

AHRQ National Scorecard on Hospital-Acquired Conditions Updated Baseline Rates and Preliminary Results 2014–2016

Summary

New patient safety data for 2014 through 2016 continue to show a downward trend previously reported for 2010 to 2014. As reported in 2016, from 2010 through 2014, the rate of hospital-acquired conditions (HACs) decreased 17 percent. New data for 2014 to 2016 show an 8 percent decrease.

For the new trend beginning in 2014, methods were updated and a larger portion of hospital inpatients were included in the calculations, the rate started at 98 HACs per 1,000 hospital discharges in 2014 and ended at 90 HACs per 1,000 discharges. In the method previously used, the 2010 rate was calculated as 145 HACs per 1,000 discharges and the 2014 rate was 121 HACs per 1,000 discharges. Both methods use the same 28 measures of patient safety events, including many types of hospital-acquired infections, adverse drug events, and injuries due to procedures, as well as pressure ulcers and falls.

The newly established baseline of 98 HACs per 1,000 discharges in 2014 equates to approximately 2,920,000 HACs among all hospital inpatients 18 years old and over. The preliminary rate for 2016 equates to approximately 2,690,000 HACs. The 2016 data are preliminary because the final data for the number of hospital patients discharged in 2016 are not yet available. In addition, 7 of the 28 measures that depend on related data are not yet available for 2016; these 7 measures are responsible for slightly less than 10 percent of the annual HACs measured.

Based on the HAC reductions seen in 2015 and 2016 compared with 2014, AHRQ estimates a total of 350,000 fewer HACs. These HAC reductions lead to projections that about \$2.9 billion in costs were saved, and about 8,000 inpatient deaths were averted. Data reported in late 2016 estimated that from 2010 through 2014, HAC reductions totaled 2.1 million, and these reductions resulted in approximately \$19.9 billion in cost savings and 87,000 fewer HAC-related inpatient deaths.¹

In the data for 2014, 2015, and 2016, not all types of HACs showed similar trends. For example, measured adverse drug events continued to drop from 2014 to 2016, while measured pressure ulcers increased from 2014 to 2016. Preliminary data for 2017 are expected within the next year to see if these and other trends have continued or changed.

The new baseline of 98 HACs per 1,000 discharges was established and calculated for 2014 to monitor the progress of the Department of Health and Human Services (HHS) goal to reduce HACs by 20 percent from 2014 to 2019. This goal is specifically tied to the Centers for Medicare & Medicaid Services' Hospital Improvement Innovation Networks, which work collaboratively with Federal and private partners toward achieving this bold aim and building on prior successes.¹

¹ See the AHRQ HAC report at <https://www.ahrq.gov/professionals/quality-patient-safety/pfp/2014-final.html>.

AHRQ estimates that if the 20 percent HAC reduction goal were achieved, the HAC rate in 2019 would equate to 78 per 1,000 discharges. That means approximately 1.8 million fewer HACs would occur compared with the number that would have occurred if HAC rates for 2015 through 2019 had stayed the same as in 2014. AHRQ projects that these 1.8 million fewer HACs would be associated with \$19.1 billion in cost savings and 53,000 fewer deaths in the 5 years from 2015 through 2019. In 2017, AHRQ released a new study on the costs and inpatient mortality due to HACs.²

Detailed Results

The new 2014 baseline for the national HAC rate (NHR) is 98 HACs per 1,000 discharges in 2014. The details (rounded) are shown in Exhibit 1. *Clostridium difficile* Infections is shown in italics because it has been added as a new “focus” HAC for reduction efforts and tracking for 2014 through 2019. *Clostridium difficile* infections were previously tracked in the “All Other HACs” measure, which is a collection of 13 other types of HACs. Methods used to calculate the NHR are provided in Appendix 1, and all the measures used in the NHR are shown in Appendix 2, Exhibit A2c.

Exhibit 1. New 2014 national HAC rate baseline

Hospital-Acquired Condition	2014 Measured Baseline for HACs	2014 Total HACs per 1,000 Discharges
Adverse Drug Events	994,000	33.4
Catheter-Associated Urinary Tract Infections	169,000	5.7
Central Line-Associated Bloodstream Infections	9,000	0.3
<i>Clostridium difficile</i> Infections	86,000	2.9
Falls	239,000	8.0
Obstetric Adverse Events	67,000	2.3
Pressure Ulcers	643,000	21.6
Surgical Site Infections	73,000	2.5
Ventilator-Associated Pneumonias	36,000	1.2
(Post-op) Venous Thromboembolisms	25,000	0.9
All Other HACs	579,000	19
Total	2,920,000	98

The new baseline established with the 2014 data was developed using a new method based on the method previously used to calculate the 2010-2014 NHR.³ The major difference between the new method and the previous method is that the new method includes patient charts for most conditions treated in acute care hospitals. Previously, the Medicare Patient Safety Monitoring System (MPSMS) used patient charts from only four conditions (acute myocardial infarction [AMI], congestive heart failure [CHF], pneumonia [PN], and Surgical Care Improvement Project

² This report is available at <https://www.ahrq.gov/sites/default/files/publications2/files/hac-cost-report2017.pdf>.

³ See the report at <https://www.ahrq.gov/sites/default/files/wysiwyg/professionals/quality-patient-safety/pfp/pfphac.pdf>.

[SCIP]) to calculate the 2010-2014 NHR. On the new method for 2014 through 2019, charts for conditions other than AMI, CHF, PN, and SCIP were sampled as a single group, producing five sets of charts. The use of these five sets of charts also eliminated the need to use 2005-2006 Medicare adverse event data in calculating the new NHR.

The 2015 rate is 94 HACs per 1,000 discharges and the preliminary 2016 rate is 90 HACs per 1,000 discharges (Exhibit 2). Also shown is the goal for 2019, 78 HACs per 1,000 discharges, which is a 20 percent reduction from the 2014 baseline NHR of 98. Detailed information on the number of HACs in 2015 and 2016 (preliminary) is shown in Appendix 2, Exhibit A2c.

Appendix 2 also shows how the current NHR, which starts in 2014 and will be trended at least through 2019, compares with the NHR trended for 2010 to 2014. The 2010 to 2014 reduction was 17 percent over 4 years, and the 2014 to 2019 goal is a 20 percent reduction over 5 years. Appendix 3 shows the details of the HAC reductions, cost savings, and inpatient mortality reductions that are projected based on meeting this goal, which total 1.8 million HACs, \$19.1 billion, and 53,000 lives. Appendix 4 describes changes in the samples used for the 2014–2016 analyses, compared with the 2010–2014 analyses.

