

2020 Healthcare-Associated Infections in the Long-Term Care Setting: *An Analysis of Reports from Pennsylvania*

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The Pennsylvania Patient Safety Reporting System (PA-PSRS) is the largest repository of patient safety data in the United States. In addition to over 3.9 million acute care records, PA-PSRS has collected more than 357,000 long-term care (LTC) healthcare-associated infection reports since 2009. A total of 26,331 infections were reported in 2020, representing a 7.0% decrease from the prior year. The Northeast region of the state had the highest overall infection rate, with 1.29 reports per 1,000 resident days, and the Southeast region had the largest increase in infection rate from the prior year (increased from 0.87 to 1.02). There was a 10.2% increase in respiratory tract infections from 2019 to 2020; however, the other four main infection types decreased (gastrointestinal by 44.6%, device-related bloodstream by 17.0%, skin and soft tissue by 16.5%, and urinary tract by 1.8%). Additionally, of the four infection subtypes that comprise the respiratory tract infections category, all increased from 2019 to 2020 except for pneumonia. The most frequently reported infection subtype in 2020 was cellulitis, soft tissue, or wound infection, although it had the second largest decrease from 2019. The infection rate for catheter-associated urinary tract infections (CAUTI) had the largest increase from 2019 to 2020, and the rate for norovirus had the largest decrease from 2019 to 2020. Infection rates also differed across the various nursing unit types. The seasonal peak for respiratory infections in 2020 occurred in the second quarter, with the exception of influenza, which peaked in the first quarter. Overall, this analysis demonstrates areas in which continued education and infection prevention measures can be applied to further enhance the safety for residents in long-term care facilities.

Keywords: long-term care, nursing homes, healthcare-associated infections, HAI, infection rates, COVID-19, annual report

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The Pennsylvania Patient Safety Reporting System (PA-PSRS) is the largest repository of patient safety data in the United States. In addition to over 3.9 million acute care records, PA-PSRS has collected more than 357,000 long-term care (LTC) healthcare-associated infection (HAI) reports since 2009. In 2020, 26,331 HAIs were reported by 658 of Pennsylvania's long-term care facilities.

Methodology

The LTC data from PA-PSRS were extracted on March 1, 2021, to allow additional time for rate calculations based on resident and device utilization days. With respect to infection rates, facilities and care areas were included for each month in which the facility reported resident and device days in PA-PSRS.

All infection counts are with respect to the year when infection reports were submitted in PA-PSRS. Rates are based on infection confirmation dates and resident days for overall rates. Specific infection rates related to catheters or central lines are based on catheter or central line days, respectively. Also, rates are all expressed as infections per 1,000 resident, catheter, or central line days. Infection rates from prior years may change from prior publications as additional facilities subsequently enter utilization data in PA-PSRS.

Tests of significance were performed using $\alpha = .05$.

Results

The number of reports for 2020 decreased by 7.0% from 2019, with 26,331 reported infections in 2020 (see **Figure 1**). This is the second annual decrease since 2018.

Regarding the infection rate overall, the 2020 rate was 1.07 infections per 1,000 resident days, which is similar to the 2019 rate of 1.05. As shown in **Figure 2**, the Northeast region had the highest rate of reported infections, with 1.29 reports per 1,000 resident days. The Southeast region had the highest increase in infection rate from 2019 to 2020, with a rate increase of 0.87 to 1.02.

The distribution of LTC infection reports submitted in 2020 by region is shown in **Table 1**. The Southeast region reported more infections than any other region, with 9,287, and it also was the only region that reported more infections in 2020 than in 2019. A further analysis showed that the reason for the increase in infections in 2020 for the Southeast region is due to respiratory tract infections, which increased by 45.6% in 2020 compared to 2019. Quarterly time frames for the Southeast region show the respiratory infection rate in the second quarter of 2020 increased by 229.7% compared to the second quarter of 2019.

LTC Healthcare-Associated Infections

Reports submitted by long-term care facilities to PA-PSRS are classified into five main infection types (see **Figure 3**). Respiratory tract infections have typically accounted for the largest portion of reports in previous years, and in 2020 respiratory tract infections made up 40.7% of all submitted infection reports, which is a significantly higher proportion than 34.4% in 2019 ($p < .001$).

LTC Healthcare-Associated Infection Subtypes

The main infection types are subdivided into subtypes in **Table 2**. The most frequently reported subtype in 2020 was cellulitis, soft tissue, or wound infection, and the second and third most frequently reported subtypes were pneumonia and symptomatic urinary tract infection (SUTI), respectively. Among all infection subtypes, lower respiratory tract infections (LRTIs) increased the most from 2019 to 2020 (increased by 895 reports), and influenza-like illness had the largest percentage increase in 2020 (308.8% increase). In addition to the three respiratory tract infection

subtypes that increased from 2019 to 2020 (LRTI, influenza, and influenza-like illness), the other infection subtype that increased in 2020 was catheter-associated urinary tract infection (CAUTI). Norovirus infections showed the largest decreases in both number and percentage from 2019 to 2020 (903 decrease, 58.3% decrease). In terms of percent decrease in 2020, scabies followed Norovirus with a 32.1% decrease, then *Clostridium difficile* (*C. diff*) with a 29.2% decrease, followed by decreases of 22.2% for bacteriologic gastroenteritis and 19.9% for conjunctivitis.

