponin to hs-cTn also allows for earlier rule out while reducing rates of missed myocardial infarction. However, troponin may also be elevated in conditions such as cancer, diabetes, and end-stage renal disease. In this setting, there are concerns that implementation of hs-cTn can include risks of diagnostic errors, inappropriate admissions, rise in cardiology consultations and unnecessary imaging, and delayed discharges from the emergency department (ED).

To provide accurate result interpretation and diagnosis, the Penn Medicine Enterprise High Sensitivity Troponin Implementation Team developed hs-cTn chest pain algorithms through multidisciplinary teams across five hospitals. This pathway was developed for various clinical settings, including the ED and outpatient and inpatient populations. The ED algorithm was particularly complex. Instead of relying on a single value and a reference range, proper use requires evaluation within the clinical context and interpretation of temporal changes (deltas) at set intervals such as baseline, at one and/or three hours relative to presentation. To further support this paradigm shift, both in workflow and interpretation, Penn Medicine developed innovative, patient-centered clinical decision support tools to display real-time status updates, including reminders for lab collection for nursing staff and automatic interpretation guidance for acute coronary syndrome in the electronic health record (EHR).

The team formed an enterprise, interdisciplinary governance group of 89 participants, designed research-based algorithms embedded in the EHR, and developed a clinical reference site. Additionally, they coordinated the launch with laboratory teams, educated more than 8,000 caregivers, and implemented an electronic dashboard for continuous monitoring. Since initiation, Penn Medicine has also scaled its tools outside of the enterprise's five hospitals to an organization in Texas.

The initiative launched successfully in June 2022, achieving a smooth transition to high-sensitivity troponin without diagnostic errors, inappropriate admissions, or increased cardiology consultations. Diagnoses of non-ST-elevation myocardial infarction (NSTEMI) and ST-elevation myocardial infarction (STEMI) improved for chest pain patients, who also benefited from detailed test results via the patient portal and providers. Benefits realized include:

- Patients with chest pain or shortness of breath saw a 13% increase in ED discharge dispositions and a 17% decrease in observation dispositions
- Patients with chest pain had a 26% decrease in ED observation dispositions
- Reduced ED length of stay by 71 minutes for admitted cardiac patients and 24 minutes for discharged patients

The initiative generated more than $3.9 million in savings within 10 months by reducing length of stay, enhancing patient throughput, and increasing ED capacity. This project aligned with Penn Medicine's institutional goals of quality, patient safety, continuity of care, high reliability, and innovation, and achieved a smooth implementation and sustained successful outcomes—providing significant safety benefits for patients, inclusive of quicker, more accurate diagnosis, as well as ED utilization.

Ambulatory Care Award

UPMC St. Margaret Harmar Outpatient Center

UPMC St. Margaret

The staff at UPMC St. Margaret Harmar Outpatient Center has made outstanding contributions to patient safety and shown commitment to excellence in ambulatory care. One of their key initiatives involved improving preoperative and postoperative calls to manage patient nausea and vomiting effectively. They discuss patient history during preoperative calls, administer medications in the perioperative setting, review discharge instructions thoroughly, and emphasize follow-up phone calls for postoperative recovery.

The team implemented a dedicated cellphone for patient communication, which has improved preoperative and postoperative contact rates. Through this initiative, the clinician texts the patients prior to calling, allowing the patient to recognize the number so that they answer the call.

They have also prioritized pain reassessment management. Active collaboration with anesthesia providers ensures that pain medication aligns with patient pain scores, providing tailored pain management. Addressing issues within the prebuilt power plan has led to overall improvements in documentation and compliance processes.

In pediatric patient care, staff have successfully increased to 100 pediatric orthopedic cases with no admissions, transfers, or infections reported for age groups 0–17.

The team continues to work on improving outreach and education, with new discharge instructions introduced earlier in the year which have received positive feedback. Operational improvements are also underway, including the installation of new tracking boards and the development of a form for support persons.

Their dedication to patient safety and continuous improvement is evident through their innovative initiatives and collaborative efforts. Their focus on effective pain management, regulatory compliance, and enhanced communication has significantly advanced surgical safety and patient care.

Transparency and Safety in Healthcare Award

The Nurses at the Crozer Endoscopy Center at Brinton Lake

Crozer Health

The nurses at the Crozer Endoscopy Center at Brinton Lake implemented an action plan to complete risk event reports for multiple events that were not captured previously due to lack of knowledge, fear of punishment, or other reasons. Their second goal was to have more people reporting these events.

The nursing staff received education, and a list of possible events was posted at every nurse's station. At the end of the day, checks were completed to see whether any events were overlooked so as not to miss reporting one. The results were successful. The number of reported event types went from two to five, and reported events per month went from one to 16 (some being procedure not completed due to poor preps). The number of nurses reporting went from one to eight (there are only nine nurses in the department). A list of the reporting nurses for that month is posted on the information board as positive reinforcement. The nurses feel safe in being transparent in event reporting now. Next, the facility will take this data to see how to improve the patient prep process.

