

Postoperative Pneumonia Prevention Checklist Improves Provider Compliance and Patient Awareness of Previously Established Reduction Protocol

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Abstract

Background: Postoperative pneumonia (PoPNA) is a highly prevalent complication in patients. Despite a previously successful protocol, this institution has become a high outlier on national metrics for PoPNA in the last four years.

Methods: Between October 2020 and May 2021, patients were surveyed to measure 10 initiatives which have shown previous success. A provider-driven 10-item checklist was implemented and patients were resurveyed.

Results: 135 patients were included: 96 pre-checklist and 39 post-checklist. Improvement was seen in all 10 categories. This included provider-driven initiatives, such as patient oral care, ambulation, frequency of patient being in chair, having incentive spirometer (IS) within reach, having information booklet within reach, and the patient's ability to perform IS correctly, as well as patient awareness initiatives, including importance of oral care, cough and deep breathing, ambulation, and IS use.

Conclusions: Implementation of a simple checklist can improve awareness and compliance with previously successful established protocols.

Keywords: *checklist, postoperative pneumonia, quality improvement, compliance*

Introduction

Postoperative pneumonia (PoPNA) accounts for 2%–5% of complications in post-surgical patients, increases length of stay by 75%, and increases cost of care per patient encounter by 47%.^{1,2} For these reasons, many quality and safety interventions in the past have been geared towards the reduction of PoPNA, including the successful ICOUGH (Incentive spirometry, Coughing and deep breathing, Oral care, Understanding, Getting out of bed three times daily, and Head of bed elevation) program.³

At this institution, PoPNA prevention protocols modeled after the ICOUGH protocol have been in place since 2016. Following initial success in lowering PoPNA rates, the same institution became a high outlier in PoPNA complications on the National Surgical Quality Improvement Program (NSQIP) semiannual report, an initiative by the American College of Surgeons (ACS) to capture postoperative complications (**Supplemental Figure S1**).⁴ This phenomenon of initial success followed by decreased compliance and awareness after new initiatives and projects take the forefront is not uncommon.

Checklists, specifically for procedural interventions, have been shown to reduce mortality significantly and have become standard of practice in many institutions.⁵ This study attempted to utilize this same tool in a non-procedural setting to attempt to increase provider compliance to and patient awareness of previous initiative protocols, namely the ICOUGH pneumonia

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prevention protocol implemented in 2016. The purpose of the intervention was to remind, reeducate, and require active engagement from providers and patients.

The aim of this study was to increase provider compliance and patient awareness of established ICOUGH PoPNA preventative initiatives by 10% over the span of nine months by incorporating a PoPNA checklist into daily progress notes which required active participation by providers and patients. Additionally, given that many quality initiatives experience a compliance decrease at some point following their implementation, we hoped to create a template tool that could be utilized by other institutions for various previously successful interventions.

Methods

This study was deemed exempt from the Thomas Jefferson University Institutional Review Board (IRB), control #18D.203. Patient participants were verbally informed of the intention of the study and their right to refuse before each interview was conducted.

Patient Population

Between October 2020 and May 2021, post-surgical general surgery patient interviews were conducted at a single academic medical center both before and after intervention implementation. Inclusion criteria included: agreement from the patient to participate in the interview, age ≥ 18 , patient admitted to a primary surgical service, on a surgical ward at the time of interview, and postoperative day one or two from their surgical procedures.

Postoperative Prevention Protocols in Place

Since 2016, the institution has modeled a PoPNA prevention policy after the ICOUGH protocol introduced by Boston University Medical Center, which includes incentive spirometry (IS) use, coughing and deep breathing, oral care twice daily, understanding of prevention protocols, getting out of bed three times daily, and head of bed elevation greater than 30 degrees at all times (when clinically safe).³ These protocols were introduced to all surgical units and all members of the care team were educated on its use. In addition, admitted patients should have been provided with an IS within reach as well as an ICOUGH booklet explaining the protocol.

