

Supplemental Online Content

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This supplemental material has been provided by the authors to give readers additional information about their work.

eText. Details Regarding the MPSMS Sample during the Period of Study

Background

The medical records included in the MPSMS were randomly selected from among those hospitals, required by the Centers for Medicare & Medicaid Services (CMS), to submit information for its Inpatient Quality Reporting (IQR) program. Many of the charts used were directly re-purposed from Hospital IQR program validation activities and the remainder were randomly sampled from the universe of all payer hospital discharges for adult inpatients reported to the program. The sample size was set based on several considerations, including budget considerations. The aim was to obtain as much information as possible within budget constraints and to produce estimates with as much precision as possible given those constraints. The belief was that the greater the number of charts evaluated, the greater the opportunity to obtain precise estimates overall, for subgroups, and among different types of adverse events. Thus, the final size was a result of considering the total budget available for chart abstraction, the number of charts available to re-purpose from the Hospital Inpatient Quality Reporting program, the adverse event rate in each stratum, and the relative frequency of discharges in that stratum relative to the total population of hospital discharges. There was no specific sample size calculation at the outset. The CMS process for selecting medical records for IQR validation changed in 2015.

Thus, we describe it separately here for 2009- to Q2 of 2014 and Q3 of 2014-2019.

2009-2014

Four Condition Sample

CMS required hospitals to submit patient information (cases) for quality measures in the IQR for four “conditions”: Acute Myocardial Infarction (AMI), Heart Failure (HF), Pneumonia and major surgical procedures included in the Surgical Care Improvement Project (SCIP). These conditions are defined by quality measure denominator specifications.¹ CMS selected medical records for case validation using the following two steps:

1. CMS randomly selected approximately 400-800 acute care hospitals per year from approximately 3400 hospitals to participate in national validation of the IQR program measures.
 - a. Through 2012, new hospitals were sampled in Q4. Starting in 2013, new hospitals were sampled in Q3. In some years and quarters, CMS included the same hospitals from the previous quarter; in others, they resampled (eTable 1).
2. From each of the selected hospitals, CMS required hospitals to submit a set number of medical records per condition per quarter (which varied across years and conditions) for validation. Typically, this was 12 medical records per condition per hospital per year. CMS randomly assigned the specific medical records the hospitals should submit from among each hospital’s reported cases for each condition. Hospitals with fewer than the 12 cases submitted all available medical records and were asked to substitute records from other conditions to meet their quota.

From these submitted records, the MPSMS team selected cases for inclusion in the MPSMS using the following two steps.

1. MPSMS team set volume targets that were budget related for each condition from among the acquired charts. In some years, all the charts provided above were included.
2. CMS then randomly selected from the submitted charts the charts for MPSMS inclusion.

¹ For AMI, SCIP:

<https://www.qualitynet.org/dcs/ContentServer?c=Page&pagename=QnetPublic%2FPage%2FQnetTier4&cid=1228774725171>.

For HF and PN, only ICD-9 codes are publicly available.

<https://www.qualitynet.org/dcs/ContentServer?c=Page&pagename=QnetPublic%2FPage%2FQnetTier3&cid=1228773989482>

Global Population 2011-Q2 2014

In Q4 2011, CMS started requiring hospitals to submit cases for a new “global population” sample, comprised of hospitalized patients representing all payers and all diagnoses. Specifically, from among the 400 -800 randomly selected “national validation sample” hospitals, CMS randomly selected 12 cases from across all discharges and those ages 18 and older, for all payers, and required hospitals to submit the medical records for these cases. The MPSMS team included a randomly selected subset of these medical records in the MPSMS. The team excluded medical records for patients that met eligibility criteria for inclusion in the four condition samples listed above. The remaining medical records comprise the “All-Other Conditions” sample in the MPSMS.

Q3 2014-2019

In 2015, CMS changed the quality measures it included in the Hospital IQR Program. A commensurate shift in the available medical records to repurpose for the MPSMS from those submitted for IQR Program validation started in Q3 2014.

1. In Q3 2014 and Q4 2014 the four-condition sample was not collected as part of the IQR, since medical records were not requested for validation. However, medical records were still in the warehouse and could be used. The same 400 hospitals from Q1 and Q2 of 2014 were included.
2. In Q1 2015 for Hospital IQR Program measure validation, CMS started by randomly selecting approximately 400 hospitals per year from approximately 3400 US hospitals to participate in national validation of the IQR program measures.
3. From each of the selected hospitals, CMS required submission of a set number of randomly selected medical records. However, the approach to medical record selection no longer targeted the four conditions.
4. Instead, CMS identified and required hospitals to submit up to 32 randomly chosen medical records per hospital per year for IQR measure validation. The MPSMS team sought to build from these medical records a sample for MPSMS that was approximately representative of the distribution of inpatient stays; the “All Other Conditions” sample.
5. In 2015 and 2016, CMS phased out reporting of all the conditions in the four-condition sample. Therefore, there were no medical records to “repurpose” for MPSMS. To re-construct the “four-condition sample,” the MPSMS team had to draw a completely new sample of hospitals and reconstruct its four-condition sample from medical records available in the Hospital IQR Program warehouse. In 2014, these medical records were still drawn from cases submitted to the program warehouse for the four-condition measures. But starting in 2015, the medical records were identified from the “global population” data representing all payers and diagnoses submitted and subsetted to include the four condition medical records. In 2014 and 2015 new reporting measures for venous thromboembolism and stroke were added to the IQR measures. Some of these cases also contained a principal diagnosis of AMI, HF pneumonia or SCIP. To maintain comparability and align with previous analyses, we excluded these medical records from the 2014 and 2015 four-condition sample.
6. The MPSMS team determined the number of medical records it had funding for to abstract for each condition, and CMS randomly selected the number of hospitals and medical records for each of the four conditions and the “All Other Conditions” samples.²

As a result of budget constraints, the total number of medical records in the MPSMS decreased from 27,898 in 2016 to 14,952 in 2018. Medical records for service delivered in Q3 and Q4 of 2019 were scheduled to be requested from hospitals during the COVID-19 pandemic. CMS determined that it would not request *any* medical records even on a voluntary basis for the four-condition sample through December 2020, and it would receive only voluntary submission of Hospital IQR Program medical records for validation. For this reason, the sample size was 10,199 in 2019, and the proportion AMI, HF, PN and SCIP charts included decreased from 2015-2019 (eTable 2).

² For more details about the validation random sample, see the Federal Register: 74 FR 43885 August 2009, 75 FR 50227 August 2010, and 79 FR 50263 August 2014

To minimize burden to hospitals submitting data for the validation samples, selection of hospitals for the MPSMS supplemental sample was limited to hospitals eligible but not selected for the validation samples in the relevant quarters. A small number of additional hospitals were excluded in certain quarters when requirements to submit data were waived because of hurricanes and other natural disasters. When hospitals were excluded after the sample was drawn for the year, additional hospitals were sampled from the remaining non-excluded hospitals. eTable 1 shows an outline of MPSMS historical sampling and exclusions starting in 2015, including the number of hospitals sampled each quarter and the number excluded each quarter.

eTable 1. MPSMS Historical Sampling and Exclusions

OBS	YEAR	QUARTER	ALL HOSPITALS ¹	ALL OPEN HOSPITALS	IQR HOSPITAL EXCLUSIONS	FEMA HOSPITAL EXCLUSIONS	IHS HOSPITAL EXCLUSIONS	MPSMS HOSPITAL SAMPLE	TOTAL HOSPITALS RESAMPLED	TOTAL HOSPITALS DELIVERED
1	2015	Q1	3,283	3,248	594	0	0	400	NA	396
2	2015	Q2	3,283	3,238	591	0	0	421	NA	413
3	2015	Q3	Not redrawn	Not redrawn	400	0	0	421	49	412
4	2015	Q4	Not redrawn	Not redrawn	NR	NR	NR	421	0	414
5	2016	Q1	3,248	3,210	591	0	0	425	NA	413
6	2016	Q2	Not redrawn	Not redrawn	P	P	P	470	45	459
7	2016	Q3	Not redrawn	Not redrawn	400	0	0	470	53	462
8	2016	Q4	Not redrawn	Not redrawn	NR	NR	NR	470	0	457
9	2017	Q1	3,218	3,200	595	0	25	319	NA	310
10	2017	Q2	Not redrawn	Not redrawn	NR	NR	NR	319	0	307
11	2017	Q3	Not redrawn	Not redrawn	385	580	25	319	95	308
12	2017	Q4	Not redrawn	Not redrawn	584	0	25	319	15	308
13	2018	Q1	3,209	3,175	578	580	25	319	NA	310
14	2018	Q2	Not redrawn	Not redrawn	584	0	25	319	2	309
15	2018	Q3	Not redrawn	Not redrawn	400	200	25	319	63	311
16	2018	Q4	Not redrawn	Not redrawn	NR	NR	NR	96	0	96
17	2019	Q1	3,173	3,125	589	0	25	125	NA	125
18	2019	Q2	Not redrawn	Not redrawn	P	1	25	125	1	126
19	2019	Q3	Not redrawn	Not redrawn	400	0	25	125	23	129

FOOTNOTES

IQR = CMS Hospital Inpatient Quality Reporting Program
IHS = Indian Health Service
FEMA = Federal Emergency Management Agency

1 Only Acute Care hospitals are drawn from the database and used for MPSMS
NA Not applicable; a new list of hospitals was drawn in that quarter
NR No resampling done in that quarter; no additional hospitals were needed in the sample
P Previous quarter's data was used for resampling, without modification

eTable 2. Percent of Overall Sample Represented by Each Condition, 2010-2019

Summarizes data contributing to the Table in the main article

Percent of Overall All-Condition Sample Represented by Each Condition, 2010-2019

Condition	2010		2011		2012		2013		2014		2015		2016		2017		2018		2019		Total	
AMI	7727	23%	7113	21%	4934	13%	4027	17%	4234	18%	4076	23%	3797	14%	2651	12%	1681	11%	567	6%	40807	17%
HF	7536	22%	6962	20%	4900	13%	4492	19%	4820	20%	2423	14%	5330	19%	3779	17%	1739	12%	774	8%	42755	17%
Pneumonia	9311	28%	9744	29%	8730	24%	4666	20%	4941	21%	2427	14%	5737	21%	4004	18%	1707	11%	858	8%	52125	21%
SCIP	9104	27%	10148	30%	8692	24%	4767	21%	5480	23%	2817	16%	5920	21%	3880	17%	1930	13%	1861	18%	54599	22%
All-Other Conditions					9532	26%	5286	23%	4308	18%	6072	34%	7114	26%	7912	36%	7895	53%	6139	60%	54258	22%
Total	33678	100%	33967	100%	36788	100%	23238	100%	23783	100%	17815	101%	27898	101%	22226	100%	14952	100%	10199	100%	244544	100%

Percent of Overall Four-Condition Sample Represented by Each Condition, 2010-2019

Condition	2010		2011		2012		2013		2014		2015		2016		2017		2018		2019		Total	
AMI	7727	23%	7113	21%	4934	18%	4027	22%	4234	22%	4076	35%	3797	18%	2651	19%	1681	24%	567	14%	40807	21%
HF	7536	22%	6962	20%	4900	18%	4492	25%	4820	25%	2423	21%	5330	26%	3779	26%	1739	25%	774	19%	42755	22%
Pneumonia	9311	28%	9744	29%	8730	32%	4666	26%	4941	25%	2427	21%	5737	28%	4004	28%	1707	24%	858	21%	52125	27%
SCIP	9104	27%	10148	30%	8692	32%	4767	27%	5480	28%	2817	24%	5920	28%	3880	27%	1930	27%	1861	46%	54599	29%
Total	33678	100%	33967	100%	27256	100%	17952	100%	19475	100%	11743	101%	20784	100%	14314	100%	7057	100%	4060	100%	190286	100%

eTable 3. Summary National Inpatient Mortality and Length-of-Stay Data from HCUPnet (<https://hcupnet.ahrq.gov/#setup>), 2010-2017

HCUPnet - Hospital Inpatient National Statistics								
Analysis Type: Trends Setting of Care: Hospital Inpatient Geographic Settings: National Categorization Type: All Stays Principal or All-Listed: Principal Outcome and Measures: Number, Rate, Length of stay, Died								
National	2010	2011	2012	2013	2014	2015	2016	2017
Outcomes for All Discharges								
LOS (length of stay), days (mean)	4.58	4.53	4.51	4.55	4.61	4.62	4.62	4.62
In-hospital deaths: %	1.86	1.87	1.84	1.89	1.90	1.91	1.91	1.95

Analysis Type: Trends Setting of Care: Hospital Inpatient Geographic Settings: National Subgroups of Interest: Non-neonatal, non-maternal discharges only, Children only (age 0-17) Categorization Type: All Stays Principal or All-Listed: Principal Outcome and Measures: Number, Rate, Length of stay, Died								
National, Non-neonatal, non-maternal discharges only	2010	2011	2012	2013	2014	2015	2016	2017
Outcomes for All Discharges								
LOS (length of stay), days (mean)	4.94	4.91	4.89	4.95	5.04	5.06	5.03	5.02
In-hospital deaths: %	2.32	2.33	2.32	2.39	2.41	2.41	2.41	2.45

eTable 4. Patient Characteristics, Hospital Characteristics, and Outcomes for Combined AMI, HF, Pneumonia, and Surgical Care (Four Conditions) Patients, 2010-2019

Four Condition (N=190,286)	2019 (N=4,060)	2018 (N=7,057)	2017 (N=14,314)	2016 (N=20,784)	2015 (N=11,743)	2014 (N=19,475)	2013 (N=17,952)	2012 (N=27,256)	2011 (N=33,967)	2010 (N=33,678)
Demographic	Rate %									
Age, Mean (Standard Deviation [SD])	67.1 (15.4)	68.8 (15.3)	68.4 (15.7)	67.9 (15.8)	68.5 (15.2)	67.9 (15.6)	68.3 (15.7)	67.7 (16.1)	67.7 (16.3)	67.9 (16.3)
Age <65	39.7	36.2	37.6	39.0	38.2	39.8	38.0	39.6	40.1	39.0
Age 65-74	26.7	25.2	24.2	24.0	24.3	23.4	23.7	22.3	21.6	21.7
Age 75-84	21.4	22.7	21.7	21.3	21.1	21.2	21.9	21.9	21.7	22.5
Age 85 and Over	12.3	15.9	16.4	15.6	16.3	15.6	16.4	16.2	16.6	16.9
Female	52.5	50.4	51.9	51.7	50.4	50.6	51.9	54.0	53.8	54.0
Male	47.5	49.6	48.1	48.3	49.6	49.4	48.1	46.0	46.2	46.0
American Indian/ Native	1.1	0.8	0.6	0.9	0.7	0.8	0.8	0.9	0.7	0.4
Asian	1.6	1.5	1.6	1.5	1.7	1.5	1.9	1.7	1.8	1.7
Black (Non-Hispanic)	13.6	11.5	11.2	12.5	12.3	12.1	11.9	12.2	12.0	12.0
Hispanic	5.4	6.5	5.5	5.6	5.3	5.5	6.3	5.4	5.4	5.7
Native Hawaiian/Pacific Islander	0.2	0.2	0.3	0.2	0.1	0.2	0.1	0.1	0.1	0.1
White (Non-Hispanic)	74.7	77.1	78.7	77.1	78.0	77.7	77.1	77.6	77.8	77.8
Other ³	3.4	2.4	2.1	2.2	2.0	2.2	1.8	2.1	2.2	2.3
Risk Factor										
Obesity	40.8	38.2	38.5	37.1	35.1	32.4	29.6	27.8	25.2	22.7
Smoking	30.3	31.0	29.3	28.4	27.6	26.7	25.5	24.9	24.2	23.5
Corticosteroids	6.7	7.8	7.7	7.1	6.8	6.9	7.1	7.7	7.3	6.9
Comorbidity										
Coronary Artery Disease	40.6	51.4	49.5	46.4	57.1	50.7	52.2	46.9	50.7	52.8
Congestive Heart Failure	34.8	45.7	45.3	43.8	43.2	43.5	44.3	38.1	41.0	43.0
Diabetes Mellitus	33.8	38.7	37.1	37.4	38.1	36.9	37.2	34.8	35.9	35.8
Kidney Disease	30.5	35.7	35.2	32.1	31.3	31.6	31.0	27.6	26.7	27.0

³ Other race includes any identified race not included in the aforementioned categories and mixed race.