Exhibit 2. Re-baselined 2014 data, with 2015 and preliminary 2016 national HAC rate data, and 2019 HAC goal

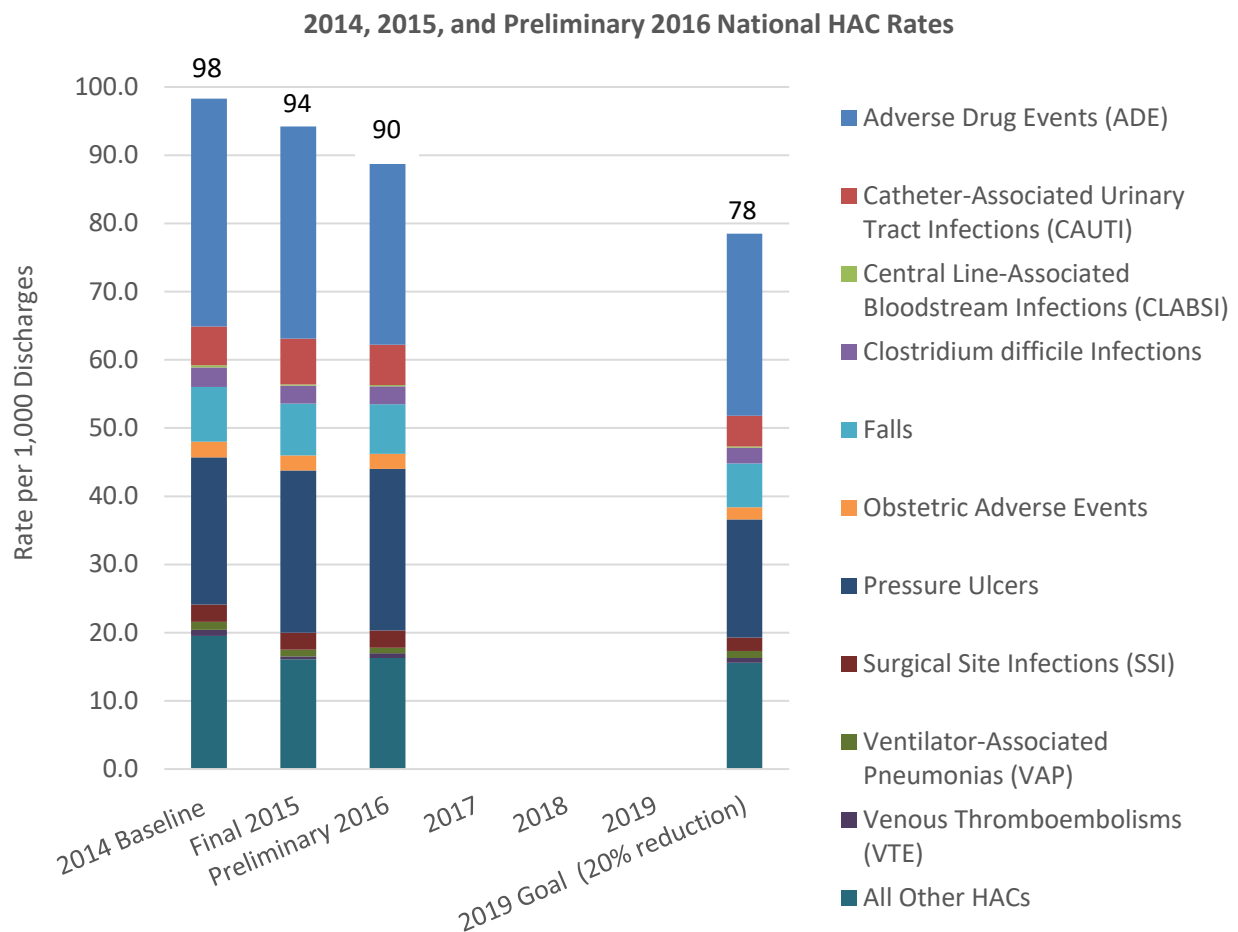
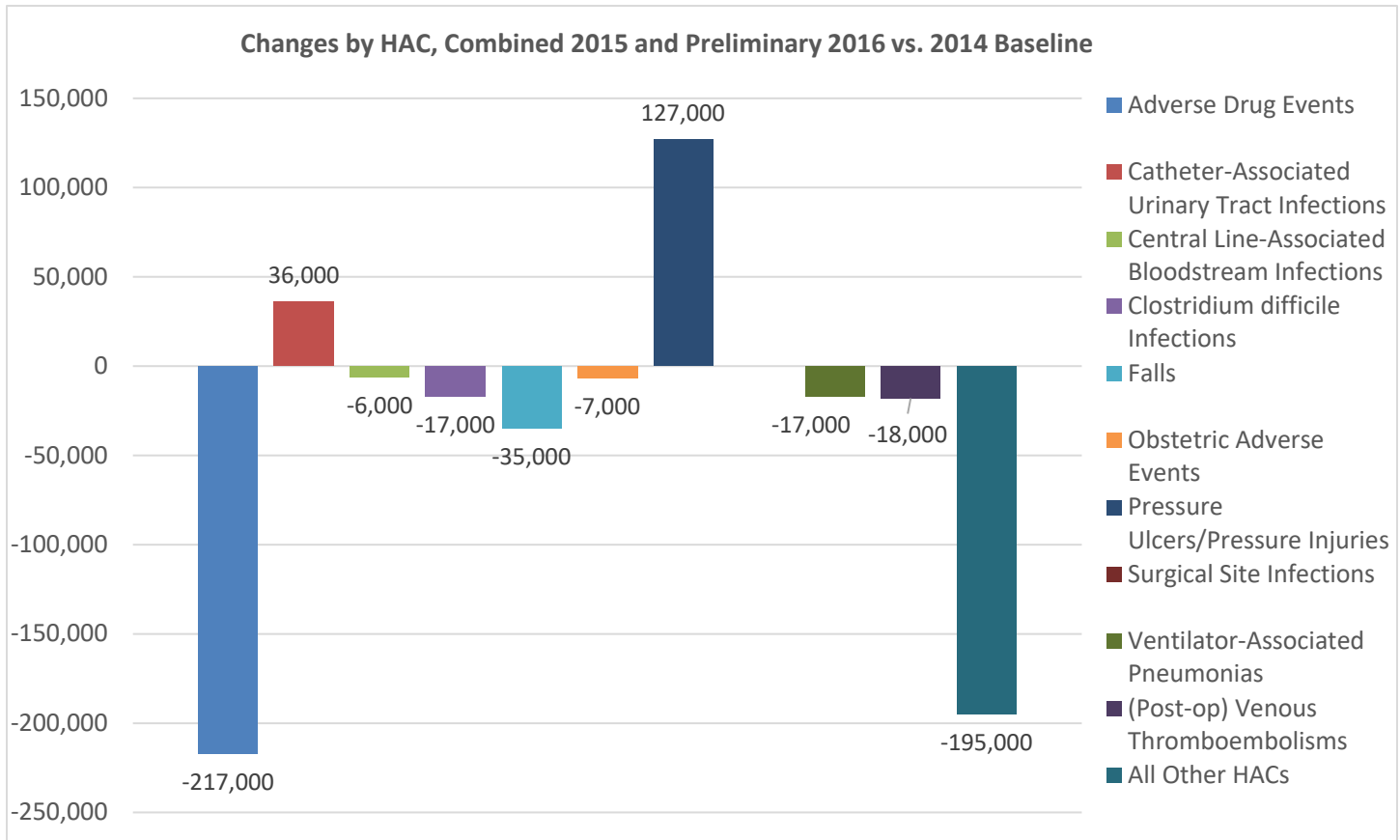


Exhibit 3 provides more detailed data on the combined results to date, based on 2015 data and preliminary data for 2016, compared with the 2014 baseline. While most HACs have decreased, two have increased, and the overall reduction for 2015 and preliminary 2016 is about 350,000 (rounded) fewer HACs than if all measured HAC rates in 2014 had remained the same in 2015 and 2016.

Exhibit 3. Changes in HACs, 2015 and preliminary 2016 data combined



Note: The number of surgical site infections increased slightly and is too small to show on the chart.

With the HAC reductions described above, and based on new per-HAC cost and mortality estimates updated in 2017 (see Appendix 5), we project that over 2015 and 2016, there were approximately \$2.9 billion in cost savings and 8,000 fewer deaths associated with HACs. These projections are tabulated in Exhibit 4.