Figure 2. LTC Infection Rates per 1,000 Resident Days by Region From Data Submitted to PA-PSRS



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

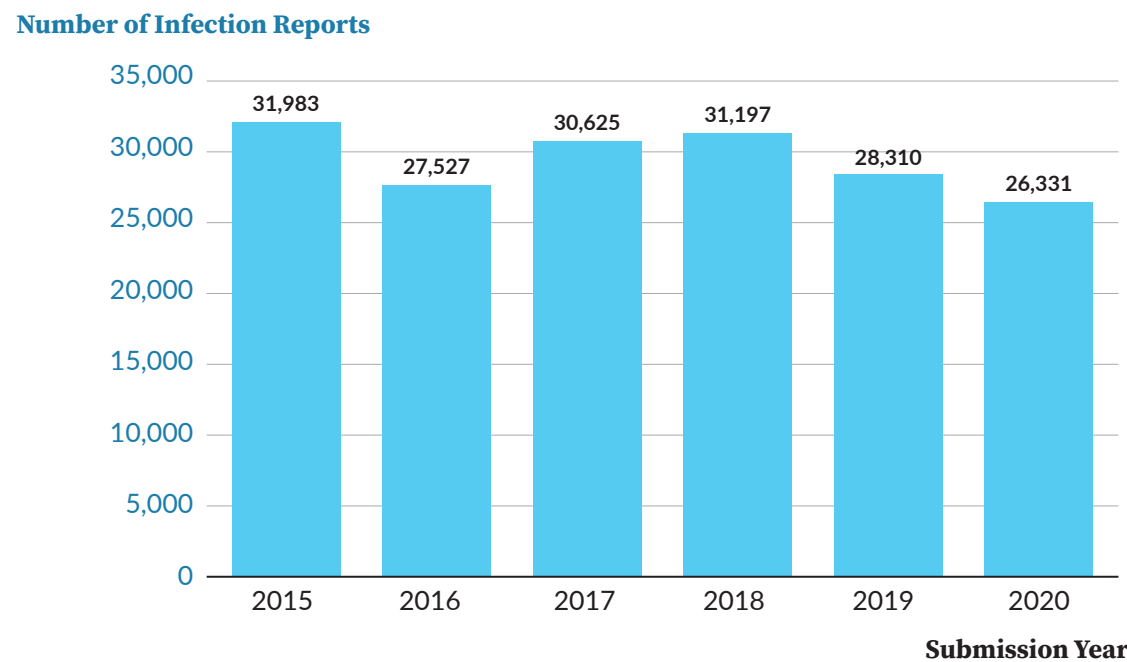


Table 1. LTC Infections Reported into PA-PSRS and Infection Rates per 1,000 Resident Days by Region

Region	2019 Infection Reports	2019 Rate/1,000 Resident Days	2020 Infection Reports	2020 Rate/1,000 Resident Days
North Central	1,844	1.09	1,547	0.98
Northeast	4,325	1.21	4,164	1.29
Northwest	3,055	1.26	2,564	1.04
South Central	4,427	1.20	4,034	1.18
Southeast	8,954	0.87	9,287	1.02
Southwest	5,705	1.08	4,735	0.97
Total	28,310	1.05	26,331	1.07

Care Area

Figure 4 shows the distribution of 2020 infections by type and care area. Skilled nursing/short-term rehabilitation units accounted for the largest proportion of infections (9,720 of 26,331, 36.9%). Respiratory tract infections were reported more than any other infection type in all care areas in 2020. Figure 5 shows the 2020 distribution of infections by subtypes and care areas. Cellulitis, soft tissue, or wound infection accounted for the largest number of reports in all units except for ventilator-dependent units, in which pneumonia was the most frequently reported infection subtype.

LTC Healthcare-Associated Infection Rates

Figure 6 shows infection rates per 1,000 resident days for the five infection types for 2018 through 2020. The rates for respiratory tract and urinary tract infections increased from 2019 to 2020. The 21.3% increase in respiratory tract infection rate from 2019 to 2020 is driven by results from second quarter 2020, in which the rate was 0.622, and moreover the month of April 2020, in which the rate was 1.038. The April 2020 rate is the largest monthly rate for respiratory tract infections since January 2015, when the rate was 1.211.

In Figure 7 and Table 3, the overall infection rates are shown for each infection subtype for 2018 through 2020. Rates increased in 2020 for CAUTI, LRTI, influenza-like illness, symptomatic urinary tract infection (SUTI), influenza, and pneumonia. SUTI rates have been steadily increasing for the past three years. The infection rate for norovirus had the greatest decrease in 2020. The rates

for cellulitis, soft tissue, or wound infections decreased over the past three years. The rates for *C. diff* and conjunctivitis have also decreased for the past three years.