Four Condition (N=190,286)	2019 (N=4,060)	2018 (N=7,057)	2017 (N=14,314)	2016 (N=20,784)	2015 (N=11,743)	2014 (N=19,475)	2013 (N=17,952)	2012 (N=27,256)	2011 (N=33,967)	2010 (N=33,678)
Chronic Obstructive Pulmonary Disease	25.7	29.6	30.5	30.7	29.8	29.9	31.0	30.7	30.9	30.9
Cancer	19.8	19.0	19.9	18.8	18.2	19.8	19.1	19.9	19.4	19.5
Cerebrovascular Disease	13.7	15.7	16.2	15.2	15.5	15.8	16.2	15.4	16.7	16.5
Outcomes										
Length of stay, Mean (SD)	4.7 (5.4)	4.7 (4.9)	4.6 (5.0)	4.5 (4.9)	4.5 (4.6)	4.9 (5.0)	5.0 (5.4)	5.1 (5.2)	5.0 (5.3)	5.2 (5.6)
In-hospital Mortality	2.7	3.7	3.8	3.5	3.8	4.2	4.3	4.6	4.5	4.6
Hospital Characteristics										
JC Accredited ⁴	81.3	77.6	79.0	79.4	80.7	78.8	79.3	82.3	81.8	82.1
Private Not for profit	66.4	68.0	66.5	61.9	59.2	60.6	62.4	60.2	60.1	63.2
PCI ⁵	57.2	50.8	48.8	49.1	46.6	51.5	48.6	42.5	43.4	45.7
CABG ⁶	40.4	36.0	34.2	32.7	31.8	38.2	36.3	33.3	32.7	35.2
Rural	29.0	28.3	30.5	31.1	28.4	28.5	27.7	31.3	29.8	27.7
Large Teaching	8.4	8.2	7.8	8.8	7.0	7.9	7.9	8.1	8.0	8.9
Beds, Median (Interquartile range [IQR])	169.0 (91.0 - 322.0)	174.0 (87.0- 312.0)	162.0 (80.0- 312.0)	142.0 (78.0- 269.0)	154.0 (72.0- 275.0)	172.0 (85.0- 306.0)	168.0 (85.0- 301.0)	155.0 (80.0- 277.0)	159.0 (80.0- 279.0)	174.0 (87.0- 313.0)

⁴ JC: Joint Commission

⁵ PCI: Percutaneous coronary intervention

⁶ CABG: Coronary artery bypass graft surgery

eTable 5. Patient Characteristics, Hospital Characteristics, and Outcomes for All-Other Conditions⁷ Patients, 2012-2019

All-Other Conditions (N=54,256)	2019 (N=6,139)	2018 (N=7,895)	2017 (N=7,910)	2016 (N=7,114)	2015 (N=6,072)	2014 (N=4,308)	2013 (N=5,286)	2012 (N=9,532)
Demographic	Rate (%)							
Age, Mean (SD)	59.1 (20.2)	58.6 (20.5)	58.6 (20.7)	58.2 (20.7)	57.3 (21.2)	55.8 (20.8)	56.5 (20.4)	56.9 (20.6)
Age <65	54.5	55.4	56.0	56.6	58.1	61.0	60.6	60.1
Age 65-74	20.1	19.2	18.3	17.9	16.9	16.4	16.7	16.3
Age 75-84	15.4	15.3	15.4	14.7	14.6	14.4	14.3	14.1
Age 85 and Over	10.0	10.1	10.4	10.8	10.5	8.1	8.3	9.5
Female	59.0	58.8	59.1	58.9	61.3	61.0	60.5	60.8
Male	41.0	41.2	40.9	41.1	38.7	39.0	39.5	39.2
American Indian/ Native	2.0	1.2	1.3	1.2	1.6	2.2	1.9	1.3
Asian	2.0	2.2	1.8	2.2	2.1	1.7	1.6	1.6
Black (Non-Hispanic)	13.9	13.3	13.3	11.7	13.5	12.3	12.1	12.4
Hispanic	7.1	7.5	7.3	7.2	7.9	7.2	7.3	6.6
Native Hawaiian/Pacific Islander	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1
White (Non-Hispanic)	71.6	72.5	73.5	74.9	72.2	73.9	74.4	75.4
Other ⁸	3.2	3.2	2.7	2.7	2.6	2.6	2.5	2.6
Risk Factor								
Obesity	35.1	34.6	33.0	30.9	29.6	27.5	26.9	23.9
Smoking	31.8	33.2	31.6	30.6	29.3	29.5	27.9	27.2
Corticosteroids	6.5	6.8	6.1	6.7	6.0	5.6	5.5	5.5
Comorbidity								
Diabetes Mellitus	30.4	30.5	29.8	28.6	29.5	27.2	25.9	26.7
Kidney Disease	26.4	26.0	24.3	22.0	21.8	17.8	17.9	15.7
Coronary Artery Disease	22.0	23.7	23.6	22.3	22.7	22.2	21.2	21.6
Chronic Obstructive Pulmonary Disease	19.9	19.5	20.8	20.2	20.0	17.3	16.6	17.8
Congestive Heart Failure	17.3	17.7	17.4	16.6	16.0	14.3	13.8	12.8
Cancer	16.4	16.8	16.8	17.4	15.8	14.6	14.6	15.2
Cerebrovascular Disease	14.5	15.1	14.8	14.5	13.9	14.0	12.8	13.0
Outcomes								

⁷ All Other Conditions Data was not available prior to 2012

⁸ Other race includes any identified race not included in the aforementioned categories and mixed race.

All-Other Conditions (N=54,256)	2019 (N=6,139)	2018 (N=7,895)	2017 (N=7,910)	2016 (N=7,114)	2015 (N=6,072)	2014 (N=4,308)	2013 (N=5,286)	2012 (N=9,532)
Length of stay, Mean (SD)	4.1 (5.1)	4.0 (4.4)	4.0 (4.4)	3.9 (4.4)	3.9 (4.2)	3.7 (4.1)	3.8 (4.4)	3.8 (4.3)
In-hospital Mortality	1.7	2.0	2.1	2.2	1.6	1.4	1.3	1.2
Hospital Characteristics								
JC Accredited ⁹	78.8	80.1	79.3	77.9	78.9	74.5	71.6	76.5
Private Not for profit	61.1	63.0	61.7	62.8	63.4	57.1	53.8	52.3
PCI ¹⁰	43.4	46.1	43.9	44.6	46.3	44.7	37.5	32.6
CABG ¹¹	30.3	32.9	31.5	31.0	33.1	31.9	27.8	25.4
Rural	29.1	27.4	29.7	32.6	31.6	30.7	27.3	31.4
Large Teaching	7.0	6.8	6.3	5.3	6.7	6.8	6.0	5.9
Beds, Median (IQR)	149.0 (72.0-312.0)	159.0 (73.0-301.0)	150.0 (71.0-280.0)	144.0 (69.0-264.0)	153.0 (68.0-267.0)	139.5(55.0-269.0)	120.0 (44.0-260.0)	113.0 (45.0-228.0)

⁹ JC: Joint Commission

¹⁰ PCI: Percutaneous coronary intervention

¹¹ CABG: Coronary artery bypass graft surgery

eTable 6. Patient Characteristics, Hospital Characteristics, and Outcomes for AMI patients, 2010-2019

AMI Sample Patient Characteristics (N=40,807)	2010 (N=7,727)	2011 (N=7,113)	2012 (N=4,934)	2013 (N=4,027)	2014 (N=4,234)	2015 (N=4,076)	2016 (N=3,797)	2017 (N=2,651)	2018 (N=1,681)	2019 (N=567)
Demographic	Rate (%)									
Age, Mean (SD) ¹²	69.7 (14.9)	69.7 (14.9)	69.9 (14.9)	69.1 (14.6)	69.0 (14.5)	69.3 (14.5)	68.7 (14.5)	68.3 (14.6)	68.7 (14.5)	69.1 (14.4)
Age <65	37.4	37.5	36.7	38.4	39.1	37.9	39.3	40.6	39.1	37.9
Age 65-74	21.3	21.4	21.8	23.9	23.3	24.5	24.3	24.7	24.5	23.8
Age 75-84	22.4	21.5	22.0	20.0	20.8	19.7	20.5	18.3	20.8	22.9
Age 85 and Over	18.9	19.6	19.6	17.7	16.7	18.0	15.9	16.3	15.6	15.3
Female	44.7	43.5	42.6	42.3	40.6	42.1	41.0	42.2	40.2	45.7
American Indian/ Native	0.3	0.4	0.4	0.7	0.9	0.5	0.8	0.6	0.7	0.7
Asian	2.1	2.6	2.2	2.3	2.1	2.0	2.2	2.1	2.2	2.5
Black (Non-Hispanic)	9.7	10.3	11.0	10.8	10.4	11.8	11.3	9.8	10.5	13.4
Hispanic	6.6	5.7	5.9	7.2	7.3	6.1	6.3	5.6	6.8	5.3
Native Hawaiian/Pacific Islander	0.2	0.1	0.2	0.2	0.1	0.1	0.2	0.5	0.5	0.2
Other ¹³	1.8	1.5	1.5	1.8	1.5	1.9	2.4	2.5	1.7	2.6
White (Non- Hispanic)	79.3	79.4	78.7	77.1	77.6	77.7	76.7	79.0	77.6	75.3
Rick factors										
Corticosteroids	4.8	5.6	5.2	4.5	4.7	4.6	4.8	5.1	5.0	3.5
Obesity	20.2	23.0	24.7	26.5	28.8	31.9	33.1	34.3	36.8	39.5
Smoking	28.6	29.6	30.0	30.6	31.6	31.6	33.9	34.6	35.9	36.7
Comorbidities										
Coronary Artery Disease	97.9	98.3	97.5	97.7	96.6	95.9	97.0	98.0	97.9	98.2
Diabetes Mellitus	39.8	41.6	40.5	41.9	41.2	43.4	42.9	39.0	44.1	41.4
Congestive Heart Failure	40.1	41.4	40.7	40.3	39.6	40.5	39.8	41.5	42.2	37.4

¹² SD: Standard Deviation

¹³ Other race includes any identified race not included in the listed categories and mixed race.

AMI Sample Patient Characteristics (N=40,807)	2010 (N=7,727)	2011 (N=7,113)	2012 (N=4,934)	2013 (N=4,027)	2014 (N=4,234)	2015 (N=4,076)	2016 (N=3,797)	2017 (N=2,651)	2018 (N=1,681)	2019 (N=567)
Kidney Disease	27.6	29.3	30.0	30.5	31.9	32.3	31.4	33.7	33.6	31.6
Chronic Obstructive Pulmonary Disease	23.3	24.2	24.4	22.8	21.6	23.1	22.7	22.9	21.8	21.9
Cerebrovascular Disease	19.0	20.6	18.5	17.9	18.6	17.7	17.7	18.2	15.7	17.8
Cancer	14.0	14.6	15.4	13.6	15.6	14.9	14.7	15.1	14.8	15.9
Outcomes										
Length of stay, Mean (SD)	4.2 (4.7)	4.1 (4.2)	4.1 (4.9)	4.0 (4.4)	4.0 (4.1)	3.9 (4.4)	3.5 (4.2)	3.6 (4.1)	3.7 (3.9)	3.7 (4.4)
In-hospital Mortality	6.1	5.8	6.3	5.6	5.4	4.7	5.0	4.4	4.7	3.5
Admitted Hospital Characteristics										
Large Teaching	9.6	9.4	9.5	8.9	9.0	9.1	10.6	9.2	9.6	9.7
Private Not for profit	66.1	65.2	64.7	66.1	63.7	63.4	64.8	70.6	70.6	66.0
Rural	26.2	27.6	27.8	24.0	23.9	24.2	25.4	22.3	19.9	22.2
JC ¹⁴ Accredited	84.1	85.5	86.2	84.0	83.2	84.5	84.1	82.8	82.3	82.0
PCI ¹⁵	49.4	50.3	49.1	55.3	59.4	56.3	63.4	61.8	64.8	71.3
CABG ¹⁶	38.5	38.1	38.8	41.8	44.6	39.3	43.5	44.2	46.0	50.1
Beds, Median (IQR) ¹⁷	189.0 (100.0-332.0)	182.0 (104.0-315.0)	181.0 (100.0-312.0)	192.0 (108.0-329.0)	200.0 (112.0-331.0)	185.0 (104.0-318.0)	185.0 (109.0-337.0)	208.0 (117.0-362.0)	214.0 (131.0-354.0)	209.0 (118.0-358.0)

¹⁴ JC: Joint Commission

¹⁵ PCI: Percutaneous coronary intervention

¹⁶ CABG: Coronary artery bypass graft surgery

¹⁷ IQR: Interquartile Range

eTable 7. Patient Characteristics, Hospital Characteristics, and Outcomes for HF patients, 2010-2019

HF Sample Patient Characteristics (N=42,755)	2010 (N=7,536)	2011 (N=6,962)	2012 (N=4,900)	2013 (N=4,492)	2014 (N=4,820)	2015 (N=2,423)	2016 (N=5,330)	2017 (N=3,779)	2018 (N=1,739)	2019 (N=774)
Demographic	Rate (%)									
Age, Mean (SD) ¹⁸	73.6 (14.2)	73.6 (14.3)	73.7 (14.3)	73.3 (14.2)	72.9 (14.5)	72.9 (14.2)	73.1 (14.4)	73.2 (14.3)	73.2 (14.5)	72.6 (14.0)
Age <65	24.6	25.7	25.3	24.9	28.0	26.3	27.0	26.3	25.6	27.6
Age 65-74	21.2	20.4	21.0	22.5	21.2	23.1	21.7	21.6	21.7	24.2
Age 75-84	29.0	28.3	27.2	28.3	26.3	27.2	26.9	27.2	28.2	26.0
Age 85 and Over	25.2	25.6	26.4	24.3	24.5	23.4	24.4	25.0	24.4	22.2
Female	52.8	51.3	51.5	50.7	49.6	49.3	49.1	48.8	50.5	48.1
American Indian/ Native	0.3	0.7	0.9	0.7	0.8	0.7	0.5	0.7	0.7	1.3
Asian	1.5	1.6	1.5	1.8	1.6	1.7	1.3	1.3	1.4	2.1
Black (Non-Hispanic)	16.5	16.8	17.4	15.3	16.9	17.5	16.0	15.3	16.3	19.9
Hispanic	5.7	5.5	5.1	6.4	5.0	4.7	5.6	5.2	6.4	5.0
Native Hawaiian/Pacific Islander	0.2	0.2	0.2	0.1	0.2	0.2	0.4	0.3	0.1	0.3
Other ¹⁹	1.9	1.5	1.8	1.3	1.8	1.6	1.8	1.4	1.5	2.3
White (Non-Hispanic)	73.9	73.7	73.1	74.4	73.7	73.8	74.3	75.8	73.5	69.1
Risk Factors										
Corticosteroids	7.1	7.1	7.4	7.0	7.0	6.6	7.3	8.1	9.0	8.0
Obesity	26.8	28.6	32.2	33.0	35.8	38.1	41.3	43.3	42.3	46.3
Smoking	18.5	19.3	20.4	21.0	23.6	24.6	27.0	27.1	28.8	31.7
Comorbidities										
Congestive Heart Failure	98.4	98.8	98.6	98.7	98.1	98.5	97.9	98.1	98.6	96.9

¹⁸ SD: Standard Deviation

¹⁹ Other race includes any identified race not included in the listed categories and mixed race.

HF Sample Patient Characteristics (N=42,755)	2010 (N=7,536)	2011 (N=6,962)	2012 (N=4,900)	2013 (N=4,492)	2014 (N=4,820)	2015 (N=2,423)	2016 (N=5,330)	2017 (N=3,779)	2018 (N=1,739)	2019 (N=774)
Coronary Artery Disease	64.0	65.1	62.9	61.7	60.8	61.0	57.9	61.0	58.8	56.6
Kidney Disease	46.0	47.0	50.6	50.3	51.2	50.3	53.4	56.7	57.0	55.7
Diabetes Mellitus	49.3	49.9	50.0	49.8	51.0	50.2	50.8	50.7	50.9	50.8
Chronic Obstructive Pulmonary Disease	41.7	42.9	42.2	41.6	39.9	42.6	42.9	42.9	40.7	39.3
Cancer	18.0	17.8	16.9	17.7	17.9	17.8	17.6	20.1	18.4	19.5
Cerebrovascular Disease	21.2	22.4	20.6	21.7	20.3	18.6	20.4	20.5	21.5	18.7
Outcomes										
Length of stay, Mean (SD)	4.7 (4.3)	4.6 (4.0)	4.6 (3.8)	4.7 (4.2)	4.8 (4.2)	4.5 (3.8)	4.5 (4.0)	4.5 (4.1)	4.6 (4.4)	4.5 (3.8)
In-hospital Mortality	2.8	3.3	4.0	3.1	2.9	2.6	2.5	2.9	2.3	2.5
Admitted Hospital Characteristics										
Large Teaching	8.7	8.0	7.9	7.9	7.9	6.9	8.4	7.7	7.5	8.0
Private Not for profit	63.0	61.6	61.4	63.9	63.2	61.0	63.1	67.3	67.6	65.4
Rural	28.7	33.0	33.8	30.4	31.6	32.9	33.8	33.4	32.8	31.3
JC ²⁰ Accredited	81.6	81.3	81.4	78.3	79.0	79.8	78.7	79.0	75.7	78.9
PCI ²¹	45.8	43.8	43.3	48.6	51.7	45.5	48.4	46.6	47.1	55.9
CABG ²²	35.0	32.9	33.9	36.5	38.5	30.7	32.1	32.8	33.2	38.8
Beds, Median (IQR) ²³	175.0 (87.0-314.0)	160.0 (82.0-282.0)	155.0 (82.0-279.0)	168.0 (86.0-301.0)	174.0 (86.0-308.0)	149.0 (72.0-273.0)	140.0 (76.0-268.0)	156.0 (78.0-303.0)	161.0 (83.0-295.0)	167.0 (91.0-315.0)

²⁰ JC: Joint Commission

²¹ PCI: Percutaneous coronary intervention

²² CABG: Coronary artery bypass graft surgery

²³ IQR: Interquartile Range

eTable 8. Patient Characteristics, Hospital Characteristics, and Outcomes for Pneumonia patients, 2010-2019

Pneumonia Sample Patient Characteristics (N=52,125)	2010 (N=9,311)	2011 (N=9,744)	2012 (N=8,730)	2013 (N=4,666)	2014 (N=4,941)	2015 (N=2,427)	2016 (N=5,737)	2017 (N=4,004)	2018 (N=1,707)	2019 (N=858)
Demographic	Rate (%)									
Age, Mean (SD) ²⁴	68.6 (17.1)	68.9 (16.9)	69.0 (16.7)	68.5 (16.9)	68.5 (16.7)	69.5 (16.3)	68.3 (16.9)	68.9 (16.7)	69.2 (16.3)	67.7 (16.6)
Age <65	36.3	36.3	35.7	36.7	36.7	35.0	37.5	35.9	34.6	39.2
Age 65-74	21.2	20.6	21.1	22.2	22.7	20.9	22.3	22.1	23.1	23.9
Age 75-84	23.4	23.5	24.4	22.6	22.8	25.1	22.0	23.2	24.0	20.7
Age 85 and Over	19.1	19.6	18.9	18.5	17.8	19.0	18.1	18.9	18.4	16.2
Female	51.9	52.0	52.9	52.2	50.4	53.2	51.1	54.1	50.7	49.1
American Indian/ Native	0.6	1.0	1.3	1.3	1.0	1.0	1.2	0.6	1.3	2.2
Asian	1.6	1.8	1.9	2.0	1.5	1.7	1.4	1.6	1.4	1.4
Black (Non-Hispanic)	11.7	11.4	11.7	11.5	11.3	10.7	12.2	10.8	10.8	14.0
Hispanic	5.2	5.2	5.1	6.0	5.4	5.7	5.3	5.2	5.7	5.6
Native Hawaiian/Pacific Islander	0.0	0.1	0.1	0.1	0.2	0.1	0.1	0.2	0.1	0.2
Other ²⁵	2.0	2.2	2.1	1.6	2.1	2.0	1.9	1.9	2.1	3.0
White (Non-Hispanic)	78.9	78.3	77.9	77.5	78.5	78.8	77.8	79.7	78.6	73.5
Risk Factors										
Corticosteroids	12.7	13.2	13.9	13.7	13.2	15.0	13.0	13.3	14.2	14.8
Obesity	19.4	20.3	22.6	24.4	26.8	28.1	29.3	31.7	31.0	31.4
Smoking	25.5	26.5	27.3	28.8	30.2	30.7	31.6	32.3	37.4	36.1
Comorbidities										
Chronic Obstructive Pulmonary Disease	46.3	46.7	45.8	46.2	47.0	47.5	44.1	40.5	45.6	44.1
Kidney Disease	29.0	29.0	30.5	33.6	34.4	33.9	34.4	36.7	39.4	36.7
Diabetes Mellitus	34.9	35.4	35.2	35.2	35.9	34.8	36.2	35.7	35.7	35.7
Congestive Heart Failure	34.3	33.7	32.2	32.9	33.5	33.7	33.0	33.0	36.3	31.5
Coronary Artery Disease	36.6	36.8	35.1	35.1	34.7	33.2	32.6	35.3	32.5	30.7

²⁴ SD: Standard Deviation

²⁵ Other race includes any identified race not included in the listed categories and mixed race.