Healthcare Disparity Award

Sarah Prylinski
UPMC Hamot

Sarah Prylinski at UPMC Hamot exemplifies what it means to be a changemaker in reducing healthcare disparities and improving patient outcomes. As the clinical program manager at a community development corporation, she mentors and directs the work of three community health workers, comprising a team focused on addressing the social determinants of health in the community.

Perhaps even more impressive is how Prylinski has served as the driving force behind a groundbreaking street medicine program, leading its development and implementation. The program's purpose is to address an urgent and challenging gap in healthcare access in the community: the needs of individuals experiencing homelessness.

In fall 2024, she helped secure more than $20,000 in grant funding to launch the street medicine program. From conceptualization to execution, she has been the backbone of the initiative. Her leadership and hands-on efforts directly contribute to reducing harm and improving patient care for the most vulnerable populations. As a result, she is hailed as an angel among the unhoused.

Prylinski's work begins where traditional healthcare often ends: inside shelters and on the streets. She meets patients where they are, providing nursing care in settings that are accessible and familiar to them. Her efforts include helping individuals manage chronic conditions by educating them about their medications, organizing and refilling pillboxes, administering vaccines, and caring for wounds and infections. Her ability to break down barriers to care is further demonstrated by her commitment to scheduling and attending medical appointments with patients, ensuring they receive the follow-up care they need.

Her approach is holistic, innovative, and deeply empathetic. She recognizes that healthcare disparity is rooted in systemic issues and actively works to educate both patients and providers about the challenges faced by those experiencing homelessness. In doing so, her efforts have provided actionable and invaluable insights for the team regarding how to best close those gaps.

The street medicine program not only delivers essential medical services but also fosters trust and dignity among a population that often faces stigmatization and neglect. As a result, Prylinski has become a lifeline for those who might otherwise resist trusting a medical professional and fall through the cracks of the healthcare system.

Through her pioneering street medicine program and daily outreach efforts, Prylinski has demonstrated that one nurse's vision and perseverance can drive meaningful change. She seamlessly combines the roles of caregiver, advocate, leader, and educator, making her a unique part of the healthcare landscape.

Patient Communication Award

Lisa Kolodziejski
UPMC St. Margaret

Over the past four years, Lisa Kolodziejski has gone above and beyond to transform total joint replacement and geriatric fracture programs at UPMC St. Margaret through innovation and patient-centeredness. She has significantly impacted patient care by reducing harm and improving outcomes.

She is not just the patient's navigator on their total joint replacement journey—she is their coach, quarterback, and cheerleader. She conducts a total joint class, first meeting all patients prior to their surgery. Initially, these classes were held only during the day and in person. To better meet patients' needs, she increased participation by offering evening and online classes, allowing more patients to participate despite daytime responsibilities or long distances from the hospital. Participation increased significantly with these additional options.

Kolodziejski expanded the class content by including examples of high-protein items that promote wound healing. A dietician now participates in the class, explaining the importance of increased protein consumption pre- and post-surgery. The class also features a physical therapist and an occupational therapist who demonstrate preoperative and postoperative exercises and the use of equipment and aids to assist in recovery. Patients and caregivers consistently provide positive feedback on the importance of the class to their recovery; the class helps reduce patient harm by preventing surgical site infections, venous thromboembolism, and mechanical failure of the joint, and by decreasing length of stay and readmissions.

Kolodziejski also visits overnight patients the day after surgery, encouraging them and their caregivers towards discharge and reinforcing the education provided during the class. All patients continue to receive coaching after discharge through follow-up phone calls to address any concerns or clarify instructions. She drives the success of the total joint program through her collaboration with surgeons, pharmacy, rehab services, nutritional services, nursing, and surgical teams.

Her dedication extends to the geriatric fracture program, focusing on improving patient care by consistently meeting door-to-operating-room times under 24 hours and developing patient care pathways to improve outcomes by reducing length of stay and readmissions. Recently, there has been an increase in patients being discharged to home. She also volunteers at health fairs, where she provided 95 bone density screenings and educated 551 community members throughout 2024.

Commitment to Safety Award

Penn Medicine Rehabilitation

Hospital of the University of Pennsylvania and GSPP Rehabilitation

When patient elopements at Penn Medicine Rehabilitation increased in fiscal year 2023, an interdisciplinary team reviewed the data to identify opportunities to reduce these events.

Elopements are high-risk events, as patients can incur harm or injury during them. Rehab defines elopement events as when patients leave the hospital premises outside of therapeutic committee activities. Upon further review of the events in FY23, it was discovered that they occurred more frequently but were not reported in the event reporting system.