In Table 4, the infection rates are displayed by year for care areas and infection subtype. CAUTI rates increased for all types of units in 2020, except for skilled nursing/short-term rehabilitation units. The CAUTI rate for mixed units increased by 66.7%, and the CAUTI rate for ventilator-dependent units more than tripled when compared to 2019. SUTI rates increased for mixed units and nursing units, as well as ventilator-dependent units. Lower respiratory tract infection (LRTI) and influenza-like illness rates also increased for all types of units in 2020. Despite increases for other types of respiratory tract infections, pneumonia rates decreased for dementia, mixed, and skilled nursing/short-term rehabilitation units. However, pneumonia rates nearly doubled for ventilator-dependent units when compared to 2019. Influenza rates also decreased for mixed and ventilator-dependent units. The rates for norovirus; conjunctivitis; and cellulitis, soft tissue, or wound infection decreased for all unit types, except ventilator-dependent units in 2020. We recommend caution when interpreting rate changes for ventilator-dependent units, as the total n size is relatively small.

Figure 8 displays the infection rates for influenza, influenza-like illness, pneumonia, lower respiratory tract infection (LRTI), and norovirus by quarter for 2018–2020. These rates are calculated as the number of infections confirmed, using the infection confirmation date, in the quarter per 1,000 resident days.

Figure 3. LTC Infection Reports Submitted to PA-PSRS by Infection Type and Year

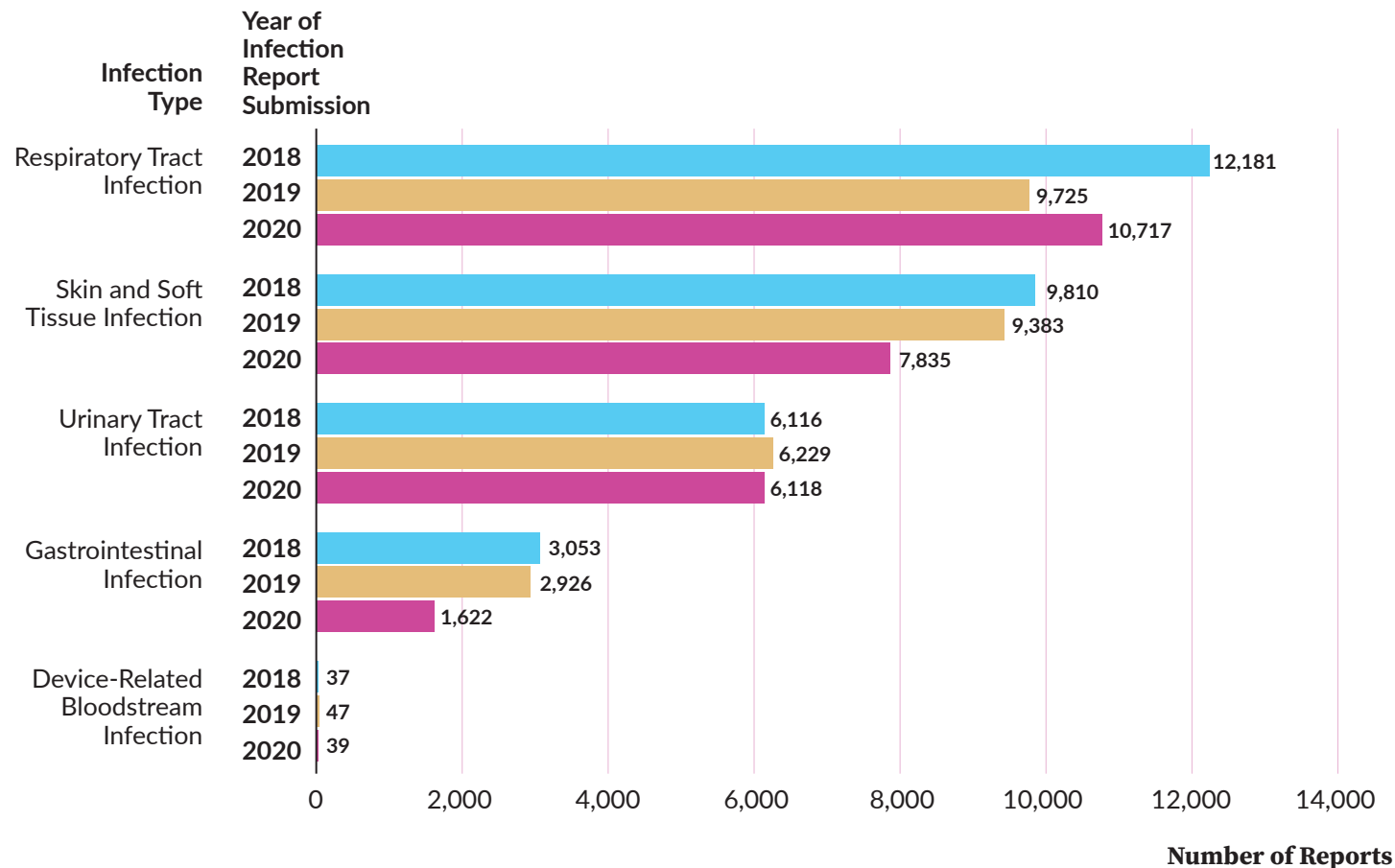


Table 2. Long-Term Care Infection Reports Submitted to PA-PSRS and Percentage Distribution by Infection Type, Infection Subtype, and Year