Pneumonia Sample Patient Characteristics (N=52,125)	2010 (N=9,311)	2011 (N=9,744)	2012 (N=8,730)	2013 (N=4,666)	2014 (N=4,941)	2015 (N=2,427)	2016 (N=5,737)	2017 (N=4,004)	2018 (N=1,707)	2019 (N=858)
Cancer	23.9	22.2	22.7	22.5	23.1	23.1	22.9	24.5	22.8	23.3
Cerebrovascular Disease	18.3	18.3	17.9	16.7	17.7	17.1	16.5	17.9	17.7	16.8
Outcomes										
Length of stay, Mean (SD)	6.2 (6.3)	5.9 (6.3)	5.8 (5.6)	6.1 (6.6)	5.9 (6.0)	5.5 (5.5)	5.5 (5.7)	5.6 (6.1)	5.7 (5.4)	5.7 (6.2)
In-hospital Mortality	7.9	7.7	7.0	7.1	8.0	6.8	6.3	7.0	6.7	6.2
Admitted Hospital Characteristics										
Large Teaching	8.8	7.8	7.7	7.5	7.6	6.1	7.9	7.1	7.0	7.2
Private Not for profit	63.5	60.7	59.5	62.6	61.8	59.5	61.9	66.1	67.4	65.9
Rural	29.3	33.2	34.7	31.5	33.6	35.3	34.9	35.1	33.7	34.8
JC ²⁶ Accredited	81.2	80.1	80.6	77.0	77.2	78.3	77.0	77.8	72.8	74.7
PCI ²⁷	44.9	42.3	41.1	46.5	49.5	40.9	44.8	44.7	43.6	50.8
CABG ²⁸	34.6	32.0	32.1	34.8	36.8	27.2	29.5	30.9	30.4	34.7
Beds, Median (IQR) ²⁹	173.0 (85.0-312.0)	155.5 (78.0-277.0)	151.0 (77.0-267.0)	159.0 (79.0-296.0)	161.0 (77.0-297.0)	131.0 (60.0-249.0)	131.0 (69.0-251.0)	148.0 (74.0-290.0)	150.0 (72.0-279.0)	150.0 (80.0-293.0)

²⁶ JC: Joint Commission

²⁷ PCI: Percutaneous coronary intervention

²⁸ CABG: Coronary artery bypass graft surgery

²⁹ IQR: Interquartile Range

eTable 9. Patient Characteristics, Hospital Characteristics, and Outcomes for SCIP patients, 2010-2019

SCIP Sample Patient Characteristics (N=54,599)	2010 (N=9,104)	2011 (N=10,148)	2012 (N=8,692)	2013 (N=4,767)	2014 (N=5,480)	2015 (N=2,817)	2016 (N=5,920)	2017 (N=3,880)	2018 (N=1,930)	2019 (N=1,861)
Demographic	Rate (%)									
Age, Mean (SD) ³⁰	61.0 (16.0)	61.0 (15.6)	61.9 (15.4)	62.5 (15.1)	62.2 (14.5)	62.8 (14.3)	62.5 (14.9)	63.2 (15.0)	64.4 (14.5)	64.0 (14.9)
Age <65	54.9	55.4	53.1	51.2	53.4	51.7	51.1	48.6	44.8	45.4
Age 65-74	23.0	23.7	24.7	26.3	26.0	28.0	27.6	28.6	30.7	29.9
Age 75-84	16.3	15.6	16.5	16.7	15.5	14.7	16.1	17.2	18.3	19.3
Age 85 and Over	5.9	5.4	5.8	5.7	5.0	5.6	5.2	5.7	6.2	5.4
Female	65.1	64.3	63.2	60.9	59.5	61.0	61.6	59.3	58.9	58.0
American Indian/ Native	0.4	0.7	0.7	0.4	0.5	0.7	0.8	0.4	0.6	0.7
Asian	1.5	1.5	1.4	1.6	1.0	1.2	1.3	1.5	1.0	1.2
Black (Non-Hispanic)	10.7	10.3	10.3	10.1	9.9	10.1	10.3	8.8	8.7	10.8
Hispanic	5.4	5.3	5.6	5.8	4.7	4.2	5.4	6.2	6.9	5.4
Native Hawaiian/Pacific Islander	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.2	0.3
Other ³¹	3.2	3.1	2.7	2.6	3.3	2.5	2.8	2.5	4.0	4.4
White (Non-Hispanic)	78.8	79.0	79.2	79.4	80.5	81.3	79.2	80.4	78.5	77.3
Risk Factors										
Corticosteroids	2.5	2.8	3.1	3.0	2.7	3.2	2.8	3.4	3.5	3.4
Obesity	24.8	28.9	32.2	34.2	37.2	43.2	43.5	43.6	41.9	43.2
Smoking	21.5	21.6	22.0	22.1	22.4	21.7	22.9	24.8	23.2	25.1
Comorbidities										
Diabetes Mellitus	22.3	22.8	22.5	23.2	22.1	23.0	23.1	23.9	25.5	23.5

³⁰ SD: Standard Deviation

³¹ Other race includes any identified race not included in the listed categories and mixed race.

SCIP Sample Patient Characteristics (N=54,599)	2010 (N=9,104)	2011 (N=10,148)	2012 (N=8,692)	2013 (N=4,767)	2014 (N=5,480)	2015 (N=2,817)	2016 (N=5,920)	2017 (N=3,880)	2018 (N=1,930)	2019 (N=1,861)
Coronary Artery Disease	21.6	20.9	21.2	21.5	20.9	18.1	17.0	19.9	21.1	20.9
Cancer	21.0	21.1	21.4	21.8	21.8	19.1	18.6	18.4	19.8	19.4
Kidney Disease	8.8	8.9	10.3	10.8	11.7	11.5	11.2	13.9	15.0	16.8
Chronic Obstructive Pulmonary Disease	12.7	12.2	12.6	13.0	12.2	13.1	12.0	13.3	12.3	12.8
Congestive Heart Failure	8.6	8.2	8.4	7.5	7.6	7.7	8.0	9.1	9.5	9.7
Cerebrovascular Disease	8.6	8.3	8.2	8.9	7.8	8.3	7.7	9.0	8.9	9.0
Outcomes										
Length of stay, Mean (SD)	5.4 (6.1)	5.0 (5.5)	5.2 (5.4)	5.1 (5.7)	4.8 (5.0)	4.4 (4.8)	4.3 (5.2)	4.4 (5.1)	4.6 (5.3)	4.6 (5.7)
In-hospital Mortality	1.5	1.5	1.5	1.6	1.1	1.1	0.9	1.2	1.3	1.0
Admitted Hospital Characteristics										
Large Teaching	8.5	7.3	7.9	7.6	7.3	5.0	8.9	7.6	8.8	8.7
Private Not for profit	60.6	54.8	57.8	57.6	54.8	51.1	58.9	63.5	66.6	67.2
Rural	26.6	25.9	28.5	24.5	24.8	24.7	28.6	28.6	26.7	27.5
JC ³² Accredited	81.7	81.0	82.2	78.4	76.6	78.0	79.4	77.8	79.6	85.1
PCI ³³	43.4	39.5	39.9	44.9	46.9	38.6	44.6	46.3	48.3	56.5
CABG ³⁴	33.1	29.5	31.2	33.1	34.2	25.9	29.6	32.2	34.9	40.7
Beds, Median (IQR) ³⁵	165.0 (77.5-300.0)	140.0 (60.0-263.5)	143.0 (70.0-262.0)	148.0 (71.0-286.0)	143.5 (64.0-288.0)	123.0 (46.0-243.0)	138.0 (67.0-252.0)	150.5 (73.5-300.0)	160.0 (78.0-295.0)	169.0 (88.0-322.0)

³² JC: Joint Commission

³³ PCI: Percutaneous coronary intervention

³⁴ CABG: Coronary artery bypass graft surgery

³⁵ IQR: Interquartile Range

eTable 10. MPSMS Adverse Event and Exposure Data for AMI patients, 2010-2019³⁶

2010-2014

Measure	2010	2011	2012	2013	2014
	adverse events/exposures (% (CI))				
Adverse Drug Events					
Adverse Events Associated with Digoxin	4/294 (1.4 [0.4-3.5])	4/224 (1.8 [0.5-4.5])	2/161 (1.2 [0.2-4.4])	1/89 (1.1 [0.0-6.1])	2/94 (2.1 [0.3-7.5])
Adverse Events Associated with Hypoglycemic Agents	262/2926 (9.0 [7.9-10.1])	265/2733 (9.7 [8.6-10.9])	140/1837 (7.6 [6.5-8.9])	113/1542 (7.3 [6.1-8.7])	111/1583 (7.0 [5.8-8.4])
Adverse Events Associated with IV Heparin	203/2274 (8.9 [7.8-10.2])	184/2236 (8.2 [7.1-9.5])	141/1540 (9.2 [7.8-10.7])	104/1322 (7.9 [6.5-9.5])	128/1446 (8.9 [7.4-10.4])
Adverse Events Associated with Low Molecular Weight Heparin and Factor Xa Inhibitor	150/3463 (4.3 [3.7-5.1])	126/3142 (4.0 [3.4-4.8])	97/2179 (4.5 [3.6-5.4])	56/1680 (3.3 [2.5-4.3])	68/1646 (4.1 [3.2-5.2])
Adverse Events Associated with Warfarin	38/595 (6.4 [4.6-8.7])	29/486 (6.0 [4.0-8.5])	21/351 (6.0 [3.7-9.0])	19/238 (8.0 [4.9-12.2])	17/258 (6.6 [3.9-10.3])
General Adverse Events					
Hospital-Acquired Pressure Ulcers	253/7727 (3.3 [2.9-3.7])	283/7113 (4.0 [3.5-4.5])	161/4934 (3.3 [2.8-3.8])	107/4027 (2.7 [2.2-3.2])	94/4234 (2.2 [1.8-2.7])
Inpatient Falls	56/7727 (0.7 [0.6-0.9])	48/7113 (0.7 [0.5-0.9])	36/4934 (0.7 [0.5-1.0])	29/4027 (0.7 [0.5-1.0])	35/4234 (0.8 [0.6-1.2])
Hospital-Acquired Infections					
Hospital-Acquired Antibiotic-Associated Clostridium difficile	15/2906 (0.5 [0.3-0.9])	14/2698 (0.5 [0.3-0.9])	10/1829 (0.5 [0.3-1.0])	6/1436 (0.4 [0.2-0.9])	7/1443 (0.5 [0.2-1.0])
Central Line-Associated Blood Stream Infections	10/881 (1.1 [0.6-2.1])	5/705 (0.7 [0.2-1.7])	5/534 (0.9 [0.3-2.2])	1/427 (0.2 [0.0-1.3])	0/531 (0.0 [0.0-0.7])
Catheter-Associated Urinary Tract Infections	134/2287 (5.9 [4.9-6.9])	108/2081 (5.2 [4.3-6.2])	59/1408 (4.2 [3.2-5.4])	45/1000 (4.5 [3.3-6.0])	36/1091 (3.3 [2.3-4.5])
Hospital-Acquired Methicillin-Resistant Staphylococcus Aureus	2/7586 (0.0 [0.0-0.1])	3/6981 (0.0 [0.0-0.1])	1/4829 (0.0 [0.0-0.1])	3/3966 (0.1 [0.0-0.2])	5/4187 (0.1 [0.0-0.3])
Hospital-Acquired Vancomycin-Resistant Enterococcus	0/7711 (0.0 [0.0-0.1])	0/7098 (0.0 [0.0-0.1])	0/4929 (0.0 [0.0-0.1])	1/4016 (0.0 [0.0-0.1])	0/4226 (0.0 [0.0-0.1])

³⁶ Note: the same adverse event may be counted twice in this table, e.g., some instances of ventilator-associated pneumonia may also be cases of postoperative pneumonia, but these adverse events are only counted once in the analyzed summary data presented in the text and figures in this paper

Measure	2010	2011	2012	2013	2014
	adverse events/exposures (% (CI))				
Postoperative Pneumonia	21/416 (5.0 [3.2-7.6])	24/364 (6.6 [4.3-9.7])	18/279 (6.5 [3.9-10.0])	7/236 (3.0 [1.2-6.0])	10/282 (3.5 [1.7-6.4])
Ventilator-Associated Pneumonia	22/228 (9.6 [6.2-14.2])	17/175 (9.7 [5.8-15.1])	13/150 (8.7 [4.7-14.4])	16/121 (13.2 [7.8-20.6])	16/129 (12.4 [7.3-19.4])
Post-Procedure Adverse Events					
Adverse Events Associated with Femoral Artery Puncture for Catheter Angiographic Procedures	85/3508 (2.4 [1.9-3.0])	59/3132 (1.9 [1.4-2.4])	57/2109 (2.7 [2.1-3.5])	32/1710 (1.9 [1.3-2.6])	42/1869 (2.2 [1.6-3.0])
Adverse Events Associated with Hip Joint Replacement	2/4 (50.0 [6.8-93.2])				0/1 (0.0 [0.0-97.5])
Contrast Nephropathy Associated with Catheter Angiography	371/3494 (10.6 [9.6-11.7])	364/3260 (11.2 [10.1-12.3])	221/2278 (9.7 [8.5-11.0])	209/1958 (10.7 [9.3-12.1])	238/2214 (10.7 [9.5-12.1])
Mechanical Complications Associated with Central Lines	37/1064 (3.5 [2.5-4.8])	24/909 (2.6 [1.7-3.9])	28/671 (4.2 [2.8-6.0])	21/538 (3.9 [2.4-5.9])	22/637 (3.5 [2.2-5.2])
Postoperative Cardiac Events (Cardiac and Non-cardiac Surgeries)	17/442 (3.8 [2.3-6.1])	14/396 (3.5 [2.0-5.9])	18/310 (5.8 [3.5-9.0])	9/252 (3.6 [1.7-6.7])	14/302 (4.6 [2.6-7.7])
Postoperative Venous Thromboembolic Event	1/442 (0.2 [0.0-1.3])	2/396 (0.5 [0.1-1.8])	4/310 (1.3 [0.4-3.3])	4/252 (1.6 [0.4-4.0])	1/302 (0.3 [0.0-1.8])
Overall					
Occurrence rate (exposure)	1683/55975 (3.0 [2.9-3.2])	1573/51242 (3.1 [2.9-3.2])	1032/35572 (2.9 [2.7-3.1])	783/28837 (2.7 [2.5-2.9])	846/30709 (2.8 [2.6-2.9])
At-least one (discharge)	1234/7727 (16.0 [15.2-16.8])	1176/7113 (16.5 [15.7-17.4])	752/4934 (15.2 [14.3-16.3])	587/4027 (14.6 [13.5-15.7])	646/4234 (15.3 [14.2-16.4])
Number of AE (per 1,000 discharges)	1683/7727 (217.8 [208.7-227.2])	1573/7113 (221.1 [211.6-231.0])	1032/4934 (209.2 [197.9-220.8])	783/4027 (194.4 [182.3-207.0])	846/4234 (199.8 [187.9-212.2])
In-hospital mortality (%)	472/7727 (6.1 [5.6-6.7])	413/7113 (5.8 [5.3-6.4])	313/4934 (6.3 [5.7-7.1])	226/4027 (5.6 [4.9-6.4])	229/4234 (5.4 [4.8-6.1])
Mean age (SD)	538189/7727 (69.7 [14.9])	495586/7113 (69.7 [14.9])	344670/4934 (69.9 [14.9])	278438/4027 (69.1 [14.6])	292210/4234 (69.0 [14.5])
Mean LOS (SD)	32704/7727 (4.2 [4.7])	28950/7113 (4.1 [4.2])	20219/4934 (4.1 [4.9])	16151/4027 (4.0 [4.4])	16826/4234 (4.0 [4.1])
Mean number of exposures (SD)	7.2 (2.5)	7.2 (2.4)	7.2 (2.5)	7.2 (2.5)	7.3 (2.6)

Measure	2010	2011	2012	2013	2014
	adverse events/exposures (% (CI))				
Median number of exposures (IQR)	7.0 (6.0-8.0)	7.0 (6.0-8.0)	7.0 (6.0-8.0)	7.0 (6.0-8.0)	7.0 (6.0-8.0)

