HHS Public Access

Author manuscript

Am J Infect Control. Author manuscript; available in PMC 2022 November 08.

Published in final edited form as:

Am J Infect Control. 2021 November ; 49(11): 1423–1426. doi:10.1016/j.ajic.2021.05.002.

How infection present at time of surgery (PATOS) data impacts your surgical site infection (SSI) standardized infection ratios (SIR), with focus on the complex 30-day SSI SIR model

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Abstract

This case study is part of a series centered on the Centers for Disease Control and Prevention's National Healthcare Safety Network's (NHSN) health care-associated infection (HAI) surveillance definitions. This is the first analytic case study published in AJIC since the CDC/ NHSN updated its HAI risk adjustment models and rebaselined the standardized infection ratios (SIRs) in 2015. This case describes a scenario that Infection Preventionists (IPs) have encountered during their analysis of surgical site infection (SSI) surveillance data. The case study is intended to illustrate how specific models can impact the SIR results by highlighting differences in the criteria for NHSN's older and newer risk models: the original versions and the updated models introduced in 2015. Understanding these differences provides insight into how SSI SIR calculations differ between the older and newer NHSN baseline models. NHSN plans to produce another set of HAI risk adjustment models in the future, using newer HAI incidence and risk factor data. While the timetable for these changes remains to be determined, the statistical methods used to produce future models and SIR calculations will continue the precedents that NHSN has established.

An online survey link is provided where participants may confidentially answer questions related to the case study and receive immediate feedback in the form of correct answers, explanations, rationales, and summary of teaching points.

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Conflicts of interest: Marc-Oliver Wright: PDI, Inc; although a commercial entity serves as my employment, the aforementioned company has no relation to the content of this manuscript, did not financially support or influence in any way, is unrelated to the content and arguably unaware of its existence. All other authors: None to report.

Details of the case study, answers, and explanations have been reviewed and approved by NHSN staff. We hope that participants take advantage of this educational offering and thereby gain a greater understanding of the NHSN's HAI data analysis.

There are 2 baselines available for SSI standardized infection ration (SIRs) in the National Healthcare Safety Network (NHSN); one based on the 2006-2008 national aggregate data and another based on the 2015 data. Each of the 2 baselines has a different set of inclusion criteria for the SSI data, which impact the calculation of the SIR. In this case study, we focused on the impact of the inclusion of PATOS in the calculation of the 2006-2008 baseline SSI SIR and the exclusion of PATOS from the calculation of the 2015 baseline SSI SIR. In the 2006-2008 baseline SSI SIRs, PATOS events and the procedures to which they are linked are included in the calculation of the SSI SIR whereas in the 2015 baseline SSI SIRs, PATOS events and the procedures to which they are linked are excluded from the calculation of the SSI SIR. Meaning, if we control for all other inclusion criteria other than PATOS data for both baselines, we will notice differences in the number of observed events as well as the number of predicted infections for the 2 baselines. For details of the 2015 baseline and risk adjustment calculation, please review the NHSN Guide to the SIR referenced below. For details of the 2006-2008 baseline4 and risk adjustment, please see the SHEA paper "Improving Risk-Adjusted Measures of Surgical Site Infection for the National Healthcare Safety Network" by author Yi Mu.

Keywords

Baseline Set 1(BS-1); Baseline Set 2 (BS-2)

INTRODUCTION

This is the first analytic case study published in the American Journal of Infection Control (AJIC) since the Centers for Disease Control and Prevention/ National Healthcare Safety Network (NHSN) updated its health care-associated infection (HAI) risk adjustment models and rebaselined the standardized infection ratios (SIRs) in 2015. This case describes an analytic scenario that Infection Preventionists (IPs) have encountered during their analysis of surgical site infection (SSI) surveillance data. The case study is intended to illustrate how specific models can impact the SIR results by highlighting differences in the criteria for NHSN's older and newer risk models: the original versions and the updated models introduced in 2015. Understanding these differences provides insight into how SSI SIR calculations differ between the older and newer NHSN baseline models. NHSN plans to produce another set of HAI risk adjustment models in the future, using newer HAI incidence and risk factor data. While the timetable for these changes remains to be determined, the statistical methods used to produce future models and SIR calculations will continue the precedents that NHSN has established. For a description of how to use logistic regression to calculate the risk adjusted number of predicted SSIs, readers should consult the NHSN SIR Guide.[1] Objectives of AJIC case studies have been previously published for this case study series.[2]