Infection Type	Infection Subtype	Number of Reports			% of Total			Change in Reports 2019–2020	
		2018	2019	2020	2018	2019	2020	Number	Percent
Respiratory Tract Infection	Pneumonia	6,069	5,282	4,862	19.5%	18.7%	18.5%	-420	-8.0%
	LRTI	3,169	2,874	3,769	10.2%	10.2%	14.3%	895	31.1%
	Influenza	2,641	1,409	1,432	8.5%	5.0%	5.4%	23	1.6%
	Influenza-Like Illness	302	160	654	1.0%	0.6%	2.5%	494	308.8%
Skin and Soft Tissue Infection	Cellulitis, Soft Tissue, or Wound Infection	6,166	6,039	5,180	19.8%	21.3%	19.7%	-859	-14.2%
	Conjunctivitis	3,444	3,157	2,528	11.0%	11.2%	9.6%	-629	-19.9%
	Scabies	200	187	127	0.6%	0.7%	0.5%	-60	-32.1%
Urinary Tract Infection	SUTI	4,754	4,939	4,715	15.2%	17.4%	17.9%	-224	-4.5%
	CAUTI	1,176	1,136	1,251	3.8%	4.0%	4.8%	115	10.1%
	ABUTI	186	154	152	0.6%	0.5%	0.6%	-2	-1.3%
Gastrointestinal Infection	<i>C. diff</i>	1,719	1,358	961	5.5%	4.8%	3.6%	-397	-29.2%
	Norovirus	1,317	1,550	647	4.2%	5.5%	2.5%	-903	-58.3%
	Bacteriologic Gastroenteritis	17	18	14	0.1%	0.1%	0.1%	-4	-22.2%
Device-Related Bloodstream Infection	CLABSI	37	47	39	0.1%	0.2%	0.1%	-8	-17.0%
Totals		31,197	28,310	26,331	100.0%	100.0%	100.0%	-1,979	-7.0%

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

Figure 4. LTC Infection Reports Submitted to PA-PSRS in 2020 by Infection Type and Care Area

Infection Type	Skilled Nursing/Short-Term Rehab. Unit	Mixed Unit	Nursing Unit	Dementia Unit	Ventilator-Dependent Unit	Total
Respiratory Tract Infection	4,023	2,799	2,951	733	211	10,717
Skin and Soft Tissue Infection	2,793	2,233	2,186	532	91	7,835
Urinary Tract Infection	2,327	1,817	1,600	299	75	6,118
Gastrointestinal Infection	559	423	478	140	22	1,622
Device-Related Bloodstream Infection	18	7	14	-	-	39
Total	9,720	7,279	7,229	1,704	399	26,331

Note: A dash “-” appearing in a cell within the table denotes zero reports.

Figure 5. LTC Infection Reports Submitted to PA-PSRS in 2020 by Infection Subtype and Care Area

Infection Subtype	Skilled Nursing/ Short-Term Rehab. Unit	Mixed Unit	Nursing Unit	Dementia Unit	Ventilator- Dependent Unit	Total
Cellulitis, Soft Tissue, or Wound Infection	1,919	1,484	1,419	304	54	5,180
Pneumonia	1,829	1,364	1,240	292	137	4,862
SUTI	1,804	1,394	1,255	245	17	4,715
LRTI	1,365	979	1,083	272	70	3,769
Conjunctivitis	812	737	725	217	37	2,528
Influenza	582	303	441	103	3	1,432
CAUTI	467	378	308	41	57	1,251
<i>C. diff</i>	409	301	199	30	22	961
Influenza-Like Infection	247	153	187	66	1	654
Norovirus	146	118	274	109	-	647
ABUTI	56	45	37	13	1	152
Scabies	62	12	42	11	-	127
CLABSI	18	7	14	-	-	39
Bacteriologic Gastroenteritis	4	4	5	1	-	14
Total	9,720	7,279	7,229	1,704	399	26,331

Note: A dash “-” appearing in a cell within the table denotes zero reports.

Figure 6. LTC Infection Rates per 1,000 Resident Days by Infection Type From Data Submitted to PA-PSRS