Appendix 5 shows the summary cost and mortality associated with each of the 10 focus HAC types, and the full report from which this table is excerpted is available on the AHRQ website.⁴ The cost and mortality for “all other HACs” was not estimated in the 2017 report and was estimated based on a weighted average of the 10 focus HACs, with the weighting based on the proportion of each of the 10 focus HACs in the 2014 baseline data.

⁴ The full report is at <https://www.ahrq.gov/sites/default/files/wysiwyg/professionals/quality-patient-safety/pfp/hac-cost-report2017.pdf>.

Exhibit 4. Projected cost savings and deaths averted due to HAC changes to date in 2015 and 2016

	2015 Change From 2014 Baseline Costs	2016 Change From 2014 Baseline Costs	2015 Change From 2014 Baseline Deaths	2016 Change From 2014 Baseline Deaths
Adverse Drug Events	-\$388,700,000	-\$855,900,000	-800	-1,800
Catheter-Associated Urinary Tract Infections	\$419,140,000	\$82,800,000	1,100	200
Central Line-Associated Bloodstream Infections	-\$143,480,000	-\$128,210,000	-400	-400
C difficile Infection (CDI)	-\$133,200,000	-\$162,430,000	-300	-400
Falls	-\$95,540,000	-\$137,670,000	-700	-1,000
Obstetric Adverse Events	-\$2,050,000	-\$2,050,000	0	0
Pressure Ulcers	\$943,920,000	\$894,680,000	2,700	2,500
Surgical Site Infections	\$1,530,000	\$1,530,000	0	0
Ventilator-Associated Pneumonias	-\$260,050,000	-\$538,260,000	-800	-1,600
Venous Thromboembolisms	-\$227,470,000	-\$92,110,000	-600	-200
All Other HACs (not including CDI)	-\$1,078,320,000	-\$1,015,990,000	-3,000	-2,800
Total Annual Change of HAC-related Costs and Deaths	-\$964,210,000	-\$1,953,600,000	-2,900	-5,500
Change Compared to 2014 Baseline	-\$964,210,000	-\$2,917,810,000	-2,900	-8,400

Detailed Goals for 2019

Achieving the goal of a 20 percent reduction in HACs (going from 98 to 78 HACs per 1,000 discharges; see Exhibit 5) would result in 1.78 million fewer HACs in the years from 2015 to 2019.

Exhibit 5. Projected goals for 2019 based on 2014 HAC rate baseline

HAC	2014 Baseline	2019 Goal (20% Reduction)
Adverse Drug Events (ADEs)	33.4	26.7
Catheter-Associated Urinary Tract Infections (CAUTIs)	5.7	4.5
Central Line-Associated Bloodstream Infections (CLABSIs)	0.3	0.2
<i>Clostridium difficile</i> Infections	2.9	2.3
Falls	8.0	6.4
Obstetric Adverse Events	2.3	1.8
Pressure Ulcers	21.6	17.3
Surgical Site Infections (SSIs)	2.5	2.0
Ventilator-Associated Pneumonias (VAPs)	1.2	1.0
Venous Thromboembolisms (VTEs)	0.9	0.7
All Other HACs	19.5	15.6
Total	98	78

With constant annual reductions toward a 20 percent reduction across all measured HACs, and based on the new per-HAC estimates for costs and mortality from the 2017 study funded by AHRQ (see Appendix 5), our projections indicate that there would be \$19.1 billion in cost savings for the 5 years and 53,000 HAC-related deaths averted. These data are tabulated in Appendix 3. Data reported in late 2016 estimated that for the 4 years from 2011 through 2014, HAC reductions totaled 2.1 million compared with 2010 baseline data, and these reductions resulted in approximately \$19.9 billion in cost savings and 87,000 fewer HAC-related inpatient deaths during this period.⁵

Looking Ahead

AHRQ and other HHS agencies recognize that improving the safety and quality of healthcare is the ultimate purpose of measurement systems, and the ability to support this improvement effectively and efficiently is a desirable characteristic of these systems. AHRQ and CMS are using the MPSMS as the primary system to measure the NHR, but AHRQ has been working with Federal partners, contractors, and other experts to develop the Quality and Safety Review System (QSRS), an improved system to succeed MPSMS.

The QSRS has been developed and is undergoing use in the Clinical Data Abstraction Center (CDAC), pilot testing at non-Federal settings, and refinement pursuant to the goal of supporting safe, high-quality care. QSRS has been designed to serve as a robust measurement platform that will serve the shared needs of different healthcare stakeholders. QSRS is designed to provide up-to-date national HAC rates, including rates of some additional types of HACs not currently measured with MPSMS, the AHRQ Patient Safety Indicators (PSIs), the Centers for Disease Control and Prevention National Healthcare Safety Network (NHSN), or other sources of information concerning patient safety in hospitals. It has been developed so that non-Federal entities, including hospitals and healthcare systems, will be able use it to measure patient safety.

⁵ See report at <https://www.ahrq.gov/professionals/quality-patient-safety/pfp/2014-final.html>.

QSRS will allow assessment of safety for new patient populations not currently captured by MPSMS, which was originally designed to focus on adverse events experienced by Medicare patients, and will allow organizations to consider aligning their local patient safety measurements with the same methods and measures used at the national level. Standard methods for measurement, such as those in QSRS, have been a valuable component of other healthcare improvement initiatives, including some that have addressed more specific safety challenges. The AHRQ Common Formats for Surveillance⁶ serve as the underlying content that provides the foundation of QSRS measures and cover a broad range of common and uncommon threats to patient safety.

Development and revision of the Common Formats for Surveillance and QSRS are ongoing processes that include structured review and public feedback facilitated by the National Quality Forum. After release of QSRS, AHRQ will rely on feedback, especially from users, to inform the development of new versions of the Common Formats for Surveillance and for QSRS. This process will enable the Common Formats and QSRS to keep pace with users' needs and the emerging scientific evidence base for patient safety and quality improvement.

Some data needed for patient safety measurement may be increasingly available from electronic health records. AHRQ has explored the feasibility of automated approaches to data abstraction in order to further improve efficiency and reduce burden while maintaining the validity of QSRS and enhancing its ease of use. These include the AHRQ Common Formats for Surveillance,⁶ a subset of the AHRQ Common Formats.⁷

⁶ More information is available at https://www.psoppc.org/psoppc_web/publicpages/surveillancecommonformats.

⁷ More information is available at www.pso.ahrq.gov/common/development.

Appendixes

Appendix 1. New Method To Estimate the Baseline 2014 National Hospital-Acquired Condition Rate

This document describes the methods AHRQ has developed to estimate the national rate of hospital-acquired conditions (HACs) for 2014 to 2019, which has as its goal a 20 percent reduction in HACs during this time. The estimate includes a wide variety of adverse events, including the 10 HACs selected for special focus by CMS as part of the programs to achieve the 20 percent reduction, as well as several other HACs. Collectively, 28 specific measures are used (Exhibit A1a): 15 measures to generate rates for the 10 specific focus HACs and 13 measures to generate a summary rate for “all other” HACs. Of the 28 measures, 21 are from the MPSMS, 6 are from the PSIs, and 1 is based on NHSN data.