2015-2019

Measure	2015	2016	2017	2018	2019
	adverse events/exposures (% (CI))				
Adverse Drug Events					
Adverse Events Associated with Digoxin	0/63 (0.0 [0.0-5.7])	1/72 (1.4 [0.0-7.5])	0/43 (0.0 [0.0-8.2])	0/10 (0.0 [0.0-30.9])	0/8 (0.0 [0.0-36.9])
Adverse Events Associated with Hypoglycemic Agents	82/1488 (5.5 [4.4-6.8])	70/1359 (5.2 [4.0-6.5])	46/870 (5.3 [3.9-7.0])	29/584 (5.0 [3.4-7.1])	5/184 (2.7 [0.9-6.2])
Adverse Events Associated with IV Heparin	85/1326 (6.4 [5.2-7.9])	67/1183 (5.7 [4.4-7.1])	45/910 (4.9 [3.6-6.6])	29/643 (4.5 [3.0-6.4])	6/275 (2.2 [0.8-4.7])
Adverse Events Associated with Low Molecular Weight Heparin and Factor Xa Inhibitor	42/1664 (2.5 [1.8-3.4])	23/1405 (1.6 [1.0-2.5])	9/898 (1.0 [0.5-1.9])	10/536 (1.9 [0.9-3.4])	1/143 (0.7 [0.0-3.8])
Adverse Events Associated with Warfarin	9/249 (3.6 [1.7-6.8])	4/177 (2.3 [0.6-5.7])	3/124 (2.4 [0.5-6.9])	2/57 (3.5 [0.4-12.1])	1/18 (5.6 [0.1-27.3])
General Adverse Events					
Hospital-Acquired Pressure Ulcers	115/4076 (2.8 [2.3-3.4])	74/3797 (1.9 [1.5-2.4])	47/2651 (1.8 [1.3-2.4])	38/1681 (2.3 [1.6-3.1])	14/567 (2.5 [1.4-4.1])
Inpatient Falls	17/4076 (0.4 [0.2-0.7])	16/3797 (0.4 [0.2-0.7])	14/2651 (0.5 [0.3-0.9])	10/1681 (0.6 [0.3-1.1])	2/567 (0.4 [0.0-1.3])
Hospital-Acquired Infections					
Hospital-Acquired Antibiotic-Associated Clostridium difficile	6/1360 (0.4 [0.2-1.0])	6/1140 (0.5 [0.2-1.1])	3/754 (0.4 [0.1-1.2])	3/498 (0.6 [0.1-1.8])	0/169 (0.0 [0.0-2.2])
Central Line-Associated Blood Stream Infections	1/419 (0.2 [0.0-1.3])	1/311 (0.3 [0.0-1.8])	0/197 (0.0 [0.0-1.9])	1/151 (0.7 [0.0-3.6])	0/47 (0.0 [0.0-7.6])
Catheter-Associated Urinary Tract Infections	36/966 (3.7 [2.6-5.1])	17/717 (2.4 [1.4-3.8])	15/490 (3.1 [1.7-5.0])	10/327 (3.1 [1.5-5.6])	5/96 (5.2 [1.7-11.7])
Hospital-Acquired Methicillin-Resistant Staphylococcus Aureus	0/4024 (0.0 [0.0-0.1])	1/3765 (0.0 [0.0-0.2])	2/2630 (0.1 [0.0-0.3])	0/1667 (0.0 [0.0-0.2])	0/561 (0.0 [0.0-0.7])
Hospital-Acquired Vancomycin-Resistant Enterococcus	0/4067 (0.0 [0.0-0.1])	0/3791 (0.0 [0.0-0.1])	0/2643 (0.0 [0.0-0.1])	0/1673 (0.0 [0.0-0.2])	0/566 (0.0 [0.0-0.7])

Measure	2015	2016	2017	2018	2019
	adverse events/exposures (% (CI))				
Postoperative Pneumonia	6/151 (4.0 [1.5-8.5])	2/120 (1.7 [0.2-5.9])	2/81 (2.5 [0.3-8.6])	0/57 (0.0 [0.0-6.3])	0/21 (0.0 [0.0-16.1])
Ventilator-Associated Pneumonia	12/109 (11.0 [5.8-18.4])	5/63 (7.9 [2.6-17.6])	7/61 (11.5 [4.7-22.2])	3/43 (7.0 [1.5-19.1])	4/17 (23.5 [6.8-49.9])
Post-Procedure Adverse Events					
Adverse Events Associated with Femoral Artery Puncture for Catheter Angiographic Procedures	44/1615 (2.7 [2.0-3.6])	54/1555 (3.5 [2.6-4.5])	14/946 (1.5 [0.8-2.5])	26/667 (3.9 [2.6-5.7])	8/207 (3.9 [1.7-7.5])
Adverse Events Associated with Hip Joint Replacement			0/1 (0.0 [0.0-97.5])		
Contrast Nephropathy Associated with Catheter Angiography	196/2027 (9.7 [8.4-11.0])	158/2034 (7.8 [6.6-9.0])	117/1444 (8.1 [6.8-9.6])	103/963 (10.7 [8.8-12.8])	27/354 (7.6 [5.1-10.9])
Mechanical Complications Associated with Central Lines	21/550 (3.8 [2.4-5.8])	8/407 (2.0 [0.9-3.8])	7/266 (2.6 [1.1-5.4])	9/193 (4.7 [2.2-8.7])	2/65 (3.1 [0.4-10.7])
Postoperative Cardiac Events (Cardiac and Non-cardiac Surgeries)	11/156 (7.1 [3.6-12.3])	4/121 (3.3 [0.9-8.3])	6/87 (6.9 [2.6-14.4])	8/62 (12.9 [5.7-23.9])	3/22 (13.6 [2.9-34.9])
Postoperative Venous Thromboembolic Event	0/156 (0.0 [0.0-2.3])	1/121 (0.8 [0.0-4.5])	1/87 (1.1 [0.0-6.2])	0/62 (0.0 [0.0-5.8])	1/22 (4.5 [0.1-22.8])
Overall					
Occurrence rate (exposure)	683/28542 (2.4 [2.2-2.6])	512/25935 (2.0 [1.8-2.2])	338/17834 (1.9 [1.7-2.1])	281/11555 (2.4 [2.2-2.7])	79/3909 (2.0 [1.6-2.5])
At-least one (discharge)	530/4076 (13.0 [12.0-14.1])	407/3797 (10.7 [9.8-11.8])	267/2651 (10.1 [9.0-11.3])	223/1681 (13.3 [11.7-15.0])	65/567 (11.5 [9.0-14.4])
Number of AE (per 1,000 discharges)	683/4076 (167.6 [156.2-179.4])	512/3797 (134.8 [124.1-146.1])	338/2651 (127.5 [115.0-140.8])	281/1681 (167.2 [149.6-185.9])	79/567 (139.3 [111.9-170.6])
In-hospital mortality (%)	192/4076 (4.7 [4.1-5.4])	189/3797 (5.0 [4.3-5.7])	116/2651 (4.4 [3.6-5.2])	79/1681 (4.7 [3.7-5.8])	20/567 (3.5 [2.2-5.4])
Mean age (SD)	282374/4076 (69.3 [14.5])	260803/3797 (68.7 [14.5])	181006/2651 (68.3 [14.6])	115406/1681 (68.7 [14.5])	39153/567 (69.1 [14.4])
Mean LOS (SD)	15719/4076 (3.9 [4.4])	13435/3797 (3.5 [4.2])	9442/2651 (3.6 [4.1])	6226/1681 (3.7 [3.9])	2081/567 (3.7 [4.4])
Mean number of exposures (SD)	7.0 (2.2)	6.8 (2.0)	6.7 (2.1)	6.9 (2.1)	6.9 (2.1)

Measure	2015	2016	2017	2018	2019
	adverse events/exposures (% (CI))				
Median number of exposures (IQR)	7.0 (6.0-8.0)	6.0 (6.0-8.0)	6.0 (5.0-7.0)	6.0 (6.0-7.0)	6.0 (6.0-8.0)

eTable 11. MPSMS Adverse Event and Exposure Data for HF patients, 2010-2019³⁷

2010-2014

Measure	2010	2011	2012	2013	2014
	adverse events/exposures (% (CI))				
Adverse Drug Events					
Adverse Events Associated with Digoxin	4/770 (0.5 [0.1-1.3])	2/641 (0.3 [0.0-1.1])	4/411 (1.0 [0.3-2.5])	0/387 (0.0 [0.0-1.0])	1/364 (0.3 [0.0-1.5])
Adverse Events Associated with Hypoglycemic Agents	417/3360 (12.4 [11.3-13.6])	382/3114 (12.3 [11.1-13.5])	213/2163 (9.8 [8.6-11.2])	189/1944 (9.7 [8.4-11.1])	243/2077 (11.7 [10.4-13.2])
Adverse Events Associated with IV Heparin	41/284 (14.4 [10.6-19.1])	31/276 (11.2 [7.8-15.6])	18/220 (8.2 [4.9-12.6])	21/202 (10.4 [6.6-15.5])	27/202 (13.4 [9.0-18.9])
Adverse Events Associated with Low Molecular Weight Heparin and Factor Xa Inhibitor	70/2679 (2.6 [2.0-3.3])	69/2515 (2.7 [2.1-3.5])	44/1774 (2.5 [1.8-3.3])	26/1642 (1.6 [1.0-2.3])	30/1807 (1.7 [1.1-2.4])
Adverse Events Associated with Warfarin	70/1783 (3.9 [3.1-4.9])	57/1557 (3.7 [2.8-4.7])	38/1047 (3.6 [2.6-5.0])	30/991 (3.0 [2.1-4.3])	31/1010 (3.1 [2.1-4.3])
General Adverse Events					
Hospital-Acquired Pressure Ulcers	346/7536 (4.6 [4.1-5.1])	305/6962 (4.4 [3.9-4.9])	223/4900 (4.6 [4.0-5.2])	179/4492 (4.0 [3.4-4.6])	187/4820 (3.9 [3.4-4.5])
Inpatient Falls	83/7536 (1.1 [0.9-1.4])	82/6962 (1.2 [0.9-1.5])	49/4900 (1.0 [0.7-1.3])	44/4492 (1.0 [0.7-1.3])	59/4820 (1.2 [0.9-1.6])
Hospital-Acquired Infections					
Hospital-Acquired Antibiotic-Associated Clostridium difficile	12/3801 (0.3 [0.2-0.6])	14/3447 (0.4 [0.2-0.7])	9/2438 (0.4 [0.2-0.7])	12/2205 (0.5 [0.3-1.0])	11/2303 (0.5 [0.2-0.9])
Central Line-Associated Blood Stream Infections	3/333 (0.9 [0.2-2.6])	4/299 (1.3 [0.4-3.4])	0/207 (0.0 [0.0-1.8])	1/213 (0.5 [0.0-2.6])	1/242 (0.4 [0.0-2.3])
Catheter-Associated Urinary Tract Infections	136/2523 (5.4 [4.5-6.3])	117/2289 (5.1 [4.3-6.1])	79/1578 (5.0 [4.0-6.2])	51/1282 (4.0 [3.0-5.2])	62/1302 (4.8 [3.7-6.1])
Hospital-Acquired Methicillin-Resistant Staphylococcus Aureus	3/7358 (0.0 [0.0-0.1])	4/6792 (0.1 [0.0-0.2])	1/4786 (0.0 [0.0-0.1])	1/4386 (0.0 [0.0-0.1])	2/4726 (0.0 [0.0-0.2])
Hospital-Acquired Vancomycin-Resistant Enterococcus	3/7511 (0.0 [0.0-0.1])	0/6932 (0.0 [0.0-0.1])	0/4877 (0.0 [0.0-0.1])	1/4470 (0.0 [0.0-0.1])	1/4794 (0.0 [0.0-0.1])

³⁷ Note: the same adverse event may be counted twice in this table, e.g., some instances of ventilator-associated pneumonia may also be cases of postoperative pneumonia, but these adverse events are only counted once in the analyzed summary data presented in the text and figures in this paper

Measure	2010	2011	2012	2013	2014
	adverse events/exposures (% (CI))				
Postoperative Pneumonia	1/31 (3.2 [0.1-16.7])	0/22 (0.0 [0.0-15.4])	0/13 (0.0 [0.0-24.7])	0/22 (0.0 [0.0-15.4])	1/15 (6.7 [0.2-32.0])
Ventilator-Associated Pneumonia	1/46 (2.2 [0.1-11.5])	3/46 (6.5 [1.4-17.9])	2/40 (5.0 [0.6-16.9])	6/34 (17.6 [6.8-34.5])	1/28 (3.6 [0.1-18.4])
Post-Procedure Adverse Events					
Adverse Events Associated with Femoral Artery Puncture for Catheter Angiographic Procedures	1/407 (0.2 [0.0-1.4])	7/318 (2.2 [0.9-4.5])	1/203 (0.5 [0.0-2.7])	1/208 (0.5 [0.0-2.7])	5/186 (2.7 [0.9-6.2])
Adverse Events Associated with Hip Joint Replacement		0/1 (0.0 [0.0-97.5])			
Contrast Nephropathy Associated with Catheter Angiography	55/399 (13.8 [10.6-17.6])	35/311 (11.3 [8.0-15.3])	37/215 (17.2 [12.4-22.9])	32/233 (13.7 [9.6-18.8])	28/210 (13.3 [9.1-18.7])
Mechanical Complications Associated with Central Lines	17/513 (3.3 [1.9-5.3])	25/466 (5.4 [3.5-7.8])	10/328 (3.0 [1.5-5.5])	12/333 (3.6 [1.9-6.2])	12/371 (3.2 [1.7-5.6])
Postoperative Cardiac Events (Cardiac and Non-cardiac Surgeries)	2/41 (4.9 [0.6-16.5])	0/28 (0.0 [0.0-12.3])	0/18 (0.0 [0.0-18.5])	0/25 (0.0 [0.0-13.7])	1/17 (5.9 [0.2-28.7])
Postoperative Venous Thromboembolic Event	1/41 (2.4 [0.1-12.9])	0/28 (0.0 [0.0-12.3])	0/18 (0.0 [0.0-18.5])	0/25 (0.0 [0.0-13.7])	0/17 (0.0 [0.0-19.5])
Overall					
Occurrence rate (exposure)	1266/46952 (2.7 [2.6-2.9])	1137/43006 (2.6 [2.5-2.8])	728/30136 (2.4 [2.3-2.6])	606/27586 (2.2 [2.0-2.4])	703/29311 (2.4 [2.2-2.6])
At-least one (discharge)	1052/7536 (14.0 [13.2-14.8])	957/6962 (13.7 [13.0-14.6])	615/4900 (12.6 [11.6-13.5])	514/4492 (11.4 [10.5-12.4])	588/4820 (12.2 [11.3-13.2])
Number of AE (per 1,000 discharges)	1266/7536 (168.0 [159.6-176.6])	1137/6962 (163.3 [154.7-172.2])	728/4900 (148.6 [138.7-158.8])	606/4492 (134.9 [125.0-145.3])	703/4820 (145.9 [136.0-156.1])
In-hospital mortality (%)	213/7536 (2.8 [2.5-3.2])	230/6962 (3.3 [2.9-3.8])	197/4900 (4.0 [3.5-4.6])	139/4492 (3.1 [2.6-3.6])	142/4820 (2.9 [2.5-3.5])
Mean age (SD)	554970/7536 (73.6 [14.2])	512573/6962 (73.6 [14.3])	361264/4900 (73.7 [14.3])	329442/4492 (73.3 [14.2])	351296/4820 (72.9 [14.5])
Mean LOS (SD)	35791/7536 (4.7 [4.3])	31954/6962 (4.6 [4.0])	22563/4900 (4.6 [3.8])	21058/4492 (4.7 [4.2])	22983/4820 (4.8 [4.2])
Mean number of exposures (SD)	6.2 (1.5)	6.2 (1.5)	6.2 (1.5)	6.1 (1.5)	6.1 (1.5)

Measure	2010	2011	2012	2013	2014
	adverse events/exposures (% (CI))				
Median number of exposures (IQR)	6.0 (5.0-7.0)	6.0 (5.0-7.0)	6.0 (5.0-7.0)	6.0 (5.0-7.0)	6.0 (5.0-7.0)

2015-2019

Measure	2015	2016	2017	2018	2019
	adverse events/exposures (% (CI))				
Adverse Drug Events					
Adverse Events Associated with Digoxin	2/148 (1.4 [0.2-4.8])	0/288 (0.0 [0.0-1.3])	0/201 (0.0 [0.0-1.8])	0/79 (0.0 [0.0-4.6])	0/31 (0.0 [0.0-11.2])
Adverse Events Associated with Hypoglycemic Agents	100/995 (10.1 [8.3-12.1])	155/2184 (7.1 [6.1-8.3])	142/1592 (8.9 [7.6-10.4])	70/726 (9.6 [7.6-12.0])	23/333 (6.9 [4.4-10.2])
Adverse Events Associated with IV Heparin	13/108 (12.0 [6.6-19.7])	10/189 (5.3 [2.6-9.5])	8/163 (4.9 [2.1-9.4])	4/76 (5.3 [1.5-12.9])	2/47 (4.3 [0.5-14.5])
Adverse Events Associated with Low Molecular Weight Heparin and Factor Xa Inhibitor	14/904 (1.5 [0.9-2.6])	21/1751 (1.2 [0.7-1.8])	18/1137 (1.6 [0.9-2.5])	5/533 (0.9 [0.3-2.2])	3/197 (1.5 [0.3-4.4])
Adverse Events Associated with Warfarin	13/436 (3.0 [1.6-5.0])	20/850 (2.4 [1.4-3.6])	18/624 (2.9 [1.7-4.5])	5/237 (2.1 [0.7-4.9])	4/85 (4.7 [1.3-11.6])
General Adverse Events					
Hospital-Acquired Pressure Ulcers	100/2423 (4.1 [3.4-5.0])	196/5330 (3.7 [3.2-4.2])	139/3779 (3.7 [3.1-4.3])	83/1739 (4.8 [3.8-5.9])	29/774 (3.7 [2.5-5.3])
Inpatient Falls	30/2423 (1.2 [0.8-1.8])	44/5330 (0.8 [0.6-1.1])	45/3779 (1.2 [0.9-1.6])	13/1739 (0.7 [0.4-1.3])	7/774 (0.9 [0.4-1.9])
Hospital-Acquired Infections					
Hospital-Acquired Antibiotic-Associated Clostridium difficile	3/1164 (0.3 [0.1-0.8])	7/2423 (0.3 [0.1-0.6])	5/1755 (0.3 [0.1-0.7])	5/811 (0.6 [0.2-1.4])	0/322 (0.0 [0.0-1.1])
Central Line-Associated Blood Stream Infections	0/104 (0.0 [0.0-3.5])	1/204 (0.5 [0.0-2.7])	1/176 (0.6 [0.0-3.1])	1/61 (1.6 [0.0-8.8])	1/40 (2.5 [0.1-13.2])
Catheter-Associated Urinary Tract Infections	23/654 (3.5 [2.2-5.2])	56/1297 (4.3 [3.3-5.6])	37/879 (4.2 [3.0-5.8])	15/403 (3.7 [2.1-6.1])	8/141 (5.7 [2.5-10.9])
Hospital-Acquired Methicillin-Resistant Staphylococcus Aureus	2/2374 (0.1 [0.0-0.3])	3/5236 (0.1 [0.0-0.2])	2/3724 (0.1 [0.0-0.2])	1/1717 (0.1 [0.0-0.3])	0/764 (0.0 [0.0-0.5])