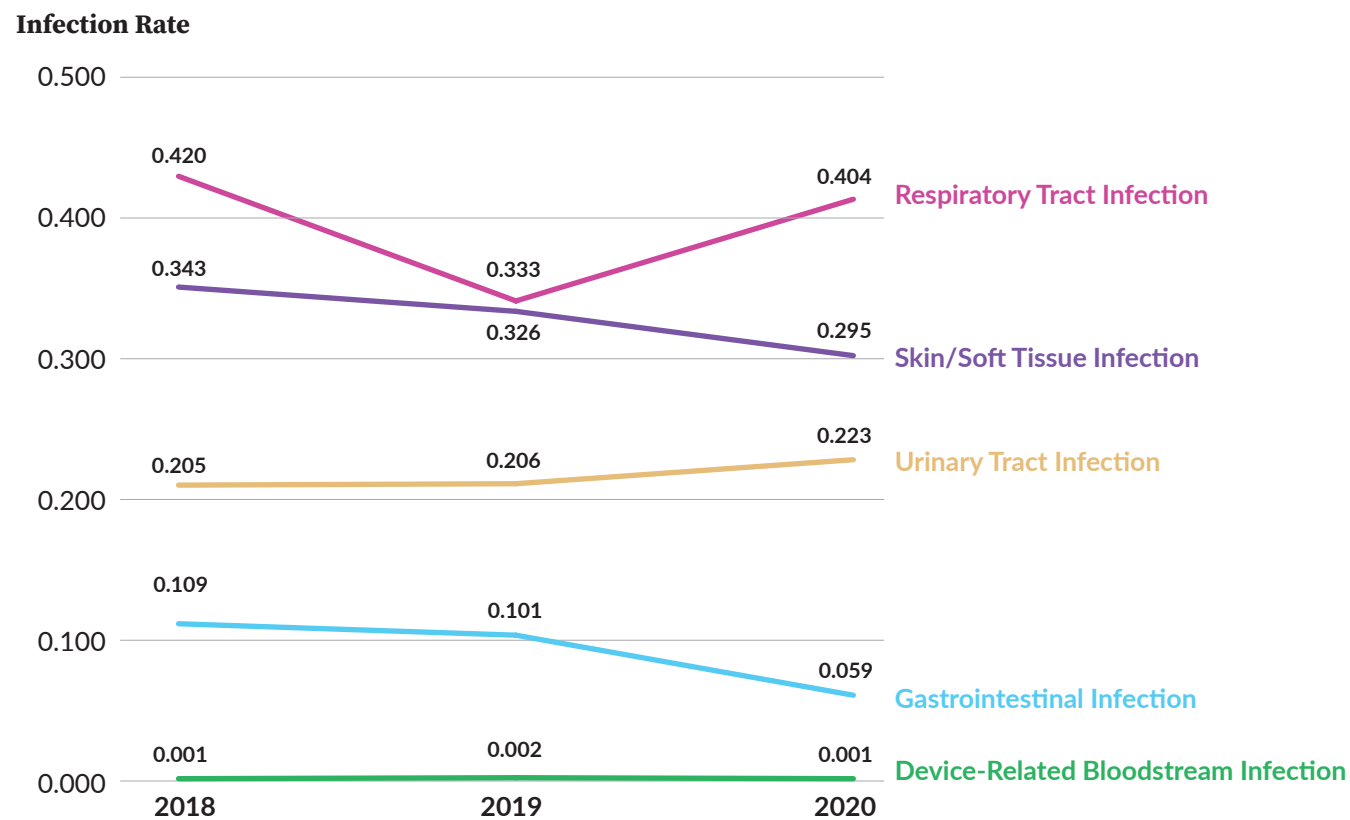


Figure 7. LTC Infection Rates per 1,000 Resident or Device Days by Infection Subtype and Year From Data Submitted to PA-PSRS