Exhibit A1a. Measures used to estimate the national HAC rate

HAC Type	Source	Measure
Adverse Drug Event	MPSMS	ADE Associated With Digoxin
	MPSMS	ADE Associated With Hypoglycemic Agents
	MPSMS	ADE Associated With IV Heparin
	MPSMS	ADE Associated With LMWH and Factor Xa Inhibitor
	MPSMS	ADE Associated With Warfarin
CAUTI	MPSMS	Catheter-Associated Urinary Tract Infections
CDI	MPSMS	<i>Clostridium difficile</i> Infections
CLABSI	MPSMS	Blood Stream Infections Associated With Central Venous Catheters
Falls	MPSMS	In-Hospital Patient Falls
Obstetric Adverse Events	PSI	OB Trauma in Vaginal Delivery With (PSI 18) and Without Instrument (PSI 19)
Pressure Ulcer	MPSMS	Hospital-Acquired Pressure Ulcers
Surgical Site Infection	NHSN	SSIs for 17 procedures w/CDC SCIP+5 data
VAP	MPSMS	Ventilator-Associated Pneumonia
VTE	MPSMS	Postoperative Venous Thromboembolic Events
All Other Hospital-Acquired Conditions	MPSMS	Femoral Artery Puncture for Catheter Angiographic Procedures
	MPSMS	Adverse Event Associated With Hip Joint Replacements
	MPSMS	Adverse Event Associated With Knee Joint Replacements
	MPSMS	Contrast Nephropathy Associated With Catheter Angiography
	MPSMS	Hospital-Acquired MRSA
	MPSMS	Hospital-Acquired Vancomycin-Resistant <i>Enterococcus</i> (VRE)
	MPSMS	Mechanical Complications Associated With Central Venous Catheters
	MPSMS	Postoperative Cardiac Events for Cardiac and Noncardiac Surgeries
	MPSMS	Postoperative Pneumonia
	PSI	Iatrogenic Pneumothorax (PSI 6)
	PSI	Post-Op Hemorrhage or Hematoma (PSI 9)
	PSI	Post-Op Respiratory Failure (PSI 11)
	PSI	Accidental Puncture or Laceration (PSI 15)

Data from these 28 measures are combined to generate a summary national HAC rate that has been calculated annually since 2010.⁸ The current method is built on the 2010-2014 methods but includes some changes. The current method removes the use of reference data from 2005-2006 and includes a fifth set or sample of charts to augment the four samples used in the 2010-2014 method.

In the 2010-2014 method, *Clostridium difficile* Infection data were included in “All Other HACs” rather than as a focus HAC, which is the case with the new method. As before, the new method uses data from the AHRQ Healthcare Cost and Utilization Project (HCUP) on the annual number of hospital inpatient discharges as the denominator for the rate calculations. The details of how the current NHR is calculated are summarized below.

1. The NHR is calculated using the following variables:
 - a. **Rate of 21 MPSMS adverse events** in the MPSMS sample provided by CMS, including those in the Surgical Care Improvement Project (SCIP) (major surgery) sample, those with a principal diagnosis of acute myocardial infarction (AMI), congestive heart failure (CHF), or pneumonia, and a “global” sample intended to complement these four groups of patients. The sample is limited to patients 18 years old and over.

For the NHR calculation, the rates of the 21 MPSMS adverse events are expressed as a rate for the whole sample population, rather than as a rate for the subpopulation that has the opportunity to experience the adverse event. For example, the CLABSI rate, like all rates in the sample, uses all patients in the denominator, not just the patients who had a central line inserted during their hospital stay.

For each of the 21 MPSMS HACs, the estimate is a weighted average of the HAC rate for each group, where each group is given a weight that approximates the fraction of patients the group represents in the hospital discharge population age 18 and over. This approach ensures that the estimated rate will not be affected by variation across years in the percentage of patients in the samples of charts representing each of the five groups (SCIP, AMI, CHF, pneumonia, and global). It also uses the data from each sample in a way that best represents the conditions treated in the actual hospital inpatient population.

The weights follow, based on their percentage of the inpatient population:

- AMI: 1.95%,
- CHF: 3.10%,
- Pneumonia: 4.19%,
- SCIP plus 5 other major surgeries: 19.20%,
- Global: 71.56%.

⁸ Information on the method used from 2010 to 2014 is available at <https://www.ahrq.gov/professionals/quality-patient-safety/pfp/methods.html>.

- These AMI, CHF, and pneumonia patient data percentages were based on data from 2012-2013 from the AHRQ National Inpatient Sample. The percentage of SCIP+5 patients was calculated based on the number of surgeries in the SCIP+5 sample from CDC, which was 5,704,493 among 29,751,955 discharges in 2014. The weighting for the global sample was 100 percent minus the contribution from the other four samples.
- b. **National number of adverse events captured by PSIs 18 and 19 on obstetric injury** and national number of four other PSIs (6, 9, 11, and 15) included among “all other” HACs.⁹
 - c. **National number of selected surgical site infections computed in a special calculation for CDC.** This calculation is based on NHSN data for 17 specific operations: the 12 SCIP operations and 5 other major surgical procedures not included in the SCIP.¹⁰
 - d. To estimate the rate of adverse events for each of the 21 HACs for all patients for which the MPSMS data are used, we follow these steps:
 - Multiply the adverse event rate for each of the 21 HACs for patients with one of the five conditions included in the 2014–2016 MPSMS samples by the number of hospital inpatients represented by the sample, as calculated by the weight of each sample and the overall total annual national discharges listed above.
 - Sum the estimates for each of the five samples for each measure to produce an estimate for each of the 21 measures.
2. The estimated **total count of annual HACs** in the national HAC rate is calculated as the sum of the total number of HACs for the 21 MPSMS HACs in (d) above, plus the estimated number of PSI HACs in (b), plus the number of NHSN-estimated HACs in (c).
 3. The **national HAC rate** is the total HAC count in (2) above divided by the number of annual hospital inpatient discharges of patients at least 18 years old, as provided by HCUP. Exhibit A1b provides a summary of the data that shows how the 28 rates from all the measures are combined into the NHR for 2014.
 4. As of April 2018, this method established for 2014 has been repeated for 2015 and for 2016 using preliminary data for the number of annual hospital discharges. We aim to compare the estimated total number of HACs in 2015 and 2016 with 2014 without having the comparison affected by changes in the total number of discharges. Thus, for 2015 and 2016, we normalized the 2015 and preliminary 2016 data to generate national counts based on 29,751,955 discharges, which was the total number of discharges in 2014 for inpatients 18 years old and over. This method will be used again to finalize estimates for 2016 and to establish new estimates for 2017, 2018, and 2019 as the data become available.

⁹ Due to the transition from International Classification of Diseases, 9th Revision (ICD-9) to ICD-10 that occurred with the start of the fourth quarter of 2015 and the effect of this change on the PSI data, only data from the first three quarters of 2015 were used to calculate the number of PSI events for 2015. The number of PSI events for January through September 2015 was multiplied by 4/3 to estimate the number of events (HACs) for the full year of 2015.

¹⁰ Due to the ICD-9 to ICD-10 transition that occurred with the start of the fourth quarter of 2015, only data from the first three quarters of 2015 were used to calculate the number of CDC NHSN SSI events for 2015. The CDC estimate provided for 2015 was based on 12 months of data, from October 2014 through September 2015.