SmartPhrases

are preprogrammed words/phrases/lists created by the end user within their electronic medical record profile which can be accessed with a few simple keystrokes and shared with other provider profiles for uniformity and efficiency's sake.



For example, the checklist in Figure 1 would populate by simply typing ".pnacheck".

Intervention

Utilizing the electronic medical record's ability to create "SmartPhrases," a 10-item checklist was created which contained key elements of the ICOUGH initiative previously in place (Figure 1).

The checklist contained a mix of prefilled instructions to the care provider team, as well as elements requiring active data input following daily rounds on the patient by the provider (e.g., quantity of volume pulled on IS). The SmartPhrase template was shared in September 2020 with all care providers within the Department of Surgery, which included the advanced practice providers (APPs), residents, and attending physicians who complete the daily progress notes and rounds. This was followed by education on the checklist and its use by a member of the research team via three emails providing instructions on how to incorporate the checklist into the daily note and tips on how to complete the elements requiring active data entry to all care providers, as well as two in-person 15-minute presentations prior to weekly educational conferences explaining the same. Topics covered were key points of the initial ICOUGH initiative; data showing initial success, but more recent decrease in compliance; and individual elements of the checklist and their rationale. Additionally, versions of these sessions were provided via email to the nursing staff of

Figure 1. Postoperative Pneumonia Prevention Checklist and Progress Note SmartPhrase Templates

Postoperative Pneumonia Prevention Checklist:

- Patient to use incentive spirometer (IS) 10 times per hour, IS currently at bedside. Please document use twice in nursing flowsheets per shift.
- Patient out of bed (OOB) to chair for all meals and at least three times daily; if patient NPO (nothing by mouth), please have them OOB to chair three times daily.
- Patient to receive oral care at least twice daily; please document in nursing flowsheet.
- Ambulated at least three times; please document ambulation distances in nursing flowsheets.
- Head of bed (HOB) elevated/not elevated to 30 degrees this morning; please keep elevated to 30 degrees at all times.

Postoperative Pneumonia Prevention Progress Note:

- Patient currently pulling *** on IS.
- Patient ambulated *** times today.
- Patient received/did not receive oral care.
- Patient was/was not OOB today.
- HOB is/is not 30 degrees.

the high-volume surgical wards in the hospital highlighting the portions of the checklist that most affected them (providing IS and making sure it is within reach). These nursing communications also included a request to disseminate the information amongst ancillary support workers on their respective floors.

After education was provided on how to incorporate and complete the checklist within the daily notes, daily monitoring by two independent members of the research team was performed to ensure incorporation of the checklist into daily progress notes by providers. This was done by each reviewer checking how many of the progress notes contained the completed checklist on each of the several general surgery teams within the institution. When the checklist was missing from the daily progress note, incomplete, or incorrectly filled out, feedback was given by the reviewer via email and either text or phone call to the individual provider who wrote the note. In these communications, the importance of the initiative and checklist was reiterated and any clarifying questions were answered.

Study of the Intervention

Patients were interviewed by four members of the research team from August to September 2020 prior to dissemination and education on how to implement and complete the checklist (which occurred in September 2020). These data were reported as pre-interview in the study. These interviews were structured using a standard survey created and recorded on REDCap (**Supplemental Figure S2**).

Interviews were halted during the periods of education and measurement of checklist incorporation. Starting in September 2020, checklist incorporation was measured (as described above). The research team chose a predetermined threshold of 75% (meaning 75% of the daily progress notes contained a completed checklist) to begin the post-intervention data collection. This metric was chosen by all co-authors after a discussion and vote was held as a reasonable and sustainable benchmark based on the volume of surgical progress notes written in the department. Post-intervention interviews were performed by the same four research team members using the same standard survey. During this time, two other research team members continued to monitor the percentage of checklists incorporated in daily progress notes, which stayed above 75% for the remainder of the study which ended in May 2021. Of note, after the post-intervention data began to be collected, no individual feedback was provided to providers that did not incorporate the checklists in their daily notes.