Measure	2015	2016	2017	2018	2019
	adverse events/exposures (% (CI))				
Hospital-Acquired Vancomycin-Resistant Enterococcus	0/2420 (0.0 [0.0-0.2])	0/5312 (0.0 [0.0-0.1])	0/3768 (0.0 [0.0-0.1])	0/1735 (0.0 [0.0-0.2])	0/773 (0.0 [0.0-0.5])
Postoperative Pneumonia	1/8 (12.5 [0.3-52.7])	0/9 (0.0 [0.0-33.6])	0/5 (0.0 [0.0-52.2])	0/5 (0.0 [0.0-52.2])	0/5 (0.0 [0.0-52.2])
Ventilator-Associated Pneumonia	1/18 (5.6 [0.1-27.3])	2/32 (6.3 [0.8-20.8])	1/21 (4.8 [0.1-23.8])	1/11 (9.1 [0.2-41.3])	0/3 (0.0 [0.0-70.8])
Post-Procedure Adverse Events					
Adverse Events Associated with Femoral Artery Puncture for Catheter Angiographic Procedures	0/92 (0.0 [0.0-3.9])	0/146 (0.0 [0.0-2.5])	2/128 (1.6 [0.2-5.5])	3/50 (6.0 [1.3-16.6])	1/25 (4.0 [0.1-20.4])
Adverse Events Associated with Hip Joint Replacement				0/1 (0.0 [0.0-97.5])	
Contrast Nephropathy Associated with Catheter Angiography	18/110 (16.4 [10.0-24.6])	22/201 (10.9 [7.0-16.1])	18/176 (10.2 [6.2-15.7])	10/70 (14.3 [7.1-24.7])	8/39 (20.5 [9.3-36.5])
Mechanical Complications Associated with Central Lines	4/161 (2.5 [0.7-6.2])	7/319 (2.2 [0.9-4.5])	8/262 (3.1 [1.3-5.9])	3/109 (2.8 [0.6-7.8])	4/62 (6.5 [1.8-15.7])
Postoperative Cardiac Events (Cardiac and Non-cardiac Surgeries)	1/12 (8.3 [0.2-38.5])	0/12 (0.0 [0.0-26.5])	0/6 (0.0 [0.0-45.9])	0/5 (0.0 [0.0-52.2])	0/5 (0.0 [0.0-52.2])
Postoperative Venous Thromboembolic Event	0/12 (0.0 [0.0-26.5])	0/12 (0.0 [0.0-26.5])	1/6 (16.7 [0.4-64.1])	0/5 (0.0 [0.0-52.2])	0/5 (0.0 [0.0-52.2])
Overall					
Occurrence rate (exposure)	325/14566 (2.2 [2.0-2.5])	544/31125 (1.7 [1.6-1.9])	445/22181 (2.0 [1.8-2.2])	219/10112 (2.2 [1.9-2.5])	90/4425 (2.0 [1.6-2.5])
At-least one (discharge)	276/2423 (11.4 [10.2-12.7])	474/5330 (8.9 [8.1-9.7])	383/3779 (10.1 [9.2-11.1])	197/1739 (11.3 [9.9-12.9])	77/774 (9.9 [7.9-12.3])
Number of AE (per 1,000 discharges)	325/2423 (134.1 [120.8-148.4])	544/5330 (102.1 [94.1-110.5])	445/3779 (117.8 [107.7-128.5])	219/1739 (125.9 [110.7-142.5])	90/774 (116.3 [94.6-141.0])
In-hospital mortality (%)	63/2423 (2.6 [2.0-3.3])	135/5330 (2.5 [2.1-3.0])	111/3779 (2.9 [2.4-3.5])	40/1739 (2.3 [1.7-3.1])	19/774 (2.5 [1.5-3.8])
Mean age (SD)	176701/2423 (72.9 [14.2])	389589/5330 (73.1 [14.4])	276768/3779 (73.2 [14.3])	127357/1739 (73.2 [14.5])	56154/774 (72.6 [14.0])
Mean LOS (SD)	10982/2423 (4.5 [3.8])	23840/5330 (4.5 [4.0])	17077/3779 (4.5 [4.1])	8058/1739 (4.6 [4.4])	3484/774 (4.5 [3.8])

Measure	2015	2016	2017	2018	2019
	adverse events/exposures (% (CI))				
Mean number of exposures (SD)	6.0 (1.5)	5.8 (1.3)	5.9 (1.3)	5.8 (1.3)	5.7 (1.4)
Median number of exposures (IQR)	6.0 (5.0-7.0)	6.0 (5.0-7.0)	6.0 (5.0-7.0)	6.0 (5.0-7.0)	6.0 (5.0-6.0)

eTable 12. MPSMS Adverse Event and Exposure Data for PNE patients, 2010-2019³⁸

2010-2014

Measure	2010	2011	2012	2013	2014
	adverse events/exposures (% (CI))				
Adverse Drug Events					
Adverse Events Associated with Digoxin	3/433 (0.7 [0.1-2.0])	2/413 (0.5 [0.1-1.7])	1/371 (0.3 [0.0-1.5])	4/151 (2.6 [0.7-6.6])	3/144 (2.1 [0.4-6.0])
Adverse Events Associated with Hypoglycemic Agents	367/3471 (10.6 [9.6-11.6])	412/3577 (11.5 [10.5-12.6])	334/3198 (10.4 [9.4-11.6])	172/1684 (10.2 [8.8-11.8])	166/1766 (9.4 [8.1-10.9])
Adverse Events Associated with IV Heparin	50/257 (19.5 [14.8-24.8])	68/278 (24.5 [19.5-30.0])	46/234 (19.7 [14.8-25.3])	22/136 (16.2 [10.4-23.5])	30/168 (17.9 [12.4-24.5])
Adverse Events Associated with Low Molecular Weight Heparin and Factor Xa Inhibitor	161/3626 (4.4 [3.8-5.2])	161/3841 (4.2 [3.6-4.9])	120/3491 (3.4 [2.9-4.1])	54/1971 (2.7 [2.1-3.6])	62/2218 (2.8 [2.2-3.6])
Adverse Events Associated with Warfarin	85/1041 (8.2 [6.6-10.0])	104/1070 (9.7 [8.0-11.7])	73/979 (7.5 [5.9-9.3])	42/498 (8.4 [6.2-11.2])	40/474 (8.4 [6.1-11.3])
General Adverse Events					
Hospital-Acquired Pressure Ulcers	726/9311 (7.8 [7.3-8.4])	716/9744 (7.3 [6.8-7.9])	639/8730 (7.3 [6.8-7.9])	291/4666 (6.2 [5.6-7.0])	304/4941 (6.2 [5.5-6.9])
Inpatient Falls	113/9311 (1.2 [1.0-1.5])	105/9744 (1.1 [0.9-1.3])	76/8730 (0.9 [0.7-1.1])	40/4666 (0.9 [0.6-1.2])	48/4941 (1.0 [0.7-1.3])
Hospital-Acquired Infections					
Hospital-Acquired Antibiotic-Associated Clostridium difficile	66/9224 (0.7 [0.6-0.9])	62/9648 (0.6 [0.5-0.8])	60/8630 (0.7 [0.5-0.9])	39/4600 (0.8 [0.6-1.2])	33/4879 (0.7 [0.5-1.0])
Central Line-Associated Blood Stream Infections	0/116 (0.0 [0.0-3.1])	2/106 (1.9 [0.2-6.7])	2/95 (2.1 [0.3-7.4])	0/48 (0.0 [0.0-7.4])	1/48 (2.1 [0.1-11.1])
Catheter-Associated Urinary Tract Infections	106/2560 (4.1 [3.4-5.0])	96/2573 (3.7 [3.0-4.5])	77/2239 (3.4 [2.7-4.3])	54/1145 (4.7 [3.6-6.1])	41/1246 (3.3 [2.4-4.4])
Hospital-Acquired Methicillin-Resistant Staphylococcus Aureus	9/8743 (0.1 [0.1-0.2])	6/9163 (0.1 [0.0-0.1])	3/8208 (0.0 [0.0-0.1])	4/4440 (0.1 [0.0-0.2])	2/4714 (0.0 [0.0-0.2])
Hospital-Acquired Vancomycin-Resistant Enterococcus	11/9231 (0.1 [0.1-0.2])	6/9664 (0.1 [0.0-0.1])	2/8654 (0.0 [0.0-0.1])	0/4611 (0.0 [0.0-0.1])	5/4894 (0.1 [0.0-0.2])

³⁸ Note: the same adverse event may be counted twice in this table, e.g., some instances of ventilator-associated pneumonia may also be cases of postoperative pneumonia, but these adverse events are only counted once in the analyzed summary data presented in the text and figures in this paper

Measure	2010	2011	2012	2013	2014
	adverse events/exposures (% (CI))				
Postoperative Pneumonia	11/49 (22.4 [11.8-36.6])	11/25 (44.0 [24.4-65.1])	10/23 (43.5 [23.2-65.5])	10/26 (38.5 [20.2-59.4])	8/28 (28.6 [13.2-48.7])
Ventilator-Associated Pneumonia	27/206 (13.1 [8.8-18.5])	34/213 (16.0 [11.3-21.6])	23/194 (11.9 [7.7-17.3])	11/99 (11.1 [5.7-19.0])	15/132 (11.4 [6.5-18.1])
Post-Procedure Adverse Events					
Adverse Events Associated with Femoral Artery Puncture for Catheter Angiographic Procedures	0/69 (0.0 [0.0-5.2])	1/56 (1.8 [0.1-9.6])	1/60 (1.7 [0.0-8.9])	2/31 (6.5 [0.8-21.4])	0/46 (0.0 [0.0-7.7])
Adverse Events Associated with Hip Joint Replacement	0/3 (0.0 [0.0-70.8])	0/1 (0.0 [0.0-97.5])	2/4 (50.0 [6.8-93.2])	1/1 (100.0 [2.5-0.0])	
Contrast Nephropathy Associated with Catheter Angiography	18/72 (25.0 [15.5-36.6])	7/47 (14.9 [6.2-28.3])	12/58 (20.7 [11.2-33.4])	8/35 (22.9 [10.4-40.1])	14/51 (27.5 [15.9-41.7])
Mechanical Complications Associated with Central Lines	63/1594 (4.0 [3.1-5.0])	67/1542 (4.3 [3.4-5.5])	56/1407 (4.0 [3.0-5.1])	27/821 (3.3 [2.2-4.8])	40/920 (4.3 [3.1-5.9])
Postoperative Cardiac Events (Cardiac and Non-cardiac Surgeries)	3/100 (3.0 [0.6-8.5])	6/75 (8.0 [3.0-16.6])	5/76 (6.6 [2.2-14.7])	2/49 (4.1 [0.5-14.0])	1/45 (2.2 [0.1-11.8])
Postoperative Venous Thromboembolic Event	0/100 (0.0 [0.0-3.6])	1/75 (1.3 [0.0-7.2])	1/76 (1.3 [0.0-7.1])	0/49 (0.0 [0.0-7.3])	1/45 (2.2 [0.1-11.8])
Overall					
Occurrence rate (exposure)	1819/59517 (3.1 [2.9-3.2])	1867/61855 (3.0 [2.9-3.2])	1543/55457 (2.8 [2.7-2.9])	783/29727 (2.6 [2.5-2.8])	814/31700 (2.6 [2.4-2.8])
At-least one (discharge)	1429/9311 (15.3 [14.6-16.1])	1452/9744 (14.9 [14.2-15.6])	1221/8730 (14.0 [13.3-14.7])	621/4666 (13.3 [12.4-14.3])	650/4941 (13.2 [12.2-14.1])
Number of AE (per 1,000 discharges)	1819/9311 (195.4 [187.4-203.6])	1867/9744 (191.6 [183.8-199.6])	1543/8730 (176.7 [168.8-184.9])	783/4666 (167.8 [157.2-178.9])	814/4941 (164.7 [154.5-175.4])
In-hospital mortality (%)	731/9311 (7.9 [7.3-8.4])	746/9744 (7.7 [7.1-8.2])	608/8730 (7.0 [6.4-7.5])	329/4666 (7.1 [6.3-7.8])	393/4941 (8.0 [7.2-8.7])
Mean age (SD)	639069/9311 (68.6 [17.1])	671506/9744 (68.9 [16.9])	602260/8730 (69.0 [16.7])	319656/4666 (68.5 [16.9])	338457/4941 (68.5 [16.7])
Mean LOS (SD)	57552/9311 (6.2 [6.3])	57582/9744 (5.9 [6.3])	50286/8730 (5.8 [5.6])	28230/4666 (6.1 [6.6])	29192/4941 (5.9 [6.0])
Mean number of exposures (SD)	6.4 (1.4)	6.3 (1.3)	6.4 (1.3)	6.4 (1.3)	6.4 (1.3)

Measure	2010	2011	2012	2013	2014
	adverse events/exposures (% (CI))				
Median number of exposures (IQR)	6.0 (5.0-7.0)	6.0 (5.0-7.0)	6.0 (5.0-7.0)	6.0 (5.0-7.0)	6.0 (6.0-7.0)

2015-2019

Measure	2015	2016	2017	2018	2019
	adverse events/exposures (% (CI))				
Adverse Drug Events					
Adverse Events Associated with Digoxin	0/67 (0.0 [0.0-5.4])	0/147 (0.0 [0.0-2.5])	0/95 (0.0 [0.0-3.8])	1/45 (2.2 [0.1-11.8])	0/11 (0.0 [0.0-28.5])
Adverse Events Associated with Hypoglycemic Agents	71/799 (8.9 [7.0-11.1])	162/1901 (8.5 [7.3-9.9])	102/1347 (7.6 [6.2-9.1])	51/572 (8.9 [6.7-11.6])	19/294 (6.5 [3.9-9.9])
Adverse Events Associated with IV Heparin	9/62 (14.5 [6.9-25.8])	21/173 (12.1 [7.7-18.0])	9/128 (7.0 [3.3-12.9])	8/69 (11.6 [5.1-21.6])	3/38 (7.9 [1.7-21.4])
Adverse Events Associated with Low Molecular Weight Heparin and Factor Xa Inhibitor	21/988 (2.1 [1.3-3.2])	51/2327 (2.2 [1.6-2.9])	25/1609 (1.6 [1.0-2.3])	13/676 (1.9 [1.0-3.3])	8/317 (2.5 [1.1-4.9])
Adverse Events Associated with Warfarin	19/231 (8.2 [5.0-12.6])	25/393 (6.4 [4.2-9.3])	18/290 (6.2 [3.7-9.6])	7/104 (6.7 [2.8-13.4])	3/43 (7.0 [1.5-19.1])
General Adverse Events					
Hospital-Acquired Pressure Ulcers	141/2427 (5.8 [4.9-6.8])	317/5737 (5.5 [5.0-6.2])	206/4004 (5.1 [4.5-5.9])	95/1707 (5.6 [4.5-6.8])	45/858 (5.2 [3.9-7.0])
Inpatient Falls	19/2427 (0.8 [0.5-1.2])	51/5737 (0.9 [0.7-1.2])	28/4004 (0.7 [0.5-1.0])	22/1707 (1.3 [0.8-1.9])	9/858 (1.0 [0.5-2.0])
Hospital-Acquired Infections					
Hospital-Acquired Antibiotic-Associated Clostridium difficile	14/2398 (0.6 [0.3-1.0])	31/5666 (0.5 [0.4-0.8])	24/3949 (0.6 [0.4-0.9])	8/1686 (0.5 [0.2-0.9])	5/848 (0.6 [0.2-1.4])
Central Line-Associated Blood Stream Infections	0/25 (0.0 [0.0-13.7])	1/53 (1.9 [0.1-10.1])	2/32 (6.3 [0.8-20.8])	0/17 (0.0 [0.0-19.5])	0/9 (0.0 [0.0-33.6])
Catheter-Associated Urinary Tract Infections	19/564 (3.4 [2.0-5.2])	32/1284 (2.5 [1.7-3.5])	16/953 (1.7 [1.0-2.7])	10/412 (2.4 [1.2-4.4])	2/188 (1.1 [0.1-3.8])
Hospital-Acquired Methicillin-Resistant Staphylococcus Aureus	1/2318 (0.0 [0.0-0.2])	2/5519 (0.0 [0.0-0.1])	2/3829 (0.1 [0.0-0.2])	1/1647 (0.1 [0.0-0.3])	1/834 (0.1 [0.0-0.7])

Measure	2015	2016	2017	2018	2019
	adverse events/exposures (% (CI))				
Hospital-Acquired Vancomycin-Resistant Enterococcus	1/2414 (0.0 [0.0-0.2])	0/5702 (0.0 [0.0-0.1])	2/3979 (0.1 [0.0-0.2])	0/1694 (0.0 [0.0-0.2])	0/857 (0.0 [0.0-0.4])
Postoperative Pneumonia	1/10 (10.0 [0.3-44.5])	3/15 (20.0 [4.3-48.1])	0/12 (0.0 [0.0-26.5])	0/5 (0.0 [0.0-52.2])	
Ventilator-Associated Pneumonia	6/59 (10.2 [3.8-20.8])	13/120 (10.8 [5.9-17.8])	9/90 (10.0 [4.7-18.1])	6/47 (12.8 [4.8-25.7])	5/20 (25.0 [8.7-49.1])
Post-Procedure Adverse Events					
Adverse Events Associated with Femoral Artery Puncture for Catheter Angiographic Procedures	0/14 (0.0 [0.0-23.2])	0/39 (0.0 [0.0-9.0])	1/25 (4.0 [0.1-20.4])	0/10 (0.0 [0.0-30.9])	0/5 (0.0 [0.0-52.2])
Adverse Events Associated with Hip Joint Replacement	1/4 (25.0 [0.6-80.6])		0/1 (0.0 [0.0-97.5])	0/1 (0.0 [0.0-97.5])	
Contrast Nephropathy Associated with Catheter Angiography	4/18 (22.2 [6.4-47.6])	5/34 (14.7 [5.0-31.1])	7/30 (23.3 [9.9-42.3])	1/12 (8.3 [0.2-38.5])	0/6 (0.0 [0.0-45.9])
Mechanical Complications Associated with Central Lines	7/381 (1.8 [0.7-3.8])	33/939 (3.5 [2.4-4.9])	17/654 (2.6 [1.5-4.1])	14/301 (4.7 [2.6-7.7])	2/142 (1.4 [0.2-5.0])
Postoperative Cardiac Events (Cardiac and Non-cardiac Surgeries)	0/14 (0.0 [0.0-23.2])	1/23 (4.3 [0.1-22.0])	1/19 (5.3 [0.1-26.0])	1/6 (16.7 [0.4-64.1])	0/3 (0.0 [0.0-70.8])
Postoperative Venous Thromboembolic Event	0/14 (0.0 [0.0-23.2])	3/23 (13.0 [2.8-33.6])	0/19 (0.0 [0.0-17.7])	0/6 (0.0 [0.0-45.9])	0/3 (0.0 [0.0-70.8])
Overall					
Occurrence rate (exposure)	334/15234 (2.2 [2.0-2.4])	751/35832 (2.1 [2.0-2.3])	469/25069 (1.9 [1.7-2.1])	238/10724 (2.2 [2.0-2.5])	102/5334 (1.9 [1.6-2.3])
At-least one (discharge)	273/2427 (11.2 [10.0-12.6])	619/5737 (10.8 [10.0-11.6])	390/4004 (9.7 [8.8-10.7])	201/1707 (11.8 [10.3-13.4])	86/858 (10.0 [8.1-12.2])
Number of AE (per 1,000 discharges)	334/2427 (137.6 [124.2-152.0])	751/5737 (130.9 [122.3-139.9])	469/4004 (117.1 [107.3-127.5])	238/1707 (139.4 [123.3-156.8])	102/858 (118.9 [98.0-142.4])
In-hospital mortality (%)	166/2427 (6.8 [5.9-7.9])	359/5737 (6.3 [5.6-6.9])	279/4004 (7.0 [6.2-7.8])	114/1707 (6.7 [5.5-8.0])	53/858 (6.2 [4.7-8.0])
Mean age (SD)	168797/2427 (69.5 [16.3])	391607/5737 (68.3 [16.9])	275915/4004 (68.9 [16.7])	118180/1707 (69.2 [16.3])	58072/858 (67.7 [16.6])
Mean LOS (SD)	13319/2427 (5.5 [5.5])	31714/5737 (5.5 [5.7])	22261/4004 (5.6 [6.1])	9773/1707 (5.7 [5.4])	4864/858 (5.7 [6.2])