Exhibit A1b. Final 2014 HAC data (finalized May 2018)

HAC Type	Source	Measure	Total 2014 HACs	Total 2014 HAC Rate per 1,000 Discharges
Adverse Drug Event	MPSMS	ADE Associated With Digoxin	6,164	0.21
	MPSMS	ADE Associated With Hypoglycemic Agents	513,932	17.27
	MPSMS	ADE Associated With IV Heparin	139,848	4.70
	MPSMS	ADE Associated With LMWH and Factor Xa Inhibitor	246,292	8.28
	MPSMS	ADE Associated With Warfarin	88,120	2.96
	MPSMS	Total ADE (sum of 5 above)	994,355	33.42
CAUTI	MPSMS	Catheter-Associated Urinary Tract Infections	169,028	5.68
CDI	MPSMS	<i>Clostridium difficile</i> Infections	85,558	2.88
CLABSI	MPSMS	Blood Stream Infections Associated With Central Venous Catheters	8,513	0.29
Falls	MPSMS	In-Hospital Patient Falls	238,965	8.03
Obstetric Adverse Events	PSI	OB Trauma in Vaginal Delivery With (PSI 18) and Without Instrument (PSI 19)	67,482	2.27
Pressure Ulcer	MPSMS	Hospital-Acquired Pressure Ulcers	643,230	21.62
Surgical Site Infection	NHSN	SSIs for 17 procedures w/CDC SCIP+5 data	73,158	2.46
VAP	MPSMS	Ventilator-Associated Pneumonia	35,588	1.20
VTE	MPSMS	Postoperative Venous Thromboembolic Events	25,407	0.85
All Other Hospital-Acquired Conditions	MPSMS	Femoral Artery Puncture for Catheter Angiographic Procedures	21,538	0.72
	MPSMS	Adverse Event Associated With Hip Joint Replacements	48,993	1.65
	MPSMS	Adverse Event Associated With Knee Joint Replacements	41,696	1.40
	MPSMS	Contrast Nephropathy Associated with Catheter Angiography	124,550	4.19
	MPSMS	Hospital-Acquired MRSA	19,526	0.66
	MPSMS	Hospital-Acquired Vancomycin-Resistant <i>Enterococcus</i> (VRE)	15,507	0.52
	MPSMS	Mechanical Complications Associated With Central Venous Catheters	58,876	1.98
	MPSMS	Postoperative Cardiac Events for Cardiac and Noncardiac Surgeries	32,592	1.10
	MPSMS	Postoperative Pneumonia	88,015	2.96
	PSI	Iatrogenic Pneumothorax (PSI 6)	10,674	0.36
	PSI	Post-Op Hemorrhage or Hematoma (PSI 9)	17,670	0.59
	PSI	Post-Op Respiratory Failure (PSI 11)	48,087	1.62
	PSI	Accidental Puncture or Laceration (PSI 15)	51,249	1.72
MPSMS & PSI	Total All Other HACs (sum of 13 above)	578,972	19.46	
		Total MPSMS-Based Measured HACs	2,651,937	89.1
		Total PSI-Based Measured HACs	195,162	6.6
		Total NHSN-Based Measured HACs	73,158	2.5
		Total HACs	2,920,257	98.2

Appendix 2. 2014–2016 NHR Data Tabulated (HACs and HAC Rate) and Compared With Summary 2010–2014 Data

Information on the HACs for 2014, 2015, and 2016 is provided below. Exhibit A2a shows the calculated number of HACs, and Exhibit A2b shows the calculated HAC rates, in terms of HACs per 1,000 discharges. Exhibit A2c shows all the measures, including those used in the calculation of “All Other HACs.”

These data have been normalized to account for the changes in annual discharges, i.e., the number of HACs shown in 2015 is based on the number of HACs that would have occurred if the number of hospital discharges in 2015 (30,167,977) was unchanged from that in 2014 (29,751,955). The 2016 data shown are also normalized to 2014, but with 2015 data being used because 2016 hospital discharge data are not yet available. Hospital discharge data are from the Healthcare Cost and Utilization Project (HCUP), and the exact numbers are based on a special analysis performed for this study to limit hospital discharges to those 18 years old and over. Data for the six Patient Safety Indicators and the Surgical Site Infection data from CDC are also wholly or partially based on HCUP data, and because 2016 data are not currently available, 2015 data are used in the preliminary estimates for 2016.

Exhibit A2a. HAC count estimates (rounded)

Hospital-Acquired Condition	2014 Measured Baseline for HACs	2015 Normalized Count of HACs	Preliminary 2016 Normalized Count of HACs	Change in HACs, 2014 vs. 2015	Percent Change (Reduction) in HACs, 2014 vs 2015	Change in HACs, 2014 vs. Preliminary 2016	Percent Change (Reduction) in HACs, 2014 vs Preliminary 2016
Adverse Drug Events	994,000	927,000	845,000	-68,000	-7%	-149,000	-15%
Catheter-Associated Urinary Tract Infections	169,000	199,000	175,000	30,000	18%	6,000	4%
Central Line-Associated Bloodstream Infections	9,000	6,000	6,000	-3,000	-35%	-3,000	-31%
<i>Clostridium difficile</i> Infections	86,000	78,000	76,000	-8,000	-9%	-9,000	-11%
Falls	239,000	225,000	218,000	-14,000	-6%	-21,000	-9%
Obstetric Adverse Events	67,000	64,000	64,000	-3,000	-5%	-3,000	-5%
Pressure Ulcers	643,000	708,000	705,000	65,000	10%	62,000	10%
Surgical Site Infections	73,000	73,000	73,000	0	0%	0	0%
Ventilator-Associated Pneumonias	36,000	30,000	24,000	-6,000	-15%	-11,000	-32%
(Post-Op) Venous Thromboembolisms	25,000	12,000	20,000	-13,000	-52%	-5,000	-21%
All Other HACs	579,000	478,000	484,000	-101,000	-17%	-95,000	-16%
Total	2,920,000	2,800,000	2,690,000	-120,000	-4%	-230,000	-8%

Exhibit A2b. HAC rates for 2014, 2015, and 2016 (preliminary), with 2019 goals

Hospital-Acquired Condition	2014 Baseline	Final 2015	Preliminary 2016	2019 Goal (20% Reduction)
Adverse Drug Events (ADEs)	33.4	31.1	28.4	26.7
Catheter-Associated Urinary Tract Infections (CAUTIs)	5.7	6.7	5.9	4.5
Central Line-Associated Bloodstream Infections (CLABSIs)	0.3	0.2	0.2	0.2
<i>Clostridium difficile</i> Infections	2.9	2.6	2.6	2.3
Falls	8.0	7.6	7.3	6.4
Obstetric Adverse Events	2.3	2.2	2.2	1.8
Pressure Ulcers	21.6	23.8	23.7	17.3
Surgical Site Infections (SSIs)*	2.5	2.5	2.5	2.0
Ventilator-Associated Pneumonias (VAPs)	1.2	1.0	0.8	1.0
Venous Thromboembolisms (VTEs)	0.9	0.4	0.7	0.7
All Other HACs	19.5	16.1	16.3	15.6
Total	98.15	94.13	90.46	78.52

Note: The “Total” numbers shown in the table are rounded to two decimal places. Rounded numbers used elsewhere in the report are sometimes not aligned with these numbers. For example, for the purpose of summarizing the HAC reduction goal for 2019, the whole number of 98 was used as the 2014 baseline. A 20% reduction from 98 is 78.4, which rounds to 78. Using the unrounded rate for 2014 would have led to the 2019 goal rounding to 79 and the 2019 goal seeming to be a 19 percent reduction (98 to 79) rather than a 20 percent reduction.