Measures

Measures were obtained from patient interview answers using the standard survey. These answers were split into two categories: provider compliance categories and patient awareness categories. Provider compliance categories included patient receiving/performing oral care (e.g., teeth brushing or rinsing with mouthwash) at least twice daily, ambulating a minimum of 20 feet at least three times daily, being out of bed and in a chair at least twice daily, having the IS within reach of the patient, having the ICOUGH booklet in the patient's room, and the patient's ability to perform correct usage of the IS when prompted by the interviewer. Patient awareness categories included patients reporting that they had been made aware of the importance of oral care, cough and deep breathing, ambulation, and IS use while admitted to the hospital.

Finally, NSQIP data were queried during the year preceding and following intervention rollout. Number of cases and case rates were recorded.

Analysis

All data were collected and recorded in REDCap. Patients were separated into pre- and post-intervention cohorts. The effects of the intervention were measured as a percent change in each of the categories after intervention implementation. Additionally, chi-squared tests were performed to measure the effect of checklist intervention on each category. Statistical significance was set as a p-value < 0.05. All statistical analyses were performed using the Stata (Stata/MP 17.1) program.

Results

135 postoperative general surgery patient interviews were conducted over the study time period, 96 were interviewed prior to implementation of the checklist, and 39 were interviewed following implementation.

Provider compliance measures from the standard patient interview were analyzed between the pre- and post-intervention patient cohorts, which showed increases in all categories: patient receiving/performing oral care twice daily +5.2% (p=0.243), ambulating a minimum of 20 feet at least three times daily +10.2% (p=0.381), being out of bed and in a chair at least twice daily +2.3% (p=0.801), having the IS within reach +14.3% (p=0.04), having the ICOUGH explanation booklet in the patient's room +12.2% (p=0.118), and patient's ability to perform correct usage of IS when prompted by interviewer +9.5% (p=0.337) (**Figure 2**).

Patient awareness measures also increased in all categories after checklist implementation: importance of oral care +1.4% (p=0.887), deep coughing +13.5% (p=0.15), ambulation +20.5% (p=0.015), and IS use +7% (p=0.182) (**Figure 3**).

After query of the NSQIP database, there were 46 cases of PoPNA amongst the 1,706 patients (rate of 2.70%) captured between January and December 2020, the year preceding the intervention. In 2021 following the intervention, there were 31 cases amongst the 1,577 patients captured (rate of 1.97%; p=0.104).

Limitations

This work had a few notable limitations. First, it is survey-based, which comes with its inherent biases. To combat this, survey questions of compliance and awareness were designed to be as straightforward as possible, with as little room for subjectivity. Also, no demographic data were collected on the patients interviewed, which could contribute to some of the variability observed between the patient cohorts. However, since interviews were conducted on the same surgical services and wards, this effect is believed to be minimal at most. Additionally, patients interviewed consisted of solely post-surgical patients in an institution which had previous PoPNA prevention protocols in place at the time of checklist implementation, therefore generalizability to other patient populations and/or institutions may not yield the same effects. Finally, all results were recorded via patient interview, including provider compliance measures, which means responses

Figure 2. Postoperative Prevention Provider Compliance Categories Pre- and Post-Checklist Implementation