With each case, a link to an online survey is provided, where you may answer the questions posed and receive immediate feedback in the form of answers and explanations. All

individual participant answers will remain confidential, although it is the authors' intention to share an aggregate of the findings later. Cases, answers, and explanations have been reviewed and approved by NHSN staff. We hope that you will take advantage of this offering, and we look forward to your active participation. The online survey may be found at: https://www.surveymonkey.com/r/PATOSSIR

We strongly recommend review/reference of the NHSN SIR Guide and the NHSN Patient Safety Component Manual[3], Procedure-associated Events Module for information that may be needed to answer the case study questions. The website links are:

https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/nhsn-sir-guide.pdf

https://www.cdc.gov/nhsn/pdfs/pscmanual/9pscssicurrent.pdf

The findings and conclusions in this case study are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

For each question, please select the most correct answer (or if appropriate, follow instructions related to ranking).

SCENARIO

Describing the case study facility (A), a fictitious facility created for educational purposes only

Facility A is actively enrolled in NHSN during the 2016 calendar year and reports colon (COLO) and abdominal hysterectomy (HYST) procedures and SSI events linked to these procedures. This facility is a non-oncology acute care hospital with 300 beds and is affiliated with a graduate teaching hospital. In 2016, facility A entered 264 in-plan, inpatient COLO and 196 in-plan, inpatient HYST procedures in adults aged 18 years and older into NHSN. Eleven of the 264 COLOs and 5 of the 196 HYSTs resulted in SSI events.

The facility is interested in viewing their SSI data using the Complex 30-day SSI SIR model/report used in CMS mandated reporting of COLO and HYST. The facility is aware of the 2 NHSN baselines for SSI data, one using 2006-2008 baseline data (BS-1)[4] and the other using 2015 baseline data (BS-2). Since the inclusion and exclusion criteria for each SSI baseline varies, the facility expects differences in their SIR reports. For ease of describing the impact of the SSI event detail *infection present at time of surgery (PATOS)*[3] on the SSI SIR in this scenario, none of the procedures were excluded due to the universal exclusion criteria, except procedures linked to PATOS SSI events. PATOS is a required data element for reporting SSIs. PATOS reflects documentation during the operative procedure, of infection at the same tissue level of a subsequent SSI event. The observation must be noted intraoperatively within the narrative portion of the operative note or report of surgery. The facility is particularly interested in the use of *PATOS SSI events and procedures in the 2 baselines.

In Table 1, we describe the SSI events that are linked to the 2016 COLO and HYST procedures. Table 2 describes the procedure risk for each of the 3 procedures that are linked

to PATOS SSIs based on the BS-1 risk adjustment calculations. The table also describes what the BS-2 procedure risks will be for the same procedures if they were linked to SSIs that were not PATOS. The purpose of showing these values is to provide a numeric value of the impact of the exclusion of PATOS events and linked procedures from the BS-2 SIR reports.

QUESTIONS (USING THE SCENARIO DESCRIBED ABOVE, PLEASE ANSWER QUESTIONS 1-5)

Question 1. Using the COLO data provided in Table 1, please determine which SSI events will be included in the BS-1 Complex 30-day SIR numerator

- **a.** Records 1, 4, 5, 6, 8, 9, 10 and 11.
- **b.** Records 2, 3, 7
- **c.** Records 1 through 11

Question 2. Using the COLO data provided in Table 1, please determine which SSI events will be included in the BS-2 Complex 30-day SIR numerator

- **a.** Records 1, 2,3,4,5,6,7,9
- **b.** Records 2, 3, 7
- **c.** Records 1 through 11

Question 3. Using the data provided in Table 1, how many COLO procedures linked to SSI events will be excluded from the BS-1 SIR report due to the resulting PATOS = YES events?

- **a.** None of the COLO procedures
- **b.** All the COLO procedures
- **c.** Records 1, 2,3,4,5,6,7

Question 4. How many COLO and HYST SSI events listed in Table 1 will be excluded from both baseline's Complex 30-day SSI SIR report due to the specific event type?