Measure	2015	2016	2017	2018	2019
	adverse events/exposures (% (CI))				
Mean number of exposures (SD)	6.3 (1.2)	6.2 (1.2)	6.3 (1.2)	6.3 (1.2)	6.2 (1.2)
Median number of exposures (IQR)	6.0 (5.0-7.0)	6.0 (5.0-7.0)	6.0 (5.0-7.0)	6.0 (5.0-7.0)	6.0 (5.0-7.0)

eTable 13. MPSMS Adverse Event and Exposure Data for SCIP patients, 2010-2019³⁹

2010-2014

Measure	2010	2011	2012	2013	2014
	adverse events/exposures (% (CI))				
Adverse Drug Events					
Adverse Events Associated with Digoxin	0/143 (0.0 [0.0-2.6])	1/112 (0.9 [0.0-4.9])	0/103 (0.0 [0.0-3.5])	0/45 (0.0 [0.0-7.9])	0/38 (0.0 [0.0-9.3])
Adverse Events Associated with Hypoglycemic Agents	190/2399 (7.9 [6.9-9.1])	157/2464 (6.4 [5.4-7.4])	132/2234 (5.9 [5.0-7.0])	68/1218 (5.6 [4.4-7.0])	76/1376 (5.5 [4.4-6.9])
Adverse Events Associated with IV Heparin	70/221 (31.7 [25.6-38.3])	61/233 (26.2 [20.7-32.3])	52/270 (19.3 [14.7-24.5])	29/131 (22.1 [15.4-30.2])	34/154 (22.1 [15.8-29.5])
Adverse Events Associated with Low Molecular Weight Heparin and Factor Xa Inhibitor	260/3573 (7.3 [6.5-8.2])	303/4273 (7.1 [6.3-7.9])	234/3386 (6.9 [6.1-7.8])	105/1871 (5.6 [4.6-6.8])	112/2056 (5.4 [4.5-6.5])
Adverse Events Associated with Warfarin	95/1830 (5.2 [4.2-6.3])	121/1967 (6.2 [5.1-7.3])	76/1473 (5.2 [4.1-6.4])	36/791 (4.6 [3.2-6.3])	29/699 (4.1 [2.8-5.9])
General Adverse Events					
Hospital-Acquired Pressure Ulcers	299/9104 (3.3 [2.9-3.7])	338/10148 (3.3 [3.0-3.7])	299/8692 (3.4 [3.1-3.8])	116/4767 (2.4 [2.0-2.9])	127/5480 (2.3 [1.9-2.8])
Inpatient Falls	70/9104 (0.8 [0.6-1.0])	79/10148 (0.8 [0.6-1.0])	70/8692 (0.8 [0.6-1.0])	42/4767 (0.9 [0.6-1.2])	41/5480 (0.7 [0.5-1.0])
Hospital-Acquired Infections					
Hospital-Acquired Antibiotic-Associated Clostridium difficile	18/9009 (0.2 [0.1-0.3])	43/10065 (0.4 [0.3-0.6])	34/8567 (0.4 [0.3-0.6])	14/4715 (0.3 [0.2-0.5])	19/5400 (0.4 [0.2-0.6])
Central Line-Associated Blood Stream Infections	16/1273 (1.3 [0.7-2.0])	18/1114 (1.6 [1.0-2.5])	17/1094 (1.6 [0.9-2.5])	6/577 (1.0 [0.4-2.3])	3/664 (0.5 [0.1-1.3])
Catheter-Associated Urinary Tract Infections	168/7801 (2.2 [1.8-2.5])	166/8681 (1.9 [1.6-2.2])	143/7374 (1.9 [1.6-2.3])	68/3897 (1.7 [1.4-2.2])	65/4376 (1.5 [1.2-1.9])
Hospital-Acquired Methicillin-Resistant Staphylococcus Aureus	6/9018 (0.1 [0.0-0.1])	7/10072 (0.1 [0.0-0.1])	6/8600 (0.1 [0.0-0.2])	0/4718 (0.0 [0.0-0.1])	3/5439 (0.1 [0.0-0.2])
Hospital-Acquired Vancomycin-Resistant Enterococcus	6/9089 (0.1 [0.0-0.1])	2/10130 (0.0 [0.0-0.1])	3/8671 (0.0 [0.0-0.1])	6/4761 (0.1 [0.1-0.3])	4/5468 (0.1 [0.0-0.2])

³⁹ Note: the same adverse event may be counted twice in this table, e.g., some instances of ventilator-associated pneumonia may also be cases of postoperative pneumonia, but these adverse events are only counted once in the analyzed summary data presented in the text and figures in this paper

Measure	2010	2011	2012	2013	2014
	adverse events/exposures (% (CI))				
Postoperative Pneumonia	186/8948 (2.1 [1.8-2.4])	177/9721 (1.8 [1.6-2.1])	149/8364 (1.8 [1.5-2.1])	65/4658 (1.4 [1.1-1.8])	81/5373 (1.5 [1.2-1.9])
Ventilator-Associated Pneumonia	31/218 (14.2 [9.9-19.6])	23/202 (11.4 [7.4-16.6])	22/202 (10.9 [7.0-16.0])	7/103 (6.8 [2.8-13.5])	14/127 (11.0 [6.2-17.8])
Post-Procedure Adverse Events					
Adverse Events Associated with Femoral Artery Puncture for Catheter Angiographic Procedures	4/275 (1.5 [0.4-3.7])	4/234 (1.7 [0.5-4.3])	5/215 (2.3 [0.8-5.3])	1/106 (0.9 [0.0-5.1])	0/141 (0.0 [0.0-2.6])
Adverse Events Associated with Hip Joint Replacement	111/1434 (7.7 [6.4-9.3])	123/1602 (7.7 [6.4-9.1])	90/1410 (6.4 [5.2-7.8])	43/905 (4.8 [3.5-6.4])	47/1035 (4.5 [3.4-6.0])
Adverse Events Associated with Knee Joint Replacement	105/2133 (4.9 [4.0-5.9])	121/2545 (4.8 [4.0-5.7])	78/2145 (3.6 [2.9-4.5])	28/1247 (2.2 [1.5-3.2])	40/1520 (2.6 [1.9-3.6])
Contrast Nephropathy Associated with Catheter Angiography	70/294 (23.8 [19.1-29.1])	64/254 (25.2 [20.0-31.0])	54/251 (21.5 [16.6-27.1])	27/130 (20.8 [14.2-28.8])	37/171 (21.6 [15.7-28.6])
Mechanical Complications Associated with Central Lines	38/1561 (2.4 [1.7-3.3])	57/1451 (3.9 [3.0-5.1])	38/1401 (2.7 [1.9-3.7])	18/725 (2.5 [1.5-3.9])	18/871 (2.1 [1.2-3.3])
Postoperative Cardiac Events (Cardiac and Non-cardiac Surgeries)	72/9061 (0.8 [0.6-1.0])	78/9872 (0.8 [0.6-1.0])	72/8519 (0.8 [0.7-1.1])	31/4718 (0.7 [0.5-0.9])	29/5429 (0.5 [0.4-0.8])
Postoperative Venous Thromboembolic Event	38/9061 (0.4 [0.3-0.6])	34/9872 (0.3 [0.2-0.5])	37/8521 (0.4 [0.3-0.6])	21/4718 (0.4 [0.3-0.7])	24/5430 (0.4 [0.3-0.7])
Overall					
Occurrence rate (exposure)	1853/95549 (1.9 [1.9-2.0])	1977/105160 (1.9 [1.8-2.0])	1611/90184 (1.8 [1.7-1.9])	731/49568 (1.5 [1.4-1.6])	803/56727 (1.4 [1.3-1.5])
At-least one (discharge)	1219/9104 (13.4 [12.7-14.1])	1299/10148 (12.8 [12.2-13.5])	1110/8692 (12.8 [12.1-13.5])	512/4767 (10.7 [9.9-11.7])	558/5480 (10.2 [9.4-11.0])
Number of AE (per 1,000 discharges)	1853/9104 (203.5 [195.3-212.0])	1977/10148 (194.8 [187.2-202.7])	1611/8692 (185.3 [177.2-193.7])	731/4767 (153.3 [143.2-163.9])	803/5480 (146.5 [137.3-156.2])
In-hospital mortality (%)	136/9104 (1.5 [1.3-1.8])	151/10148 (1.5 [1.3-1.7])	128/8692 (1.5 [1.2-1.8])	74/4767 (1.6 [1.2-1.9])	62/5480 (1.1 [0.9-1.5])
Mean age (SD)	555744/9104 (61.0 [16.0])	619208/10148 (61.0 [15.6])	538095/8692 (61.9 [15.4])	297810/4767 (62.5 [15.1])	340707/5480 (62.2 [14.5])
Mean LOS (SD)	49140/9104 (5.4 [6.1])	51107/10148 (5.0 [5.5])	45112/8692 (5.2 [5.4])	24246/4767 (5.1 [5.7])	26048/5480 (4.8 [5.0])
Mean number of exposures (SD)	10.5 (1.5)	10.4 (1.5)	10.4 (1.5)	10.4 (1.5)	10.4 (1.5)

Measure	2010	2011	2012	2013	2014
	adverse events/exposures (% (CI))				
Median number of exposures (IQR)	10.0 (9.0-11.0)	10.0 (9.0-11.0)	10.0 (9.0-11.0)	10.0 (9.0-11.0)	10.0 (9.0-11.0)

2015-2019

Measure	2015	2016	2017	2018	2019
	adverse events/exposures (% (CI))				
Adverse Drug Events					
Adverse Events Associated with Digoxin	0/16 (0.0 [0.0-20.6])	0/28 (0.0 [0.0-12.3])	0/23 (0.0 [0.0-14.8])	0/13 (0.0 [0.0-24.7])	0/2 (0.0 [0.0-84.2])
Adverse Events Associated with Hypoglycemic Agents	34/610 (5.6 [3.9-7.7])	52/1290 (4.0 [3.0-5.3])	36/919 (3.9 [2.8-5.4])	34/475 (7.2 [5.0-9.9])	27/435 (6.2 [4.1-8.9])
Adverse Events Associated with IV Heparin	8/36 (22.2 [10.1-39.2])	22/125 (17.6 [11.4-25.4])	18/110 (16.4 [10.0-24.6])	12/63 (19.0 [10.3-30.9])	11/75 (14.7 [7.6-24.7])
Adverse Events Associated with Low Molecular Weight Heparin and Factor Xa Inhibitor	38/974 (3.9 [2.8-5.3])	67/1906 (3.5 [2.7-4.4])	33/1301 (2.5 [1.8-3.5])	14/565 (2.5 [1.4-4.1])	24/588 (4.1 [2.6-6.0])
Adverse Events Associated with Warfarin	13/324 (4.0 [2.2-6.8])	20/599 (3.3 [2.1-5.1])	9/260 (3.5 [1.6-6.5])	5/130 (3.8 [1.3-8.8])	11/101 (10.9 [5.6-18.7])
General Adverse Events					
Hospital-Acquired Pressure Ulcers	68/2817 (2.4 [1.9-3.1])	112/5920 (1.9 [1.6-2.3])	78/3880 (2.0 [1.6-2.5])	69/1930 (3.6 [2.8-4.5])	41/1861 (2.2 [1.6-3.0])
Inpatient Falls	13/2817 (0.5 [0.3-0.8])	45/5920 (0.8 [0.6-1.0])	27/3880 (0.7 [0.5-1.0])	18/1930 (0.9 [0.6-1.5])	7/1861 (0.4 [0.2-0.8])
Hospital-Acquired Infections					
Hospital-Acquired Antibiotic-Associated Clostridium difficile	9/2763 (0.3 [0.2-0.6])	23/5726 (0.4 [0.3-0.6])	10/3746 (0.3 [0.1-0.5])	5/1888 (0.3 [0.1-0.6])	3/1825 (0.2 [0.0-0.5])
Central Line-Associated Blood Stream Infections	1/226 (0.4 [0.0-2.4])	0/510 (0.0 [0.0-0.7])	3/361 (0.8 [0.2-2.4])	1/206 (0.5 [0.0-2.7])	1/209 (0.5 [0.0-2.6])
Catheter-Associated Urinary Tract Infections	32/2010 (1.6 [1.1-2.2])	57/4036 (1.4 [1.1-1.8])	37/2470 (1.5 [1.1-2.1])	16/1212 (1.3 [0.8-2.1])	9/1159 (0.8 [0.4-1.5])
Hospital-Acquired Methicillin-Resistant Staphylococcus Aureus	1/2786 (0.0 [0.0-0.2])	2/5865 (0.0 [0.0-0.1])	2/3848 (0.1 [0.0-0.2])	1/1920 (0.1 [0.0-0.3])	0/1843 (0.0 [0.0-0.2])

Measure	2015	2016	2017	2018	2019
	adverse events/exposures (% (CI))				
Hospital-Acquired Vancomycin-Resistant Enterococcus	2/2809 (0.1 [0.0-0.3])	1/5916 (0.0 [0.0-0.1])	1/3872 (0.0 [0.0-0.1])	0/1926 (0.0 [0.0-0.2])	0/1856 (0.0 [0.0-0.2])
Postoperative Pneumonia	38/2772 (1.4 [1.0-1.9])	66/5871 (1.1 [0.9-1.4])	42/3839 (1.1 [0.8-1.5])	30/1907 (1.6 [1.1-2.2])	23/1847 (1.2 [0.8-1.9])
Ventilator-Associated Pneumonia	4/41 (9.8 [2.7-23.1])	10/105 (9.5 [4.7-16.8])	7/79 (8.9 [3.6-17.4])	5/38 (13.2 [4.4-28.1])	2/41 (4.9 [0.6-16.5])
Post-Procedure Adverse Events					
Adverse Events Associated with Femoral Artery Puncture for Catheter Angiographic Procedures	1/44 (2.3 [0.1-12.0])	0/77 (0.0 [0.0-4.7])	2/66 (3.0 [0.4-10.5])	2/42 (4.8 [0.6-16.2])	0/41 (0.0 [0.0-8.6])
Adverse Events Associated with Hip Joint Replacement	24/610 (3.9 [2.5-5.8])	64/1311 (4.9 [3.8-6.2])	34/837 (4.1 [2.8-5.6])	22/451 (4.9 [3.1-7.3])	14/520 (2.7 [1.5-4.5])
Adverse Events Associated with Knee Joint Replacement	20/969 (2.1 [1.3-3.2])	44/2159 (2.0 [1.5-2.7])	33/1339 (2.5 [1.7-3.4])	13/610 (2.1 [1.1-3.6])	15/468 (3.2 [1.8-5.2])
Contrast Nephropathy Associated with Catheter Angiography	5/51 (9.8 [3.3-21.4])	24/109 (22.0 [14.7-31.0])	17/101 (16.8 [10.1-25.6])	13/64 (20.3 [11.3-32.2])	18/61 (29.5 [18.5-42.6])
Mechanical Complications Associated with Central Lines	3/321 (0.9 [0.2-2.7])	22/675 (3.3 [2.1-4.9])	9/509 (1.8 [0.8-3.3])	9/280 (3.2 [1.5-6.0])	5/291 (1.7 [0.6-4.0])
Postoperative Cardiac Events (Cardiac and Non-cardiac Surgeries)	13/2796 (0.5 [0.3-0.8])	22/5919 (0.4 [0.2-0.6])	30/3879 (0.8 [0.5-1.1])	16/1928 (0.8 [0.5-1.3])	17/1860 (0.9 [0.5-1.5])
Postoperative Venous Thromboembolic Event	6/2796 (0.2 [0.1-0.5])	20/5919 (0.3 [0.2-0.5])	14/3879 (0.4 [0.2-0.6])	5/1928 (0.3 [0.1-0.6])	14/1860 (0.8 [0.4-1.3])
Overall					
Occurrence rate (exposure)	333/28588 (1.2 [1.0-1.3])	673/59986 (1.1 [1.0-1.2])	442/39198 (1.1 [1.0-1.2])	290/19506 (1.5 [1.3-1.7])	242/18804 (1.3 [1.1-1.5])
At-least one (discharge)	235/2817 (8.3 [7.4-9.4])	480/5920 (8.1 [7.4-8.8])	329/3880 (8.5 [7.6-9.4])	204/1930 (10.6 [9.2-12.0])	185/1861 (9.9 [8.6-11.4])
Number of AE (per 1,000 discharges)	333/2817 (118.2 [106.5-130.7])	673/5920 (113.7 [105.7-122.0])	442/3880 (113.9 [104.1-124.3])	290/1930 (150.3 [134.6-167.0])	242/1861 (130.0 [115.1-146.2])
In-hospital mortality (%)	31/2817 (1.1 [0.8-1.6])	52/5920 (0.9 [0.7-1.2])	45/3880 (1.2 [0.9-1.6])	25/1930 (1.3 [0.8-1.9])	19/1861 (1.0 [0.6-1.6])
Mean age (SD)	176992/2817 (62.8 [14.3])	370015/5920 (62.5 [14.9])	245289/3880 (63.2 [15.0])	124267/1930 (64.4 [14.5])	119026/1861 (64.0 [14.9])