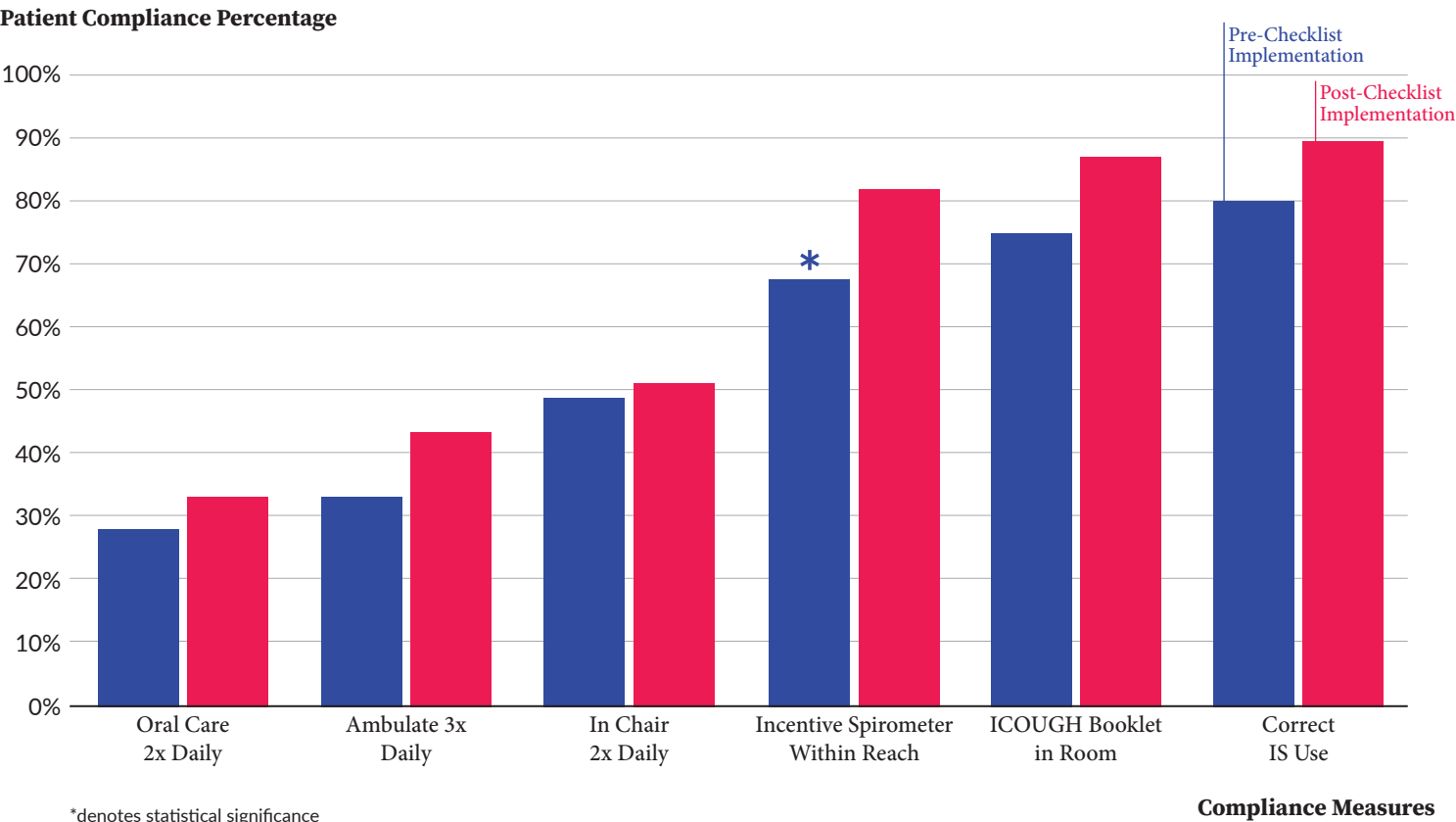