Exhibit A2c. All 2014, 2015, and 2016 (preliminary) HACs (not rounded)

HAC Type	Source	Measure	Total 2014 HACs	Total 2014 HAC Rate per 1,000 Discharges	Total 2015 HACs Normalized to 2014 Baseline	Total 2015 HAC Rate Normalized to 2014 Baseline	Total Preliminary 2016 HACs Normalized to 2014 Baseline	Total Preliminary 2016 HAC Rate Normalized to 2014 Baseline
Adverse Drug Event	MPSMS	ADE Associated With Digoxin	6,164	0.21	761	0.03	153	0.01
	MPSMS	ADE Associated With Hypoglycemic Agents	513,932	17.27	561,740	18.88	510,139	17.15
	MPSMS	ADE Associated With IV Heparin	139,848	4.70	88,296	2.97	88,154	2.96
	MPSMS	ADE Associated With LMWH and Factor Xa Inhibitor	246,292	8.28	166,356	5.59	162,451	5.46
	MPSMS	ADE Associated With Warfarin	88,120	2.96	109,555	3.68	84,502	2.84
	MPSMS	Total ADE (sum of 5 above)	994,355	33.42	926,709	31.15	845,400	28.41
CAUTI	MPSMS	Catheter-Associated Urinary Tract Infections	169,028	5.68	199,417	6.70	175,032	5.88
CDI	MPSMS	<i>Clostridium difficile</i> Infections	85,558	2.88	77,841	2.62	76,148	2.56

HAC Type	Source	Measure	Total 2014 HACs	Total 2014 HAC Rate per 1,000 Discharges	Total 2015 HACs Normalized to 2014 Baseline	Total 2015 HAC Rate Normalized to 2014 Baseline	Total Preliminary 2016 HACs Normalized to 2014 Baseline	Total Preliminary 2016 HAC Rate Normalized to 2014 Baseline
CLABSI	MPSMS	Blood Stream Infections Associated With Central Venous Catheters	8,513	0.29	5,530	0.19	5,848	0.20
Falls	MPSMS	In-Hospital Patient Falls	238,965	8.03	224,693	7.55	218,399	7.34
Obstetric Adverse Events	PSI	OB Trauma in Vaginal Delivery With (PSI 18) and Without Instrument (PSI 19)	67,482	2.27	64,077	2.15	64,077	2.15
Pressure Ulcer	MPSMS	Hospital-Acquired Pressure Ulcers	643,230	21.62	708,301	23.81	704,906	23.69
Surgical Site Infection	NHSN	SSIs for 17 procedures w/CDC SCIP+5 data	73,158	2.46	73,212	2.46	73,212	2.46
VAP	MPSMS	Ventilator-Associated Pneumonia	35,588	1.20	30,083	1.01	24,194	0.81
VTE	MPSMS	Postoperative Venous Thromboembolic Events	25,407	0.85	12,309	0.41	20,103	0.68
All Other Hospital-Acquired Conditions	MPSMS	Femoral Artery Puncture for Catheter Angiographic Procedures	21,538	0.72	15,011	0.50	13,556	0.46
	MPSMS	Adverse Event Associated With Hip Joint Replacements	48,993	1.65	49,181	1.65	61,755	2.08
	MPSMS	Adverse Event Associated With Knee Joint Replacements	41,696	1.40	40,556	1.36	42,457	1.43
	MPSMS	Contrast Nephropathy Associated With Catheter Angiography	124,550	4.19	83,906	2.82	89,326	3.00
	MPSMS	Hospital-Acquired MRSA	19,526	0.66	6,663	0.22	5,689	0.19

HAC Type	Source	Measure	Total 2014 HACs	Total 2014 HAC Rate per 1,000 Discharges	Total 2015 HACs Normalized to 2014 Baseline	Total 2015 HAC Rate Normalized to 2014 Baseline	Total Preliminary 2016 HACs Normalized to 2014 Baseline	Total Preliminary 2016 HAC Rate Normalized to 2014 Baseline
	MPSMS	Hospital-Acquired Vancomycin-Resistant <i>Enterococcus</i> (VRE)	15,507	0.52	4,569	0.15	3,617	0.12
	MPSMS	Mechanical Complications Associated With Central Venous Catheters	58,876	1.98	54,514	1.83	65,313	2.20
	MPSMS	Postoperative Cardiac Events for Cardiac and Noncardiac Surgeries	32,592	1.10	28,593	0.96	22,057	0.74
	MPSMS	Postoperative Pneumonia	88,015	2.96	79,604	2.68	64,643	2.17
	PSI	Iatrogenic Pneumothorax (PSI 6)	10,674	0.36	9,694	0.33	9,694	0.33
	PSI	Post-Op Hemorrhage or Hematoma (PSI 9)	17,670	0.59	16,154	0.54	16,154	0.54
	PSI	Post-Op Respiratory Failure (PSI 11)	48,087	1.62	47,300	1.59	47,300	1.59
	PSI	Accidental Puncture or Laceration (PSI 15)	51,249	1.72	42,599	1.43	42,599	1.43
	MPSMS & PSI	Total All Other HACs (sum of 13 above)	578,972	19.46	478,345	16.08	484,161	16.27
		Total MPSMS-Based Measured HACs	2,651,937	89.1	2,547,480	85.6	2,438,443	82.0
		Total PSI-Based Measured HACs	195,162	6.6	179,824	6.0	179,824	6.0
		Total NHSN-Based Measured HACs	73,158	2.5	73,212	2.5	73,212	2.5
		Total HACs	2,920,257	98.2	2,800,516	94.13	2,691,479	90.5

The estimates that were used in 2016 to trend 2010 to 2014 results and the estimates for 2014 that are being used to establish a new trend for 2014–2019 results are shown below in Exhibit A2d. More details on the 2010–2014 results is available in the final data report.¹¹

Exhibit A2d. Historical and new estimates for 2014 (rounded)

New Data for Trending 2014–2019 Results			Historical Data for Trending 2010–2014 Results
Hospital-Acquired Condition	2014 Measured Baseline for HACs	2014 Total HACs per 1,000 Discharges	HAC Rate for 2014 (Calculated for Comparison With 2010)
Adverse Drug Events	994,000	33.4	41.4
Catheter-Associated Urinary Tract Infections	169,000	5.7	7.6
Central Line-Associated Bloodstream Infections	9,000	0.3	0.2
<i>Clostridium difficile</i> Infections	86,000	2.9	(Included in All Other HACs)
Falls	239,000	8.0	7.9
Obstetric Adverse Events	67,000	2.3	2.3
Pressure Ulcers	643,000	21.6	30.9
Surgical Site Infections	73,000	2.5	2.5
Ventilator-Associated Pneumonias	36,000	1.2	1.2
(Post-Op) Venous Thromboembolisms	25,000	0.9	0.5
All Other HACs	579,000	19.5	26.4
Total	2,920,000	98	121

Data in Exhibits A2e and A2f provide summary information on the trends from 2010 to 2014 based on historical data and methods as reported in 2016.¹¹ They also provide new summary information on the data from 2014 to 2016’s preliminary results that were computed using the new methods established for tracking results from 2014 to 2019.