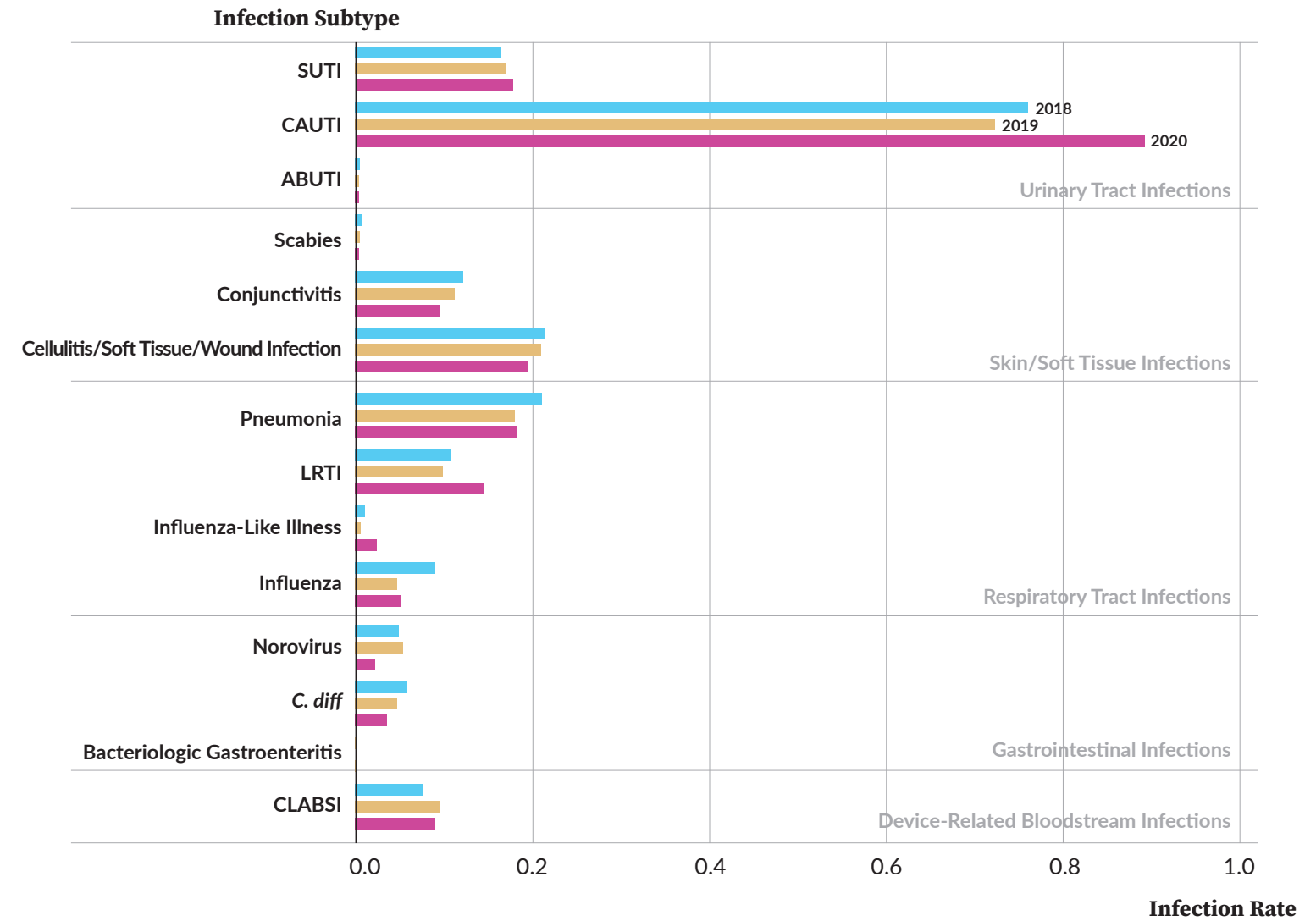


Table 3. LTC Infection Rates per 1,000 Resident or Device Days by Infection Subtype and Year From Data Submitted to PA-PSRS

Infection Subtype	Rates		
	2018	2019	2020
Pneumonia	0.211	0.180	0.182
LRTI	0.108	0.099	0.146
Influenza	0.090	0.047	0.052
Influenza-Like Illness	0.011	0.006	0.024
CAUTI	0.760	0.723	0.892
SUTI	0.165	0.170	0.178
ABUTI	0.005	0.004	0.004
Norovirus	0.049	0.054	0.022
<i>C. diff</i>	0.059	0.047	0.036
Bacteriologic Gastroenteritis	0.001	0.001	<0.001
CLABSI	0.076	0.095	0.090
Cellulitis, Soft Tissue, or Wound Infection	0.215	0.210	0.196
Conjunctivitis	0.122	0.112	0.095
Scabies	0.007	0.005	0.004

Table 4. LTC Infection Rates per 1,000 Resident or Device Days by Infection Subtype, Care Area, and Year From Data Submitted to PA-PSRS

Care Area	Infection Subtype	2018	2019	2020
Dementia Unit	ABUTI	0.001	0.004	0.005
	Bacteriologic Gastroenteritis	-	-	0.001
	<i>C. diff</i>	0.022	0.016	0.015
	CAUTI	0.765	1.078	1.109
	CLABSI	-	-	-
	Cellulitis, Soft Tissue, or Wound Infection	0.169	0.164	0.147
	Conjunctivitis	0.134	0.127	0.107
	Influenza	0.075	0.040	0.044
	Influenza-Like Illness	0.008	0.006	0.024
	LRTI	0.117	0.099	0.131
	Norovirus	0.088	0.098	0.046
	Pneumonia	0.162	0.142	0.139
	SUTI	0.110	0.124	0.117
	Scabies	0.012	0.012	0.006
	Mixed Unit	ABUTI	0.006	0.005
Bacteriologic Gastroenteritis		< 0.001	0.001	< 0.001
<i>C. diff</i>		0.053	0.040	0.042
CAUTI		0.816	0.642	1.070
CLABSI		0.088	0.039	0.042
Cellulitis, Soft Tissue, or Wound Infection		0.225	0.212	0.201
Conjunctivitis		0.121	0.115	0.101
Influenza		0.089	0.049	0.039
Influenza-Like Illness		0.013	0.007	0.022
LRTI		0.114	0.104	0.141
Norovirus		0.041	0.056	0.014
Pneumonia		0.226	0.187	0.185
SUTI		0.181	0.169	0.191
Scabies		0.005	0.005	0.002
Nursing Unit		ABUTI	0.006	0.005
	Bacteriologic Gastroenteritis	< 0.001	0.001	0.001
	<i>C. diff</i>	0.044	0.036	0.024
	CAUTI	0.544	0.598	0.755
	CLABSI	0.090	0.090	0.088
	Cellulitis, Soft Tissue, or Wound Infection	0.203	0.188	0.172
	Conjunctivitis	0.121	0.098	0.089
	Influenza	0.076	0.043	0.051
	Influenza-Like Illness	0.011	0.004	0.023
	LRTI	0.101	0.091	0.127
	Norovirus	0.060	0.049	0.033
	Pneumonia	0.194	0.145	0.151
	SUTI	0.143	0.137	0.152
	Scabies	0.007	0.005	0.003