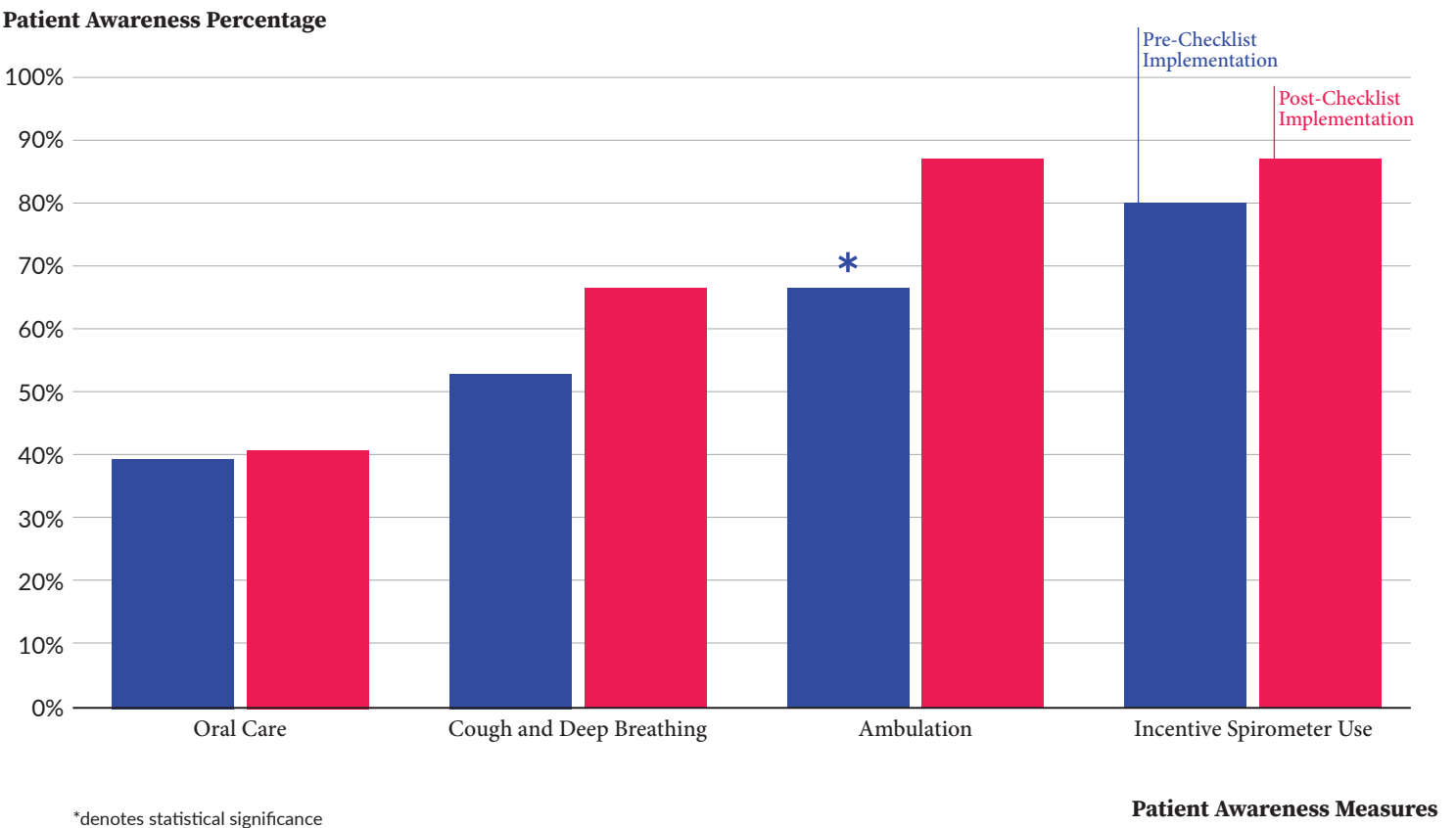