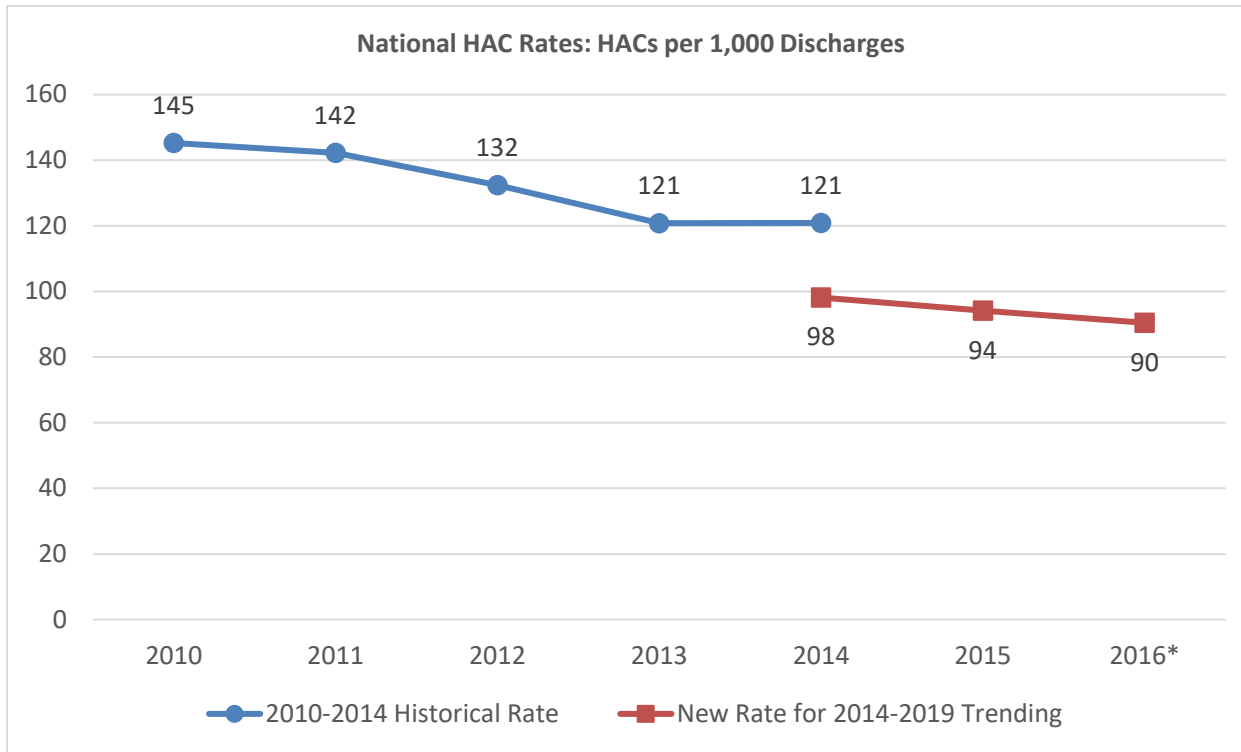
Exhibit A2e. Summary data trended from 2010-2014 (historical) and 2014–2019 (new)

CY	2010-2014 Historical Rate	Annual Change From Previous Year	Annual Reduction From Baseline Year (2010)	New Rate for 2014–2019 Trending	Annual Change From Previous Year	Annual Reduction From Baseline Year (2014)
2010	145					
2011	142	-2.1%	-2.1%			
2012	132	-6.9%	-8.8%			
2013	121	-8.8%	-16.8%			
2014	121	0.0%	-16.8%	98		
2015				94	-4.1%	-4.1%
2016*				90	-3.9%	-7.8%
Average Annual Percent Change		-4.4%			-4.0%	

*Preliminary data. Percentages shown were calculated using unrounded numbers.

¹¹ See the AHRQ HAC report at <https://www.ahrq.gov/professionals/quality-patient-safety/pfp/2014-final.html>.

Exhibit A2f. Summary data trended from 2010–2014 (historical) and 2014–2016 (new)



* Preliminary data.

Appendix 3. National Goals for 2019 Based on 2014 NHR Baseline (Projected Reductions in HACs, Costs, and Deaths)

Exhibit A3 shows annual summary data for achieving the goals associated with a 20 percent HAC reduction from 2014 to 2019. In these projections, which are based on annual reductions of 4.3 percent from 2014 to 2018 and a 20 percent reduction from 2014 to 2019, the total cumulative cost reductions total approximately \$19.1 billion, and the total HAC-related deaths averted total approximately 53,000.

Exhibit A3. HAC reduction goals for 2015 to 2019 based on new 2014 baseline and projected cost savings and deaths averted associated with meeting the HAC reduction goals

Annual	2015 Goal	2016 Goal	2017 Goal	2018 Goal	2019 Goal (20% Reduction in HACs)
Annual HAC Reductions From 2014 Baseline	-126,000	-246,000	-361,000	-471,000	-580,000
Annual Cost Reductions Associated With Achieving Goal	-\$1,346,000,000	-\$2,633,000,000	-\$3,866,000,000	-\$5,045,000,000	-\$6,174,000,000
Annual Deaths Averted Associated With Achieving Goal	-4,000	-7,000	-11,000	-14,000	-17,000
Cumulative					
Cumulative HAC Reductions From 2014 Baseline	-126,000	-371,000	-732,000	-1,203,000	-1,780,000
Cumulative Cost Reductions Associated With Achieving Goal	-\$1,346,000,000	-\$3,979,000,000	-\$7,845,000,000	-\$12,890,000,000	-\$19,064,000,000
Cumulative Deaths Averted Associated With Achieving Goal	-4,000	-11,000	-22,000	-36,000	-53,000

Appendix 4. Changes in the Samples Used for the MPSMS 2014–2016, Compared With 2010–2014 Previous Analyses

The Medicare Patient Safety Monitoring System (MPSMS) methodology to identify adverse events within each chart from 2014 to 2016 is the same as in prior years. However, the methodology by which charts are identified, sampled, and included for review with the MPSMS has changed significantly during the period. The most significant are a consequence of changes to the requirements for the Hospital Inpatient Quality Reporting Program (IQR) and changes from International Classification of Diseases, 9th Revision (ICD-9) to 10th Revision (ICD-10) coding.

Changes to the Hospital IQR Program and Its Impact on the MPSMS Four-Condition Sample

When the original method for calculating a national HAC rate (NHR) was developed,¹² CMS and AHRQ monitored patient safety for the NHR using charts from patients treated for four conditions: acute myocardial infarction (AMI), congestive heart failure (CHF), and pneumonia (PN), and for major surgeries associated with the Surgical Care Improvement Project (SCIP).¹³ CMS reduced burden and costs by reusing charts for these conditions already obtained to support validation of the Hospital Inpatient Quality Reporting (IQR) program as described in the *Federal Register*.¹⁴

Briefly, all acute care hospitals subject to the Inpatient Prospective Payment System (IPPS) receive payment incentives for meeting Hospital IQR program reporting requirements. Therefore, from 2010 through 2014, nearly all IPPS hospitals submitted data to CMS on random samples of all inpatient stays that met the definitions for the four noted conditions.

To validate the reported data on AMI, CHF, PN, and SCIP, CMS contractors randomly sampled between 400 and 800 hospitals (depending on the year) and requested 12 medical records (3 from each category) from each sampled hospital. CMS's Hospital IQR program requirements for AMI, CHF, PN, and SCIP remained similar for several consecutive years such that we obtained a stable consistent sample of medical charts from these four conditions from 2010 to 2014.

From 2015 onward, the MPSMS four-condition sample (AMI, CHF, PN, and SCIP) has been an approximation of the previous four-condition samples used from 2010 to 2014. It had to be reconstructed by sampling hospitals reimbursed under IPPS and requesting charts from available all-payer data submitted to the Hospital IQR program. The Hospital IQR program is mandated by law. As the hospital care environment changed, the Hospital IQR program discontinued chart-based reporting requirements for these four conditions in 2015 (CHF, PN, and SCIP) and 2016 (AMI).¹⁵ Thus, from 2015 onward, after randomly sampling hospitals to provide data for MPSMS, CMS contractors identified medical records submitted to the Hospital IQR program

¹² See <https://www.ahrq.gov/professionals/quality-patient-safety/pfp/methods.html>.

¹³ See “Section 4, Population and Sampling Specifications,” at <https://www.qualitynet.org/dcs/ContentServer?c=Page&pagename=OnetPublic%2FPage%2FOnetTier4&cid=1228773989482>.

¹⁴ See 75 FR 50225-50229, August 26, 2010, at <https://www.gpo.gov/fdsys/pkg/FR-2010-08-16/pdf/2010-19092.pdf>.