- **a.** Record numbers 12 and 13
- **b.** Record numbers 1,2,10,14 and 16
- **c.** Records 1,2 and 16

Question 5. According to Table 4, the predicted number of infections using the BS-2 risk adjustment calculation is 7.833. Would the BS-2 number of predicted infections remain the same if the PATOS SSIs were instead not PATOS? If Yes, what would be the BS-2 number of predicted infections? Hint: use Table 2.

- **a.** No, the number of predicted infections will be 7.773
- **b.** No, the number of predicted infections will be 7.958
- **c.** Yes, the number of predicted infections will be 7.833

References

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Table 1

Line listing of SSI events resulting from in-plan, inpatient COLO and HYST procedures, facility A, 2016

Record number	Procedure category	Procedure date	Age at time of procedure	Specific type of SSI event	Gender	Closure	SSI detection method	PATOS
1	COLO	4/27/2016	37	DIP	F	PRI	A	N
2	COLO	5/23/2016	56	DIP	M	PRI	RO	N
3	COLO	5/9/2016	49	IAB	M	PRI	RO	N
4	COLO	5/14/2016	41	IAB	M	PRI	RF	N
5	COLO	1/19/2016	49	OREP	M	PRI	RF	N
6	COLO	1/28/2016	55	IAB	F	PRI	A	N
7	COLO	2/12/2016	53	OREP	M	PRI	RO	N
8	COLO	2/14/2016	39	GIT	F	PRI	A	Y
9	COLO	2/27/2016	49	OREP	M	PRI	RF	N
10	COLO	1/7/2016	41	DIP	F	PRI	A	Y
11	COLO	2/9/2016	40	GIT	F	PRI	A	Y
12	HYST	2/13/2016	21	SIP	F	PRI	RO	N
13	HYST	2/16/2016	20	SIP	F	PRI	RO	N
14	HYST	2/27/2016	17	DIP	F	PRI	RO	N
15	HYST	1/3/2016	39	OREP	F	PRI	P	N
16	HYST	1/15/2016	33	DIP	F	PRI	RF	N

NOTE. All SSI events are linked to procedures. Days between procedure and SSI event for all of the above SSI events were under 30 days. Deep incisional primary (DIP), secondary incisional primary (SIP), intraabdominal infection (IAB), GI tract infection (GIT). An SSI detected during a current admission (A) or during a follow-up admission (RF) to the hospital at which the procedure was performed. SSI detected during a follow-up admission to a different hospital other than the hospital at which the procedure was performed (RO). SSI detected through post-discharge surveillance efforts (P).

*Inclusion and exclusion criteria for PATOS events and associated procedures vary by NHSN baseline and therefore impact each baseline SSI SIR differently; this will be demonstrated throughout the case study. A brief summary of the 2 NHSN SSI baselines is provided in the abstract.

Table 2

Procedure risk (BS-1 and BS-2 model risks) for PATOS records, complex 30-day SSI SIR model

Record number	BS-1 model risk for patient	BS-2 model risk for patient (If PATOS = No)
8	0.0302	0.0370
10	0.0305	0.0501
11	0.0309	0.0380
Sum of procedure risks adding to Number of Predicted Infections	0.0916	0.1251

Tables 3 and 4 display the Complex 30-day SIR reported based on the BS-I and BS-2 risk adjusted models.

Table 3

National Healthcare Safety Network. SIR for complex 30-Day SSI data for complex 30-day SSI SIR by procedure (2006-2008 baseline), facility A

Procedure code	Year	Procedure count	Infection count—complex 30-day	Number of expected infections Complex 30-day	SIR-complex 30-day	*P* value for the complex 30-day SIR	95% CI for the complex 30-day SIR
COLO	2016	264	11	8.756	1.256	.4395	0.661, 2.184
HYST	2016	196	3	2.517	1.192	.7066	0.303, 3.244

Table 4

National Healthcare Safety Network. SIR for complex 30-day SSI data for hospital IQR by procedure (2015 baseline), facility A

Procedure code	Year	Procedure count	Infection count—complex 30-day	Number of predicted infections Complex 30-day	SIR-complex 30-day	*P* value for the complex 30-day SIR	95% CI for the complex 30-day SIR
COLO	2016	261	8	7.833	1.021	.9077	0.474, 1.939
HYST	2016	196	3	1.969	1.524	.4523	0.388, 4.147