Figure 3. Postoperative Patient Awareness Categories Pre- and Post-Checklist Implementation



were biased by the patient's ability to remember performing certain initiatives or being told about the importance of them. While this is a true bias, patients are more likely to underreport these activities and data were compared between two similar cohorts to attempt to combat this recall bias.

Discussion

This study showed improvement in provider compliance and patient awareness of PoPNA prevention protocols in place at the institution following the implementation of a checklist in daily surgical progress notes by care providers. While our findings failed to reach *statistical* significance, we were able to reduce our cases from 46 to 31 (a reduction of 33%), which we believe is quite *clinically* significant given our intervention. This reduction also came at a time when elective cases were reduced due to the global pandemic, which is reflected in the lower case numbers in 2021 compared to 2020. Additionally, we outline a process which we hope others will duplicate to increase basic preventative practices important to the general surgery patient cohort, and we encourage others to use our template to elevate compliance with and awareness of quality and safety improvement initiatives after the initial success of a project rollout starts to decrease.

The efficacy and success of checklist implementation to increase patient safety has been validated and demonstrated in many settings, from childbirth in India to operative room safety in Scotland.^{6,7} However, there is debate amongst the experts on how causative these types of checklists are and whether before-and-after analyses can be trusted, as they are prone to confounding variables.⁸ Also, not all checklists are considered equal and key elements have been identified that help programs utilize them successfully. Specifically, good checklist implementation projects have effective engagement with providers and a variety of methods in how a specific intention is addressed within the checklist.⁹ The daily checklist used in this study required providers to actively participate in their completion and addressed multiple elements of the ICOUGH PoPNA prevention, which likely contributed to its success.

As mentioned earlier, another important consideration is the sustainability of quality and safety improvement initiatives. Only a few publications have reported on the long-term success of quality and safety improvement initiatives, with one systematic review reporting a median follow-up of only one year in most studies published.¹⁰ From what is published, there is evidence that many of these types of projects often lose compliance over the long term.^{11,12} This was the case with the initial rollout of the ICOUGH-modeled protocol in the institution included in this study, which showed low provider compliance and patient awareness levels in the pre-intervention data. Very little is known about what contributes to low sustainability over the long term.^{13,14} However, the intentional incorporation of long-term "checkpoints," such as checklists, during the development phase of an improvement project can be an effective and easy way to ensure long-term success. The hope is that the checklist utilized in this study can serve as one starting point for future initiatives to use in their design.

The rate of decrease observed in the year following the checklist, from 2.7% to 1.9%, was small, but substantial. We anticipate that as the checklist becomes incorporated into the daily progress

notes this rate will continue to decrease. Additionally, with implementation of this checklist in other service lines, both surgical and medical, this intervention has the potential to increase the number of patients who will be protected from PoPNA exponentially.

Finally, not all of the initiatives designed to be targeted by the checklist improved equally or statistically significantly in the study. One reason could be the low sample size. Another includes the fact that some of the categories had a reasonable level of compliance or awareness at baselines, so although improvements were present, they were not significant. Perhaps this represents a flaw in the design of the checklist used in this study, but nonetheless it provides valuable information on what elements of the original ICOUGH initiative have persisted and which need retargeting. An equally important consideration is that certain elements of the ICOUGH initiative are "resource-heavy," meaning they require multiple providers' time and effort, such as patient receiving/performing oral care at least twice daily, ambulating a minimum of 20 feet at least three times daily, and being out of bed and in a chair at least twice daily. These measures appear to be "less" improved by the checklist. In these instances, checklists alone may not be enough and programs may need to make alternative efforts to increase compliance with these elements. One strong example of this is the implementation of a medical student-driven, patient ambulation program which can lead to improvements in this category of the initiative.

Conclusion

This study showed the utility of incorporating checklists into daily progress notes to increase provider compliance and patient awareness of a previously established initiative, namely the ICOUGH postoperative pneumonia prevention protocol. Specifically, in institutions with prior protocols in place, the active participation required to complete these checklists in the daily notes, when checklists are constructed thoughtfully, can help enforce previous practices and create safer patient care environments.