¹⁵ See “CY 2015 reporting period” and “CY2016 reporting period” at <https://www.qualitynet.org/dcs/ContentServer?c=Page&pagename=OnetPublic%2FPage%2FOnetTier4&cid=1228775411587>.

under global population specifications¹⁶ and also met the formally defined criteria for AMI, CHF, PN, or SCIP.¹⁷

The samples in 2015 and 2016 only approximate the data from 2014, it therefore it is possible that the four condition sample in 2015 and 2016 had a different risk profile than the sample data from 2014. This potential issue may be addressed by risk-adjusting the data, which has been done in previous studies using MPSMS data. In general, the risk adjusted results have shown similar trends to the results prior to risk adjustment.

Changes From ICD-9 to ICD-10 Coding and Its Impact on the MPSMS Four-Condition Sample

In quarter 4, 2015, hospitals began using ICD-10 coded data in place of ICD-9 coded data. It is notable that because MPSMS is based on chart-abstraction, results do not depend on this coding system. However, the specifications that CMS’s contractors used to identify charts for the four conditions (AMI, CHF, PN, and SCIP) did depend on these specifications. Therefore, this coding change introduced an inherent uncertainty regarding the nature of the comparability of the four-condition sample before and after quarter 4, 2015.

Introduction of the Four-Condition Complement Sample

To improve the number of conditions represented by MPSMS, we introduced the four-condition complement sample designed to include most types of patients not included in the four-condition sample. All charts abstracted as part of MPSMS’s four-condition complement were originally submitted to the CDAC for validation of Hospital IQR program measures.

The MPSMS abstracted sample is representative of hospitals submitting cases to the Hospital IQR program as specified for the “global” population.¹⁸ At first, we excluded cases younger than 18 years of age to increase consistency with the four-condition sample and cases meeting the definitions for AMI, CHF, PN, and SCIP, because these charts were monitored in the four-condition sample; later, we excluded cases undergoing non-SCIP surgery to increase consistency in the observed sample from year to year.

From 2014 to 2016, the overall number of charts used in the analyses to calculate the NHR and other information included in this document did not change markedly, although the number of charts decreased for most groups from 2014 to 2015 and increased in 2016. The increase was most consistent and largest in the four-condition complement group. Detailed information is provided in Exhibit A4.

¹⁶ See Section 2.9, “Global Initial Patient Population,” at <https://www.qualitynet.org/dcs/ContentServer?c=Page&pagename=QnetPublic%2FPPage%2FQnetTier4&cid=1228773989482>.

¹⁷ Our 2015 interim estimate also included data from charts submitted for Venous Thromboembolism (see Section 2.7 at <https://www.qualitynet.org/dcs/ContentServer?c=Page&pagename=QnetPublic%2FPPage%2FQnetTier4&cid=1228773989482>). However, reporting requirements for VTE were also discontinued from the IQR program in 2016. Therefore, we removed these charts from our current approach.

¹⁸ See “Section 2.9, “Global Initial Patient Population,”” at <https://www.qualitynet.org/dcs/ContentServer?c=Page&pagename=QnetPublic%2FPPage%2FQnetTier4&cid=1228773989482>.

Exhibit A4. Number of charts used in the 2014, 2015, and 2016 MPSMS Analyses for the NHR

Year and Sample	2014	2015	2016
AMI	4,234	4,076	3,797
CHF	4,820	2,423	5,330
Pneumonia	4,941	2,427	5,737
SCIP	5,480	2,817	5,920
"Global" (Four-condition complement)	4,308	6,336	8,027
Total	23,783	18,079	28,811

Because the four-condition complement is defined by excluding cases with AMI, CHF, PN, and SCIP, the complement is also potentially affected by the introduction of ICD-10 in quarter 4, 2015. However, because this sample reflects a much broader spectrum of conditions treated in acute care hospitals, we anticipate that the influence of this change would be smaller when applied to the four-condition “complement” than to the four conditions themselves.

Charts selected for 2017 to 2019 for use in the calculation of the national HAC rate will be acquired using methods as similar as possible to the methods used to acquire the 2016 samples.

Results for Individual Measures

Depending on the year, the sample size varied from approximately 18,000 to 29,000 charts, reflecting care delivered in approximately 800 to 1,600 hospitals. Data are more precise for the overall harm rates than for individual metrics. MPSMS is also sensitive to changes in documentation practices, which in turn may be sensitive to changes in other measurement practices. For example, changes to the technical specifications used to define hospital-acquired infections or other adverse events might influence the way that harms get documented in the medical record over time. These changes to documentation in turn might influence some of the observed chart-abstracted HAC rates derived from the MPSMS. Changes in documentation and definitions also have the potential to influence the rates of other (PSI and NHSN-based) data used in this analysis.

Possible Overrepresentation of Care Delivered in Small Hospitals

The design of the MPSMS sample is closely linked to the current and historical designs of the Hospital IQR program validation sample. Therefore, hospitals in any given quarter generally contributed approximately the same number of records of each type each quarter regardless of hospital size and volume. For example, a hospital that discharges 10 patients per day and one that discharges 100 patients per day would both have contributed approximately the same number of SCIP charts. As a result of this strategy, the MPSMS sample overrepresents care delivered in smaller hospitals. We anticipate this overrepresentation to be consistent over time. However, because larger hospitals generally tend to treat more complex cases, it is conceivable that the overrepresentation of patients from smaller hospitals may have a greater impact on cases from the four-condition complement (“global”) sample, which is much younger and healthier than the four-condition sample.

Appendix 5. New Estimates for HAC Costs and Mortality

These data are based on the report Estimating the Additional Hospital Inpatient Cost and Mortality Associated With Selected Hospital-Acquired Conditions.¹⁹ Additional information is also available in Exhibit 1 and in the final report on 2013 hospital-acquired conditions and estimates.²⁰

Exhibit A5. New estimates and comparisons with historical estimates used to calculate projections based on 2010–2014 data

NORC (2017)	Additional Cost		Excess Mortality	
	Current (New) Study Estimate (95% CI)	2010 AHRQ Estimate	Current (New) Study Estimate (95% CI)	2010 AHRQ Estimate
ADE	\$5,746 (-\$3,950–\$15,441)	\$5,452	0.012 (0.003–0.025)	0.02
CAUTI	\$13,793 (\$5,019–\$22,568)	\$1,090	0.036 (0.004–0.079)	0.023
CLABSI	\$48,108 (\$27,232–\$68,983)	\$18,537	0.150 (0.070–0.270)	0.185
Falls	\$6,694 (-\$1,277–\$14,665)	\$7,888	0.050 (0.035–0.070)	0.055
OB Adverse Events	\$602 (-\$578–\$1,782)	\$3,271	0.005 (0.003–0.013)	0.0015
Pressure Ulcers	\$14,506 (-\$12,313–\$41,326)	\$18,537	0.041 (0.013–0.093)	0.072
SSI	\$28,219 (\$18,237–\$38,202)	\$22,898	0.026 (0.009–0.059)	0.028
VAP	\$47,238 (\$21,890–\$72,587)	\$22,898	0.140 (-0.110–0.730)	0.144
VTE	\$17,367 (\$11,837–\$22,898)	\$8,723	0.043 (0.040–0.078)	0.104
CDI	\$17,260 (\$9,341–\$25,180)	N/A	0.044 (0.028–0.064)	N/A

¹⁹ This report is available at <https://www.ahrq.gov/sites/default/files/wysiwyg/professionals/quality-patient-safety/pfp/hac-cost-report2017.pdf>.

²⁰ This report is available at <https://www.ahrq.gov/professionals/quality-patient-safety/pfp/hacrate2013.html>.