Measure	2015	2016	2017	2018	2019
	adverse events/exposures (% (CI))				
Mean LOS (SD)	12381/2817 (4.4 [4.8])	25561/5920 (4.3 [5.2])	16905/3880 (4.4 [5.1])	8854/1930 (4.6 [5.3])	8507/1861 (4.6 [5.7])
Mean number of exposures (SD)	10.1 (1.3)	10.1 (1.3)	10.1 (1.4)	10.1 (1.4)	10.1 (1.5)
Median number of exposures (IQR)	10.0 (9.0-11.0)	10.0 (9.0-11.0)	10.0 (9.0-11.0)	10.0 (9.0-11.0)	10.0 (9.0-11.0)

eTable 14. MPSMS Adverse Event and Exposure Data for All-Other Conditions patients, 2012-2019⁴⁰

2012-2015

Measure	2012	2013	2014	2015
	adverse events/exposures (% (CI))			
Adverse Drug Events				
Adverse Events Associated with Digoxin	1/138 (0.7 [0.0-4.0])	0/65 (0.0 [0.0-5.5])	1/44 (2.3 [0.1-12.0])	0/71 (0.0 [0.0-5.1])
Adverse Events Associated with Hypoglycemic Agents	164/2200 (7.5 [6.4-8.6])	89/1179 (7.5 [6.1-9.2])	67/941 (7.1 [5.6-9.0])	112/1470 (7.6 [6.3-9.1])
Adverse Events Associated with IV Heparin	22/207 (10.6 [6.8-15.7])	11/111 (9.9 [5.1-17.0])	15/116 (12.9 [7.4-20.4])	12/121 (9.9 [5.2-16.7])
Adverse Events Associated with Low Molecular Weight Heparin and Factor Xa Inhibitor	39/1956 (2.0 [1.4-2.7])	21/1245 (1.7 [1.1-2.6])	20/1032 (1.9 [1.2-3.0])	17/1526 (1.1 [0.7-1.8])
Adverse Events Associated with Warfarin	27/660 (4.1 [2.7-5.9])	16/368 (4.3 [2.5-7.0])	8/243 (3.3 [1.4-6.4])	17/337 (5.0 [3.0-8.0])
General Adverse Events				
Hospital-Acquired Pressure Ulcers	222/9532 (2.3 [2.0-2.7])	120/5286 (2.3 [1.9-2.7])	78/4308 (1.8 [1.4-2.3])	123/6072 (2.0 [1.7-2.4])
Inpatient Falls	84/9532 (0.9 [0.7-1.1])	38/5286 (0.7 [0.5-1.0])	34/4308 (0.8 [0.6-1.1])	50/6072 (0.8 [0.6-1.1])
Hospital-Acquired Infections				
Hospital-Acquired Antibiotic-Associated <i>Clostridium difficile</i>	11/6119 (0.2 [0.1-0.3])	8/3411 (0.2 [0.1-0.5])	11/2645 (0.4 [0.2-0.7])	14/3802 (0.4 [0.2-0.6])

⁴⁰ Note: the same adverse event may be counted twice in this table, e.g., some instances of ventilator-associated pneumonia may also be cases of postoperative pneumonia, but these adverse events are only counted once in the analyzed summary data presented in the text and figures in this paper

Measure	2012	2013	2014	2015
	adverse events/exposures (% (CI))			
Central Line-Associated Blood Stream Infections	2/279 (0.7 [0.1-2.6])	0/156 (0.0 [0.0-2.3])	1/116 (0.9 [0.0-4.7])	0/169 (0.0 [0.0-2.2])
Catheter-Associated Urinary Tract Infections	54/2713 (2.0 [1.5-2.6])	35/1462 (2.4 [1.7-3.3])	15/1120 (1.3 [0.8-2.2])	29/1467 (2.0 [1.3-2.8])
Hospital-Acquired Methicillin-Resistant Staphylococcus Aureus	2/9310 (0.0 [0.0-0.1])	0/5172 (0.0 [0.0-0.1])	3/4236 (0.1 [0.0-0.2])	1/5944 (0.0 [0.0-0.1])
Hospital-Acquired Vancomycin-Resistant Enterococcus	1/9485 (0.0 [0.0-0.1])	3/5273 (0.1 [0.0-0.2])	2/4292 (0.0 [0.0-0.2])	0/6040 (0.0 [0.0-0.1])
Ventilator-Associated Pneumonia	5/59 (8.5 [2.8-18.7])	2/27 (7.4 [0.9-24.3])	3/29 (10.3 [2.2-27.4])	4/64 (6.3 [1.7-15.2])
Post-Procedure Adverse Events				
Adverse Events Associated with Femoral Artery Puncture for Catheter Angiographic Procedures	3/142 (2.1 [0.4-6.1])	1/86 (1.2 [0.0-6.3])	3/77 (3.9 [0.8-11.0])	2/122 (1.6 [0.2-5.8])
Contrast Nephropathy Associated with Catheter Angiography	14/160 (8.8 [4.9-14.3])	7/100 (7.0 [2.9-13.9])	9/97 (9.3 [4.3-16.9])	10/134 (7.5 [3.6-13.3])
Mechanical Complications Associated with Central Lines	16/549 (2.9 [1.7-4.7])	10/318 (3.1 [1.5-5.7])	5/240 (2.1 [0.7-4.8])	11/418 (2.6 [1.3-4.7])
Overall				
Occurrence rate (exposure)	667/53041 (1.3 [1.2-1.4])	361/29545 (1.2 [1.1-1.4])	275/23844 (1.2 [1.0-1.3])	402/33829 (1.2 [1.1-1.3])
At-least one (discharge)	588/9532 (6.2 [5.7-6.7])	312/5286 (5.9 [5.3-6.6])	237/4308 (5.5 [4.8-6.2])	349/6072 (5.7 [5.2-6.4])
Number of AE (per 1,000 discharges)	667/9532 (70.0 [64.9-75.3])	361/5286 (68.3 [61.6-75.4])	275/4308 (63.8 [56.7-71.6])	402/6072 (66.2 [60.1-72.8])
In-hospital mortality (%)	111/9532 (1.2 [1.0-1.4])	68/5286 (1.3 [1.0-1.6])	62/4308 (1.4 [1.1-1.8])	97/6072 (1.6 [1.3-2.0])
Mean age (SD)	542707/9532 (56.9 [20.6])	298657/5286 (56.5 [20.4])	240300/4308 (55.8 [20.8])	347955/6072 (57.3 [21.2])
Mean LOS (SD)	36553/9532 (3.8 [4.3])	20339/5286 (3.8 [4.4])	15827/4308 (3.7 [4.1])	23455/6072 (3.9 [4.2])

Measure	2012	2013	2014	2015
	adverse events/exposures (% (CI))			
Mean number of exposures (SD)	5.6 (1.2)	5.6 (1.2)	5.5 (1.2)	5.6 (1.2)
Median number of exposures (IQR)	5.0 (5.0-6.0)	5.0 (5.0-6.0)	5.0 (5.0-6.0)	5.0 (5.0-6.0)

2015-2019

Measure	2016	2017	2018	2019
	adverse events/exposures (% (CI))			
Adverse Drug Events				
Adverse Events Associated with Digoxin	0/71 (0.0 [0.0-5.1])	1/74 (1.4 [0.0-7.3])	0/78 (0.0 [0.0-4.6])	0/47 (0.0 [0.0-7.6])
Adverse Events Associated with Hypoglycemic Agents	116/1670 (6.9 [5.8-8.3])	117/1920 (6.1 [5.1-7.3])	161/1950 (8.3 [7.1-9.6])	77/1517 (5.1 [4.0-6.3])
Adverse Events Associated with IV Heparin	15/147 (10.2 [5.8-16.3])	11/197 (5.6 [2.8-9.8])	12/228 (5.3 [2.8-9.0])	9/163 (5.5 [2.6-10.2])
Adverse Events Associated with Low Molecular Weight Heparin and Factor Xa Inhibitor	29/1830 (1.6 [1.1-2.3])	31/2022 (1.5 [1.0-2.2])	27/2076 (1.3 [0.9-1.9])	21/1630 (1.3 [0.8-2.0])
Adverse Events Associated with Warfarin	17/323 (5.3 [3.1-8.3])	11/341 (3.2 [1.6-5.7])	16/284 (5.6 [3.3-9.0])	7/183 (3.8 [1.6-7.7])
General Adverse Events				
Hospital-Acquired Pressure Ulcers	151/7114 (2.1 [1.8-2.5])	170/7912 (2.1 [1.8-2.5])	211/7895 (2.7 [2.3-3.1])	174/6139 (2.8 [2.4-3.3])
Inpatient Falls	53/7114 (0.7 [0.6-1.0])	61/7912 (0.8 [0.6-1.0])	75/7895 (0.9 [0.8-1.2])	54/6139 (0.9 [0.7-1.2])
Hospital-Acquired Infections				
Hospital-Acquired Antibiotic-Associated Clostridium difficile	14/4433 (0.3 [0.2-0.5])	11/4996 (0.2 [0.1-0.4])	12/4956 (0.2 [0.1-0.4])	10/3928 (0.3 [0.1-0.5])

Measure	2016	2017	2018	2019
	adverse events/exposures (% (CI))			
Central Line-Associated Blood Stream Infections	2/212 (0.9 [0.1-3.4])	1/235 (0.4 [0.0-2.4])	0/248 (0.0 [0.0-1.5])	1/205 (0.5 [0.0-2.7])
Catheter-Associated Urinary Tract Infections	32/1721 (1.9 [1.3-2.6])	33/1796 (1.8 [1.3-2.6])	33/1832 (1.8 [1.2-2.5])	27/1437 (1.9 [1.2-2.7])
Hospital-Acquired Methicillin-Resistant Staphylococcus Aureus	0/6962 (0.0 [0.0-0.1])	4/7748 (0.1 [0.0-0.1])	0/7743 (0.0 [0.0-0.1])	0/6026 (0.0 [0.0-0.1])
Hospital-Acquired Vancomycin-Resistant Enterococcus	1/7092 (0.0 [0.0-0.1])	0/7876 (0.0 [0.0-0.1])	3/7872 (0.0 [0.0-0.1])	1/6126 (0.0 [0.0-0.1])
Ventilator-Associated Pneumonia	4/67 (6.0 [1.7-14.6])	6/82 (7.3 [2.7-15.3])	8/88 (9.1 [4.0-17.1])	11/75 (14.7 [7.6-24.7])
Post-Procedure Adverse Events				
Adverse Events Associated with Femoral Artery Puncture for Catheter Angiographic Procedures	0/127 (0.0 [0.0-2.9])	3/145 (2.1 [0.4-5.9])	6/164 (3.7 [1.4-7.8])	4/101 (4.0 [1.1-9.8])
Contrast Nephropathy Associated with Catheter Angiography	8/153 (5.2 [2.3-10.0])	14/177 (7.9 [4.4-12.9])	22/213 (10.3 [6.6-15.2])	17/145 (11.7 [7.0-18.1])
Mechanical Complications Associated with Central Lines	12/500 (2.4 [1.3-4.2])	14/613 (2.3 [1.3-3.8])	19/661 (2.9 [1.7-4.5])	18/519 (3.5 [2.1-5.4])
Overall				
Occurrence rate (exposure)	454/39536 (1.1 [1.1-1.3])	488/44046 (1.1 [1.0-1.2])	605/44183 (1.4 [1.3-1.5])	431/34380 (1.3 [1.1-1.4])
At-least one (discharge)	398/7114 (5.6 [5.1-6.2])	435/7912 (5.5 [5.0-6.0])	524/7895 (6.6 [6.1-7.2])	380/6139 (6.2 [5.6-6.8])
Number of AE (per 1,000 discharges)	454/7114 (63.8 [58.3-69.8])	488/7912 (61.7 [56.5-67.2])	605/7895 (76.6 [70.9-82.7])	431/6139 (70.2 [63.9-76.9])
In-hospital mortality (%)	160/7114 (2.2 [1.9-2.6])	168/7912 (2.1 [1.8-2.5])	161/7895 (2.0 [1.7-2.4])	106/6139 (1.7 [1.4-2.1])
Mean age (SD)	414176/7114 (58.2 [20.7])	463316/7912 (58.6 [20.7])	462496/7895 (58.6 [20.5])	362853/6139 (59.1 [20.2])
Mean LOS (SD)	27711/7114 (3.9 [4.4])	31722/7912 (4.0 [4.4])	31827/7895 (4.0 [4.4])	25425/6139 (4.1 [5.1])

Measure	2016	2017	2018	2019
	adverse events/exposures (% (CI))			
Mean number of exposures (SD)	5.6 (1.2)	5.6 (1.2)	5.6 (1.2)	5.6 (1.2)
Median number of exposures (IQR)	5.0 (5.0-6.0)	5.0 (5.0-6.0)	5.0 (5.0-6.0)	5.0 (5.0-6.0)

eTable 15. Table Containing the Data in Figure 1

Domain	Condition	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
		adverse events/exposures									
Adverse Drug Events	AMI	657/7727 (85)	608/7113 (86)	401/4934 (81)	293/4027 (73)	326/4234 (77)	218/4076 (54)	165/3797 (44)	103/2651 (39)	70/1681 (42)	13/567 (23)
	HF	602/7536 (80)	541/6962 (78)	317/4900 (65)	266/4492 (59)	332/4820 (69)	142/2423 (59)	206/5330 (39)	186/3779 (49)	84/1739 (48)	32/774 (41)
	PNE	666/9311 (72)	747/9744 (77)	574/8730 (66)	294/4666 (63)	301/4941 (61)	120/2427 (49)	259/5737 (45)	154/4004 (39)	80/1707 (47)	33/858 (39)
	SCIP	615/9104 (68)	643/1014 8 (63)	494/8692 (57)	238/4767 (50)	251/5480 (46)	93/2817 (33)	161/5920 (27)	96/3880 (25)	65/1930 (34)	73/1861 (39)
	All-Other Conditions			253/9532 (27)	137/5286 (26)	111/4308 (26)	158/6072 (26)	177/7114 (25)	171/7910 (22)	216/7895 (27)	114/6138 (19)
General Adverse Events	AMI	309/7727 (40)	331/7113 (47)	197/4934 (40)	136/4027 (34)	129/4234 (31)	132/4076 (32)	90/3797 (24)	61/2651 (23)	48/1681 (29)	16/567 (28)
	HF	429/7536 (57)	387/6962 (56)	272/4900 (56)	223/4492 (50)	246/4820 (51)	130/2423 (54)	240/5330 (45)	184/3779 (49)	96/1739 (55)	36/774 (47)
	PNE	839/9311 (90)	821/9744 (84)	715/8730 (82)	331/4666 (71)	352/4941 (71)	160/2427 (66)	368/5737 (64)	234/4004 (58)	117/1707 (69)	54/858 (63)
	SCIP	369/9104 (41)	417/1014 8 (41)	369/8692 (43)	158/4767 (33)	168/5480 (31)	81/2817 (29)	157/5920 (27)	105/3880 (27)	87/1930 (45)	48/1861 (26)
	All-Other Conditions			306/9532 (32)	158/5286 (30)	112/4308 (26)	173/6072 (29)	204/7114 (29)	231/7910 (29)	286/7895 (36)	228/6138 (37)
Hospital-Acquired Infections	AMI	204/7727 (26)	171/7113 (24)	106/4934 (22)	79/4027 (20)	74/4234 (18)	61/4076 (15)	32/3797 (8)	29/2651 (11)	17/1681 (10)	9/567 (16)
	HF	159/7536 (21)	142/6962 (20)	91/4900 (19)	72/4492 (16)	79/4820 (16)	30/2423 (12)	69/5330 (13)	46/3779 (12)	23/1739 (13)	9/774 (12)
	PNE	230/9311 (25)	217/9744 (22)	177/8730 (20)	118/4666 (25)	105/4941 (21)	42/2427 (17)	82/5737 (14)	55/4004 (14)	25/1707 (15)	13/858 (15)
	SCIP	431/9104 (47)	436/1014 8 (43)	374/8692 (43)	166/4767 (35)	189/5480 (35)	87/2817 (31)	159/5920 (27)	102/3880 (26)	58/1930 (30)	38/1861 (20)
	All-Other Conditions			75/9532 (8)	48/5286 (9)	35/4308 (8)	48/6072 (8)	53/7114 (8)	55/7910 (7)	56/7895 (7)	50/6138 (8)
	AMI	513/7727 (66)	463/7113 (65)	328/4934 (67)	275/4027 (68)	317/4234 (75)	272/4076 (67)	225/3797 (59)	145/2651 (55)	146/1681 (87)	41/567 (72)

Domain	Condition	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
		adverse events/exposures									
Post-Procedure Adverse Events	HF	76/7536 (10)	67/6962 (10)	48/4900 (10)	45/4492 (10)	46/4820 (10)	23/2423 (10)	29/5330 (5)	29/3779 (8)	16/1739 (9)	13/774 (17)
	PNE	84/9311 (9)	82/9744 (8)	77/8730 (9)	40/4666 (9)	56/4941 (11)	12/2427 (5)	42/5737 (7)	26/4004 (7)	16/1707 (9)	2/858 (2)
	SCIP	438/9104 (48)	489/1014 8 (48)	374/8692 (43)	169/4767 (36)	195/5480 (36)	72/2817 (26)	196/5920 (33)	139/3880 (36)	80/1930 (42)	83/1861 (45)
	All-Other Conditions			33/9532 (4)	18/5286 (3)	17/4308 (4)	23/6072 (4)	20/7114 (3)	31/7910 (4)	47/7895 (6)	39/6138 (6)
All-Other Conditions Data was not available prior to 2012.											