Care Area	Infection Subtype	2018	2019	2020
Skilled Nursing/ Short-Term Rehabilitation Unit	ABUTI	0.010	0.006	0.006
	Bacteriologic Gastroenteritis	0.001	< 0.001	0.001
	<i>C. diff</i>	0.087	0.068	0.047
	CAUTI	0.902	0.874	0.838
	CLABSI	0.047	0.096	0.083
	Cellulitis, Soft Tissue, or Wound Infection	0.229	0.238	0.225
	Conjunctivitis	0.120	0.116	0.090
	Influenza	0.107	0.051	0.068
	Influenza-Like Illness	0.010	0.006	0.026
	LRTI	0.108	0.102	0.167
	Norovirus	0.037	0.047	0.014
	Pneumonia	0.223	0.212	0.207
	SUTI	0.186	0.213	0.210
	Scabies	0.007	0.004	0.007
	Ventilator-Dependent Unit	ABUTI	-	0.007
Bacteriologic Gastroenteritis		0.008	-	-
<i>C. diff</i>		0.101	0.115	0.135
CAUTI		0.396	0.294	1.099
CLABSI		-	0.145	-
Cellulitis, Soft Tissue, or Wound Infection		0.233	0.223	0.327
Conjunctivitis		0.117	0.209	0.282
Influenza		0.031	0.043	0.019
Influenza-Like Illness		-	-	0.006
LRTI		0.062	0.187	0.404
Norovirus		-	-	-
Pneumonia		0.459	0.490	0.821
SUTI		0.148	0.043	0.103
Scabies		-	-	-

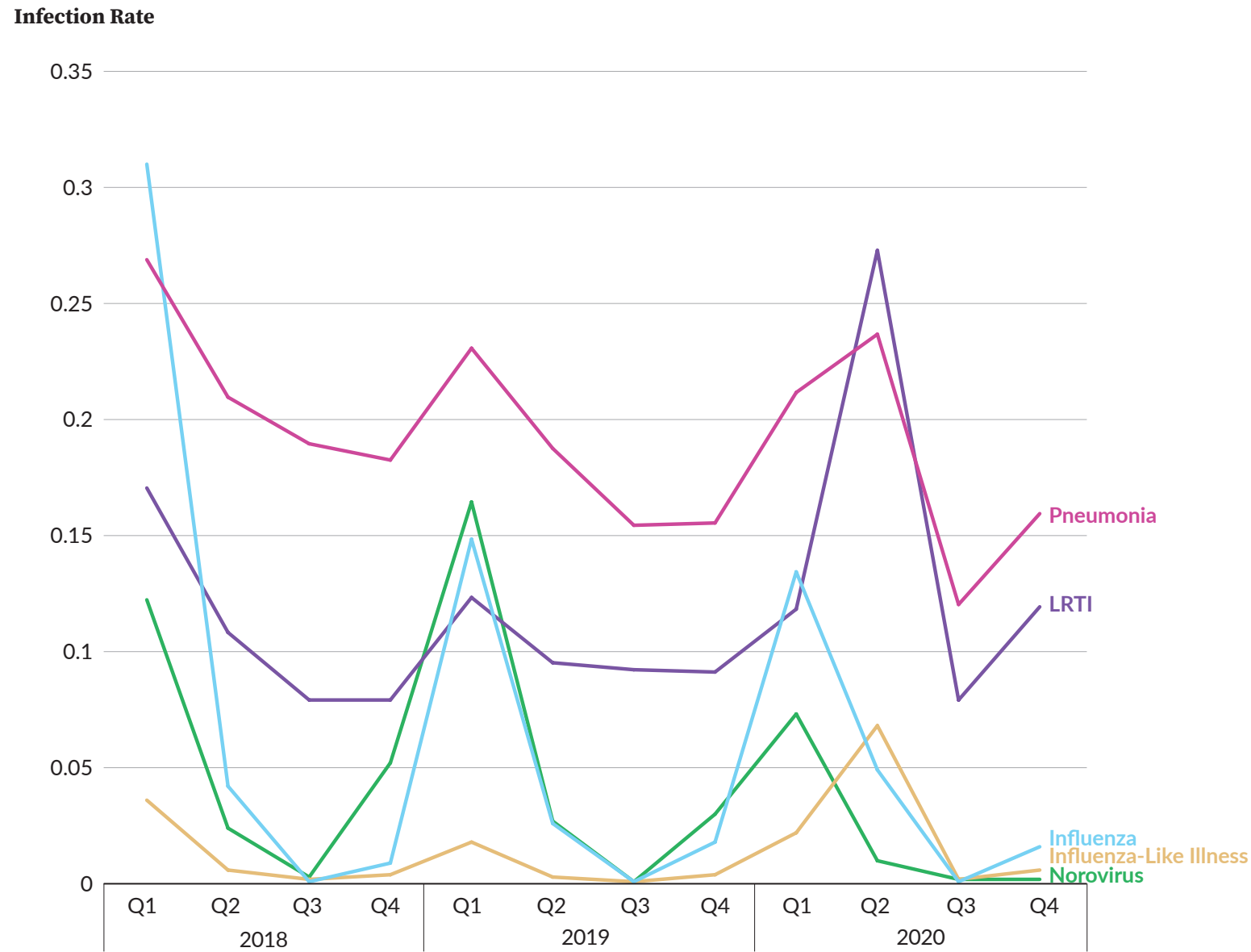
Note: When a dash “-” appears in a cell within the table, it means that the rate is exactly zero. If “< 0.001” appears in a cell, it means that the rate is greater than zero but less than 0.001. Highlighting is used to indicate the higher rates and can be used to see year-over-year changes for particular rows.