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Supplementary Material

Figure S1. 2020 Semiannual Report (SAR) From the National Surgical Quality Improvement Project (NSQIP) With Postoperative Pneumonia Metrics Circled

ACS NSQIP Semiannual Report: Site Summary Over Time										
All Cases*										
	07/15-06/16	01/16-12/16	07/16-06/17	01/17-12/17	07/17-06/18	01/18-12/18	07/18-06/19	01/19-12/19	07/19-06/20	01/20-12/20
ALLCASES Mortality	1.19	1.35	1.39 H	1.23	0.95	0.84	0.92	0.84	0.94	0.97
ALLCASES Morbidity	1.10	1.05	1.08	1.12	1.11	1.06	1.14	1.14	1.12	1.33 H
ALLCASES Cardiac	0.57	0.61	0.68	0.74	0.83	0.94	0.81	0.64	0.64	0.74
ALLCASES Pneumonia	1.06	1.33	1.49 H	1.45 H	1.46 H	1.67 H	1.72 H	1.34	1.33	1.74 H
ALLCASES Unplanned Intubation	1.49 H	1.35	1.33	1.27	1.09	1.10	1.40	1.19	1.01	1.31
ALLCASES Ventilator > 48 Hours	1.93 H	1.91 H	1.77 H	1.30	1.00	1.12	1.51 H	1.37	1.48	1.47 H
ALLCASES VTE	1.50 H	1.46 H	1.30	1.45 H	1.50 H	1.33	1.10	1.12	1.06	0.91
ALLCASES Renal Failure	1.18	1.23	1.04	1.01	1.10	1.22	1.16	0.99	1.15	1.31
ALLCASES UTI	1.88 H	1.77 H	1.25	1.30	1.05	0.71	0.92	1.18	1.15	1.64 H
ALLCASES SSI	0.83	1.00	1.07	1.09	1.20	1.22	1.37 H	1.34 H	1.20	1.40 H
ALLCASES Sepsis	1.55 H	1.23	1.00	0.97	0.98	1.01	1.08	1.16	0.91	0.99
ALLCASES C.diff Colitis	0.76	1.19	1.23	1.00	0.89	0.94			0.83	1.16
ALLCASES ROR	0.71 L	0.73 L	0.86	0.78 L	0.72 L	0.98	1.05	1.01	1.14	1.14
ALLCASES Readmission	0.93	0.97	0.96	0.98	0.93	0.91	1.07	1.07	1.09	1.16
General/Vascular*										
	07/15-06/16	01/16-12/16	07/16-06/17	01/17-12/17	07/17-06/18	01/18-12/18	07/18-06/19	01/19-12/19	07/19-06/20	01/20-12/20
GV Mortality	1.21	1.37	1.46 H	1.25	0.95	0.86	0.95	0.87	0.97	1.01
GV Morbidity	1.15	1.12	1.16	1.18 H	1.16	1.12	1.20 H	1.20 H	1.21 H	1.50 H
GV Cardiac	0.57	0.62	0.70	0.77	0.83	0.93	0.82	0.65	0.65	0.75
GV Pneumonia	1.09	1.44 H	1.62 H	1.55 H	1.54 H	1.75 H	1.84 H	1.44 H	1.40	1.87 H
GV Unplanned Intubation	1.54 H	1.37	1.36	1.33	1.13	1.12	1.36	1.15	1.01	1.30
GV Ventilator > 48 Hours	1.92 H	1.89 H	1.83 H	1.34	1.01	1.13	1.45	1.33	1.53 H	1.55 H
GV VTE	1.40	1.30	1.25	1.41 H	1.54 H	1.44 H	1.17	1.14	1.12	0.94
GV Renal Failure	1.19	1.28	1.07	1.02	1.12	1.22	1.17	0.98	1.14	1.34
GV UTI	1.85 H	1.80 H	1.29	1.26	1.04	0.74	0.98	1.27	1.22	1.79 H
GV SSI	0.85	1.03	1.13	1.13	1.23	1.28 H	1.41 H	1.38 H	1.29 H	1.57 H
GV Sepsis	1.60 H	1.29	1.09	1.03	1.03	1.08	1.14	1.12	0.89	1.10
GV C.diff Colitis	0.77	1.19	1.24	0.98	0.83	0.96	0.98	1.04	1.04	1.22
GV ROR	0.70 L	0.76 L	0.92	0.80	0.72 L	1.05	1.14	1.05	1.20	1.21
GV Readmission	0.94	0.99	0.99	0.96	0.90	0.91	1.05	1.08	1.11	1.18 H
General*										
	07/15-06/16	01/16-12/16	07/16-06/17	01/17-12/17	07/17-06/18	01/18-12/18	07/18-06/19	01/19-12/19	07/19-06/20	01/20-12/20
GEN Mortality	1.02	1.22	1.40	1.20	0.96	0.86	0.91	0.79	0.84	0.87
GEN Morbidity	1.06	1.09	1.09	1.11	1.15	1.11	1.20 H	1.18	1.17	1.48 H
GEN Cardiac	0.60	0.74	0.89	0.82	0.77	0.86	0.80	0.63	0.61	0.70
GEN Pneumonia	0.98	1.21	1.38	1.44 H	1.52 H	1.69 H	1.69 H	1.36	1.36	1.74 H
GEN Unplanned Intubation	1.31	1.23	1.17	1.09	1.01	0.96	1.17	1.04	1.01	1.20
GEN Ventilator > 48 Hours	1.71 H	1.69 H	1.62 H	1.19	0.93	1.07	1.41	1.33	1.62 H	1.71 H
GEN VTE	1.30	1.28	1.17	1.25	1.21	1.07	1.04	1.00	0.91	0.86
GEN Renal Failure	1.11	1.27	1.13	1.04	1.10	1.09	1.10	0.97	1.02	1.48
GEN UTI	1.88 H	1.80 H	1.12	1.25	1.09	0.74	1.00	1.18	1.16	1.83 H
GEN SSI	0.86	1.00	1.09	1.13	1.24	1.25	1.42 H	1.37 H	1.29 H	1.57 H
GEN Sepsis	1.31	1.19	0.95	0.85	0.95	0.97	1.07	1.17	0.88	1.06
GEN C.diff Colitis	0.82	1.23	1.23	0.93	0.82	0.99	0.95	0.98	0.95	0.93
GEN ROR	0.60 L	0.65 L	0.79	0.69 L	0.58 L	0.72 L	0.81	0.78	0.98	1.09
GEN Readmission	0.96	1.01	0.95	0.91	0.88	0.84	0.99	1.02	1.01	1.10