Upon diving deeper into the events, the team noted that most elopements occurred between 6 p.m. and 9 p.m., and the most reported reason was to purchase food or snacks at nearby food retail establishments. Most often, staff were not aware the patient had left the floor. Penn Rehab did have a "patient outside" process that required an order from the provider, the patient staying on the property in the patient-designated outside area, the patient being accompanied by a family member or other visitor, signing out before they leave the unit, and returning to the unit within 30 minutes of leaving. The team discovered that most patients who left reported not being aware of the outside process.

The hospital implemented an action plan which included

- Closing the unit doors during peak elopement times
- Adding vending machines to the rehab unit in space accessible to patients
- Creating signs for the outside of the building that identify patient-designated areas with pictures and include instructions that patients are not to leave the premises and must return to the unit within 30 minutes
- Creating patient and staff education about the off-unit process and reviewing the process with patients upon admission
- Adding yellow tape to all hospital wheelchairs so inpatients will stand out if they are off the unit
- Educating all staff, including security, that if a patient is off the unit and alone, they contact the unit and bring the patient back to the unit.

The hospital is currently trialing Apple AirTags on hospital wheelchairs so if a patient does elope, they can be located quickly.

The initiative reduced inpatient elopement events from nine in FY23 to six in FY24. Of note, the team feels there were more events in FY23 that were just underreported. They continue to review each elopement event to learn from it and are working on additional interventions to continue reducing these events.

Runners–Up

Ambulatory Care

Jazmin Mendoza
Farm Journal Building, Pennsylvania Hospital

Julie Triplett
AHN Bethel Park Surgery Center

Commitment to Safety

Jennifer Higgins
WellSpan Good Samaritan Hospital

Perioperative Services Leadership and Education Team
Pennsylvania Hospital

Healthcare Disparity

Michele Ferguson-Davis, Guljinder Chera, Salman Qureshi, Olubunmi Olarewaju, and Patricia Nichols
Jefferson Torresdale Hospital

Community Health Needs Assessment Committee: Terri Pellegrino, LaQuicha Anderson, Valerie Bicker, Diane Corr, Donna Tassos, Lia Gallagher, Kristen Guinther, Daniel Hedayati, Michele Hilty, Carole Hoy, Michelle Ikoma, Bill Jordan, Kevin MacDonald, Megan McGrady, Jennifer McMahon, James Mercuri, Lacey Murray, Erin O'Connor, Michele Orsini, Alex Pantoja, Sanketh Proddutur, Courtney Riedel, Bethany Rose, Justin Rose, Ryan Witt, Chelsey Wojcik, Linda Yelen, and Faith Colen
UPMC St. Margaret

Improving Diagnosis

Jefferson Health Northeast and Bensalem Rescue Squad Mobile Stroke Unit
Jefferson Torresdale Hospital

Saundra Jones
UPMC St. Margaret

Individual Impact

Gustaaf De Ridder and Physician Clinical Pathology Laboratory Medicine PhDs
Geisinger Medical Center

Elizabeth King
Penn State Health Milton S. Hershey Medical Center

Medication Safety

Maryann Scholl
UPMC Hamot

Infusion Center Pharmacy Nursing Workgroup
Pennsylvania Hospital

Patient Communication

Kirkland Village Healthcare Center Clinical Team
Kirkland Village

Melissa Smock
UPMC Hamot

Safety Story

Robert Bayer and John Paoletti
Jefferson Torresdale

Maura Kessler
Lehigh Valley Hospital–Pocono

Transparency and Safety in Healthcare

Rebecca Geddes and the PAH Patient Safety Team
Pennsylvania Hospital

Lisa Esolen, Kelly Goff, Matthew Jesso, and the System Quality Department
The Guthrie Clinic

I **AM** PATIENT SAFETY **2025**

Thank you to this year's judges:

Jackie Afranie, MPH, *Betsy Lehman Center for Patient Safety*

Mike Bruno, MD, *Penn State Health*

Sophie Campbell, MSN, RN, *PADONA/LTCN*

Daniel Feinberg, MD, *Pennsylvania Hospital*

Diane Frndak, PhD, MBA, *Robert Morris University*

Regina Hoffman, MBA, RN, *Patient Safety Authority*

Stephen Lawless, MD, *Nemours Children's Health*

Ariana Longley, MPH, *Patient Safety Movement Foundation*

Dwight McKay, *Patient representative*

Heidi McMullan, MSN, RN-BC, W*ellSpan Philhaven*

Marty Raniowski, MPP, *PAMED*

Rob Shipp, PhD, RN, *HAP*

Stanton Smullens, MD, *Retired*

Eric Weitz, Esq., *The Weitz Firm*

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About the Author

Eugene Myers (eugmyers@pa.gov) is the associate editor of Engagement and Publications for the Patient Safety Authority. He previously served as editor-in-chief of Communications, Office of Institutional Advancement, at Thomas Jefferson University and Jefferson Health. He earned his bachelor's degree from Columbia University, is a graduate of the Clarion West Writers Workshop, and is an award-winning author of seven novels for young adult readers.

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