Seasonal rate increases for influenza and norovirus peak in the first quarter of each year (Figure 8). However, unlike previous years, the rate for LRTI, pneumonia, and influenza-like illness peaked in the second quarter of 2020 (Figure 8). The infection rates for each seasonal infection subtype are shown in Table 5. Combined influenza, influenza-like illness, pneumonia, and LRTI rates for the second quarter of 2020 (0.621) were similar to the combined rates for these infection types in the first quarter of 2018 (0.779), which was described as a particularly severe influenza season.¹⁻³

COVID-19

SARS-CoV-2, which causes COVID-19, is reported to cause a wide variety of symptoms ranging from asymptomatic or mild to severe respiratory illnesses.⁴ COVID-19 is also described to cause gastrointestinal symptoms.⁴ Reporting in PA-PSRS is based on determination of whether symptoms meet surveillance definitions for various types of infections per revised McGeer criteria. Thus, asymptomatic or mild cases of COVID-19 would not have met reportable criteria for most infection types. Furthermore, COVID-19 infection may result in a set of symptoms that differ from symptoms resulting from other agents that also cause respiratory

Figure 8. LTC Infection Rates per 1,000 Resident Days Trending for Seasonal Infection Subtypes by Event Confirmation Quarter From Data Submitted to PA-PSRS



infections. In addition, guidance for testing, treating, or reporting of COVID-19 may have also biased reporting toward LRTI, especially if chest X-rays were not performed, or toward influenza-like illness if symptoms remained mild. Another important point is that efforts used to prevent the spread of SARS-CoV-2 also may have changed the type of conditions for care for residents, due to residents being isolated, not having family caretakers visit, and staffing limitations. These efforts and changes to prioritization may have affected infection prevention activities and monitoring for various types of infections, such as urinary tract infections, and isolation and social distancing of residents may have further decreased the spread of other types of communicable infections, such as *C. diff*, norovirus, and influenza. Thus, we recommend consideration of the broader picture when interpreting changes in reporting for the various healthcare-associated infections in long-term care facilities during 2020.

Conclusion

Pennsylvania's long-term care facilities reported 26,311 health-care-associated infections in PA-PSRS in 2020. This represents a 7.0% decrease in reports from 2019. There was a 10.2% increase in respiratory tract infections from 2019 to 2020; however, the other four main infection types decreased. For specific infection types, cellulitis, soft tissue, or wound infections; pneumonia; and SUTI were the three most frequently reported infection subtypes in 2020. The number of reports for most subtypes of infections decreased in 2020; however, LRTI, influenza, influenza-like illness, and CAUTI reports increased. Most notably, the norovirus reports decreased by 58.3%, and the influenza-like illness reports increased by 308.8% when compared to 2019. The skilled nursing/short-term rehabilitation units account for most of the reports in 2020, and respiratory infections account for 40.7% of all reported infections. Analysis of

Table 5. Overall LTC Seasonal Infection Rates per 1,000 Resident Days by Year From Data Submitted to PA-PSRS

	Influenza	Influenza-Like Illness	LRTI	Norovirus	Pneumonia
2018 Q1	0.308	0.035	0.169	0.121	0.267
Q2	0.041	0.005	0.107	0.023	0.208
Q3	0.000	0.001	0.078	0.002	0.188
Q4	0.008	0.003	0.078	0.051	0.181
2019 Q1	0.147	0.017	0.122	0.163	0.229
Q2	0.025	0.002	0.094	0.026	0.186
Q3	0.000	0.000	0.091	0.000	0.153
Q4	0.017	0.003	0.090	0.029	0.154
2020 Q1	0.133	0.021	0.117	0.072	0.210
Q2	0.048	0.067	0.271	0.009	0.235
Q3	0.000	0.001	0.078	0.001	0.119
Q4	0.015	0.005	0.118	0.001	0.158

infection rates generally demonstrates similar infection profiles in the various types of long-term care units across Pennsylvania. However, this article further highlights some notable differences, including increases in CAUTI rates for all types of units except skilled nursing/short-term rehabilitation units, and increases in pneumonia rates in ventilator-dependent units. As expected, the respiratory tract and norovirus infection rates have seasonal trends. However, the seasonal peak for LRTI, pneumonia, and influenza-like illness peaked in second quarter 2020. Overall, the analysis demonstrates areas where continued education and infection prevention measures can be applied to further enhance the safety for residents in long-term care facilities.

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Note

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

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