Figure S2. REDCap Survey Tool Used to Measure Compliance and Awareness Metrics

Postoperative Pneumonia Compliance and Awareness Survey

Survey Details
Survey Date:
Observational Details
What is the patient's current location? ☐ Ambulating ☐ Chair ☐ In Bed - Head greater than 30deg ☐ In Bed - Head less than 30deg ☐ N/A - other, out of room , or activity restrictions
Is the incentive spirometer within reach? ☐ Yes ☐ No ☐ N/A
Is the ICOUGH booklet in the room? ☐ Yes ☐ No ☐ N/A
Patient Interview/Patient Booklet (if the patient is unable to complete an interview, please interview the current bedside nurse)
How many hours were you (the patient) out of bed to the chair in the past 24 hours? (Encourage the patient to make their best guess) ☐ 0 Hours ☐ 1-3 Hours ☐ 4-8 Hours ☐ 9-12 Hours ☐ 12+ Hours ☐ N/A or unable to answer
How many times did you (the patient) ambulate in the hall in the past 24 hours? ☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5+ ☐ N/A or patient has activity or weight bearing restrictions
How many times did you (the patient) brush your teeth or perform oral care in the past 24 hours? ☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4+ ☐ N/A
Patient Interview
As it relates to breathing complications, has someone explained to you the importance of (select all that apply): ☐ Incentive Spirometry ☐ Cough/Deep Breathing ☐ Oral Care ☐ Ambulation ☐ None of the above ☐ N/A or patient unable to complete interview
Show me how to use the IS. (Does patient demonstrate proper IS technique on first attempt?) ☐ Yes ☐ No ☐ N/A
Comments