eTable 16. Table Containing the Data in Figure 4

Domain	Condition	Index	OR 95CI
All Adverse Events	AMI	Occurrence of adverse events	0.93 (0.92-0.94)
		One or more adverse events per hospitalization	0.92 (0.91-0.93)
		# of adverse events per 1,000 hospitalizations	0.94 (0.93-0.94)
	HF	Occurrence of adverse events	0.95 (0.94-0.96)
		One or more adverse events per hospitalization	0.94 (0.93-0.95)
		# of adverse events per 1,000 hospitalizations	0.95 (0.94-0.96)
	PNE	Occurrence of adverse events	0.94 (0.93-0.95)
		One or more adverse events per hospitalization	0.93 (0.92-0.94)
		# of adverse events per 1,000 hospitalizations	0.94 (0.93-0.95)
	SCIP	Occurrence of adverse events	0.92 (0.91-0.93)
		One or more adverse events per hospitalization	0.92 (0.91-0.93)
		# of adverse events per 1,000 hospitalizations	0.93 (0.92-0.94)
	All-Other Conditions	Occurrence of adverse events	0.97 (0.96-0.99)
		One or more adverse events per hospitalization	0.97 (0.96-0.99)
		# of adverse events per 1,000 hospitalizations	0.97 (0.96-0.99)
Adverse Drug Events	AMI	Occurrence of adverse events	0.89 (0.88-0.91)
		One or more adverse events per hospitalization	0.88 (0.87-0.90)
		# of adverse events per 1,000 hospitalizations	0.90 (0.89-0.92)
	HF	Occurrence of adverse events	0.94 (0.92-0.95)
		One or more adverse events per hospitalization	0.92 (0.91-0.94)

Domain	Condition	Index	OR 95CI	
	PNE	# of adverse events per 1,000 hospitalizations	0.94 (0.93-0.96)	
		Occurrence of adverse events	0.93 (0.91-0.95)	
		One or more adverse events per hospitalization	0.92 (0.91-0.94)	
	SCIP	# of adverse events per 1,000 hospitalizations	0.94 (0.92-0.95)	
		Occurrence of adverse events	0.91 (0.90-0.93)	
		One or more adverse events per hospitalization	0.90 (0.89-0.92)	
		# of adverse events per 1,000 hospitalizations	0.93 (0.91-0.94)	
		All-Other Conditions	Occurrence of adverse events	0.95 (0.93-0.97)
			One or more adverse events per hospitalization	0.94 (0.92-0.97)
	# of adverse events per 1,000 hospitalizations		0.95 (0.93-0.97)	
	General Adverse Events	AMI	Occurrence of adverse events	0.93 (0.91-0.95)
			One or more adverse events per hospitalization	0.92 (0.90-0.95)
# of adverse events per 1,000 hospitalizations			0.93 (0.91-0.95)	
HF		Occurrence of adverse events	0.97 (0.96-0.99)	
		One or more adverse events per hospitalization	0.97 (0.95-0.99)	
		# of adverse events per 1,000 hospitalizations	0.97 (0.96-0.99)	
PNE		Occurrence of adverse events	0.95 (0.93-0.96)	
		One or more adverse events per hospitalization	0.95 (0.93-0.96)	
		# of adverse events per 1,000 hospitalizations	0.95 (0.94-0.96)	
SCIP		Occurrence of adverse events	0.94 (0.92-0.95)	
		One or more adverse events per hospitalization	0.94 (0.92-0.95)	
		# of adverse events per 1,000 hospitalizations	0.94 (0.92-0.96)	

Domain	Condition	Index	OR 95CI
	All-Other Conditions	Occurrence of adverse events	0.99 (0.97-1.01)
		One or more adverse events per hospitalization	0.99 (0.97-1.01)
		# of adverse events per 1,000 hospitalizations	0.99 (0.97-1.01)
Hospital-Acquired Infections	AMI	Occurrence of adverse events	0.88 (0.85-0.90)
		One or more adverse events per hospitalization	0.86 (0.83-0.89)
		# of adverse events per 1,000 hospitalizations	0.88 (0.86-0.90)
	HF	Occurrence of adverse events	0.93 (0.90-0.96)
		One or more adverse events per hospitalization	0.92 (0.89-0.95)
		# of adverse events per 1,000 hospitalizations	0.93 (0.91-0.95)
	PNE	Occurrence of adverse events	0.93 (0.90-0.95)
		One or more adverse events per hospitalization	0.93 (0.90-0.95)
		# of adverse events per 1,000 hospitalizations	0.93 (0.91-0.95)
	SCIP	Occurrence of adverse events	0.92 (0.90-0.94)
		One or more adverse events per hospitalization	0.91 (0.89-0.93)
		# of adverse events per 1,000 hospitalizations	0.92 (0.90-0.94)
	All-Other Conditions	Occurrence of adverse events	0.95 (0.91-0.99)
		One or more adverse events per hospitalization	0.95 (0.91-0.99)
		# of adverse events per 1,000 hospitalizations	0.95 (0.92-0.98)
Post-Procedure Adverse Events	AMI	Occurrence of adverse events	0.99 (0.98-1.01)
		One or more adverse events per hospitalization	0.96 (0.95-0.98)
		# of adverse events per 1,000 hospitalizations	1.00 (0.98-1.01)
	HF	Occurrence of adverse events	1.00 (0.96-1.04)

Domain	Condition	Index	OR 95CI
		One or more adverse events per hospitalization	0.98 (0.94-1.02)
		# of adverse events per 1,000 hospitalizations	1.00 (0.97-1.04)
	PNE	Occurrence of adverse events	0.96 (0.92-1.00)
		One or more adverse events per hospitalization	0.95 (0.91-0.99)
		# of adverse events per 1,000 hospitalizations	0.96 (0.93-1.00)
	SCIP	Occurrence of adverse events	0.94 (0.93-0.96)
		One or more adverse events per hospitalization	0.94 (0.92-0.96)
		# of adverse events per 1,000 hospitalizations	0.95 (0.93-0.96)
	All-Other Conditions	Occurrence of adverse events	1.03 (0.97-1.09)
		One or more adverse events per hospitalization	1.02 (0.96-1.09)
		# of adverse events per 1,000 hospitalizations	1.03 (0.98-1.09)

eTable 17. Observed In-hospital Mortality Data for Patients Experiencing and not Experiencing each of the 21 MPSMS Adverse Events⁴¹

Four Conditions, 2010-2015:

MPSMS Adverse Event Type	2010 Deaths in patients with this AE			2010 Deaths in patients without this AE			2011 Deaths in patients with this AE			2011 Deaths in patients without this AE			2012 Deaths in patients with this AE			2012 Deaths in patients without this AE			2013 Deaths in patients with this AE			2013 Deaths in patients without this AE			2014 Deaths in patients with this AE			2014 Deaths in patients without this AE			2015 Deaths in patients with this AE			2015 Deaths in patients without this AE		
	HM	Total	Rate	HM	Total	Rate	HM	Total	Rate	HM	Total	Rate	HM	Total	Rate	HM	Total	Rate	HM	Total	Rate	HM	Total	Rate	HM	Total	Rate	HM	Total	Rate	HM	Total	Rate	HM	Total	Rate
Adverse Drug Events																																				
Digixon AE	3	11	27.27	127	1629	7.8	5	9	55.6	107	1381	7.7	2	7	28.6	81	1039	7.8	2	5	40.0	44	667	6.6	4	6	66.7	44	634	6.9	1	2	50.0	24	292	8.2
Hypoglycemic AE	125	1236	10.11	641	10920	5.9	118	1216	9.7	589	10672	5.5	88	819	10.7	476	8613	5.5	44	542	8.1	295	5846	5.0	55	596	9.2	304	6206	4.9	22	287	7.7	146	3605	4.0
IV Heparin AE	55	364	15.11	148	2672	5.5	55	344	16.0	139	2679	5.2	53	257	20.6	117	2007	5.8	31	176	17.6	75	1615	4.6	41	219	18.7	109	1751	6.2	25	115	21.7	64	1417	4.5
LMWH, etc., AE	85	641	13.26	483	12700	3.8	94	659	14.3	436	13112	3.3	49	495	9.9	333	10335	3.2	32	241	13.3	220	6923	3.2	31	272	11.4	216	7455	2.9	17	115	14.8	108	4415	2.4
Warfarin AEs	26	288	9.03	91	4961	1.8	48	311	15.4	92	4769	1.9	26	208	12.5	72	3642	2.0	26	127	20.5	38	2391	1.6	21	117	17.9	46	2324	2.0	9	54	16.7	25	1186	2.1
General Adverse Events																																				
HAPU	216	1624	13.30	1336	32054	4.2	239	1642	14.6	1301	32325	4.0	162	1322	12.3	1084	25934	4.2	90	693	13.0	678	17259	3.9	80	712	11.2	746	18763	4.0	47	424	11.1	405	11319	3.6
Inpatient Falls	30	322	9.32	1522	33356	4.6	25	314	8.0	1515	33653	4.5	9	231	3.9	1237	27025	4.6	14	155	9.0	754	17797	4.2	12	183	6.6	814	19292	4.2	3	79	3.8	449	11664	3.8
Hospital-Acquired Infections																																				
C diff	21	111	18.92	1251	24829	5.0	23	133	17.3	1262	25725	4.9	14	113	12.4	1019	21351	4.8	11	71	15.5	603	12885	4.7	9	70	12.9	659	13955	4.7	4	32	12.5	351	7653	4.6
CLABSI	9	29	31.03	231	2574	9.0	9	29	31.0	229	2195	10.4	6	24	25.0	176	1906	9.2	4	8	50.0	137	1257	10.9	3	5	60.0	126	1480	8.5	0	2	0.0	84	772	10.9
CAUTI	44	544	8.09	889	14627	6.1	42	487	8.6	891	15137	5.9	31	358	8.7	739	12241	6.0	23	218	10.6	428	7106	6.0	12	204	5.9	463	7811	5.9	9	110	8.2	255	4084	6.2
MRSA	2	20	10.00	1429	32685	4.4	10	20	50.0	1405	32988	4.3	2	11	18.2	1157	26412	4.4	0	8	0.0	718	17502	4.1	2	12	16.7	783	19054	4.1	3	4	75.0	428	11498	3.7
VRE	10	20	50.00	1519	33522	4.5	4	8	50.0	1518	33816	4.5	2	5	40.0	1227	27126	4.5	3	8	37.5	751	17850	4.2	5	10	50.0	811	19372	4.2	2	3	66.7	446	11707	3.8
Post-op Pneumonia	30	219	13.70	124	9225	1.3	29	212	13.7	123	9920	1.2	20	177	11.3	103	8502	1.2	7	82	8.5	70	4860	1.4	8	100	8.0	56	5598	1.0	0	46	0.0	30	2895	1.0
VAP	18	81	22.22	170	617	27.6	18	77	23.4	170	559	30.4	13	60	21.7	128	526	24.3	9	40	22.5	80	317	25.2	8	46	17.4	93	370	25.1	2	23	8.7	62	204	30.4
Post-Procedure Adverse Events																																				
FAPCAP	2	90	2.22	135	4169	3.2	5	71	7.0	117	3669	3.2	5	64	7.8	89	2523	3.5	2	36	5.6	69	2019	3.4	4	47	8.5	87	2195	4.0	3	45	6.7	62	1720	3.6
AE with Hip Rep.	5	113	4.42	10	1328	0.8	3	123	2.4	7	1481	0.5	3	92	3.3	8	1322	0.6	2	44	4.5	7	862	0.8	1	47	2.1	4	989	0.4	0	25	0.0	2	589	0.3
AE with Knee Rep.	1	105	0.95	0	2028	0.0	3	121	2.5	4	2424	0.2	0	78	0.0	1	2067	0.0	0	28	0.0	2	1219	0.2	1	40	2.5	0	1480	0.0	0	20	0.0	0	949	0.0
Contrast Nephrop.	46	514	8.95	74	3745	2.0	33	470	7.0	78	3402	2.3	37	324	11.4	47	2478	1.9	27	276	9.8	40	2080	1.9	33	317	10.4	58	2329	2.5	20	223	9.0	37	1983	1.9
Mech Comp. w/CL	18	155	11.61	627	4577	13.7	31	173	17.9	639	4195	15.2	23	132	17.4	545	3675	14.8	9	78	11.5	335	2339	14.3	8	92	8.7	372	2707	13.7	3	35	8.6	203	1378	14.7
Post-op Cardiac AE	53	94	56.38	127	9550	1.3	56	98	57.1	128	10273	1.2	46	95	48.4	111	8828	1.3	22	42	52.4	65	5002	1.3	27	45	60.0	51	5748	0.9	11	25	44.0	24	2953	0.8
Post-op VTE	3	40	7.50	177	9604	1.8	7	37	18.9	177	10334	1.7	2	42	4.8	155	8883	1.7	0	25	0.0	87	5019	1.7	0	26	0.0	78	5768	1.4	0	6	0.0	35	2972	1.2

⁴¹ Note: Patients “without this AE” are those who were exposed to the AE type but did not experience it; those “with this AE” experienced the AE. All patients are exposed to the MPSMS Fall and HAPU measures, for all other measures less than 100 percent of patients are exposed to the AE measure.

Four Conditions, 2016-2019:

MPSMS Adverse Event Type	2016 Deaths in patients with this AE			2016 Deaths in patients without this AE			2017 Deaths in patients with this AE			2017 Deaths in patients without this AE			2018 Deaths in patients with this AE			2018 Deaths in patients without this AE			2019 Deaths in patients with this AE			2019 Deaths in patients without this AE			Combined 2010-2019 Deaths in patients with this AE			Combined 2010-2019 Deaths in patients without this AE				
	HM	Total	Rate	HM	Total	Rate	HM	Total	Rate	HM	Total	Rate	HM	Total	Rate	HM	Total	Rate	HM	Total	Rate	HM	Total	Rate	HM	Total	Rate	HM	Total	Rate	HM	Total
Adverse Drug Events																																
Digixon AE	1	1	100.0	32	534	6.0	N/A	0	N/A	17	362	4.7	1	1	100.0	10	146	6.9	N/A	0	N/A	1	52	1.9	19	42	45.2	487	6736	7.2		
Hypoglycemic AE	34	439	7.7	240	6295	3.8	32	326	9.8	202	4402	4.6	16	184	8.7	99	2173	4.6	6	74	8.1	45	1172	3.8	540	5719	9.4	3037	59904	5.1		
IV Heparin AE	25	120	20.8	94	1550	6.1	17	80	21.3	72	1231	5.8	8	53	15.1	43	798	5.4	2	22	9.1	14	413	3.4	312	1750	17.8	875	16133	5.4		
LMWH, etc., AE	23	162	14.2	173	7227	2.4	9	85	10.6	121	4860	2.5	7	42	16.7	60	2268	2.7	3	36	8.3	22	1209	1.8	350	2748	12.7	2172	70504	3.1		
Warfarin AEs	12	69	17.4	29	1950	1.5	8	48	16.7	32	1250	2.6	3	19	15.8	13	509	2.6	1	19	5.3	1	228	0.4	180	1260	14.3	439	23210	1.9		
General Adverse Events																																
HAPU	69	699	9.9	666	20085	3.3	59	470	12.6	492	13844	3.6	25	285	8.8	233	6772	3.4	14	129	10.9	97	3931	2.5	1001	8000	12.5	7038	182286	3.9		
Inpatient Falls	7	156	4.5	728	20628	3.5	5	114	4.4	546	14200	3.8	4	63	6.4	254	6994	3.6	0	25	0.0	111	4035	2.8	109	1642	6.6	7930	188644	4.2		
Hospital-Acquired Infections																																
C diff	7	67	10.4	563	14888	3.8	5	42	11.9	440	10162	4.3	1	21	4.8	214	4862	4.4	2	8	25.0	95	3156	3.0	97	668	14.5	6457	139466	4.6		
CLABSI	1	3	33.3	103	1075	9.6	2	6	33.3	88	760	11.6	2	3	66.7	53	432	12.3	1	2	50.0	19	303	6.3	37	111	33.3	1246	12754	9.8		
CAUTI	12	162	7.4	385	7172	5.4	6	105	5.7	315	4687	6.7	5	51	9.8	148	2303	6.4	2	24	8.3	59	1560	3.8	186	2263	8.2	4572	76728	6.0		
MRSA	1	8	12.5	702	20377	3.4	2	8	25.0	520	14023	3.7	0	3	0.0	248	6948	3.6	0	1	0.0	108	4001	2.7	22	95	23.2	7498	185488	4.0		
VRE	0	1	0.0	731	20720	3.5	1	3	33.3	544	14259	3.8	N/A	0	N/A	257	7028	3.7	N/A	0	N/A	111	4052	2.7	27	58	46.6	7915	189452	4.2		
Post-op Pneumonia	5	71	7.0	47	5944	0.8	7	44	15.9	43	3893	1.1	3	30	10.0	25	1944	1.3	4	23	17.4	14	1850	0.8	113	1004	11.3	635	54631	1.2		
VAP	4	30	13.3	79	290	27.2	4	24	16.7	55	227	24.2	5	15	33.3	33	124	26.6	1	11	9.1	15	70	21.4	82	407	20.2	885	3304	26.8		
Post-Procedure Adverse Events																																
FAPCAP	3	54	5.6	63	1763	3.6	3	19	15.8	43	1146	3.8	0	31	0.0	34	738	4.6	0	9	0.0	17	269	6.3	27	466	5.8	716	20211	3.5		
AE with Hip Rep.	2	64	3.1	4	1247	0.3	3	34	8.8	3	805	0.4	2	22	9.1	1	431	0.2	0	14	0.0	2	506	0.4	21	578	3.6	48	9560	0.5		
AE with Knee Rep.	3	44	6.8	3	2115	0.1	1	33	3.0	1	1306	0.1	0	13	0.0	0	597	0.0	0	15	0.0	0	453	0.0	9	497	1.8	11	14638	0.1		
Contrast Nephrop.	15	209	7.2	40	2169	1.8	15	159	9.4	34	1592	2.1	9	127	7.1	23	982	2.3	3	53	5.7	11	407	2.7	238	2672	8.9	442	21167	2.1		
Mech Comp. w/CL	11	70	15.7	302	2270	13.3	8	41	19.5	240	1650	14.5	4	35	11.4	134	848	15.8	0	13	0.0	63	547	11.5	115	824	14.0	3460	24186	14.3		
Post-op Cardiac AE	14	27	51.9	44	6048	0.7	19	37	51.4	36	3954	0.9	14	25	56.0	15	1976	0.8	8	20	40.0	11	1870	0.6	270	508	53.2	612	56202	1.1		
Post-op VTE	1	24	4.2	57	6051	0.9	1	16	6.3	54	3975	1.4	0	5	0.0	29	1996	1.5	1	15	6.7	18	1875	1.0	16	244	6.6	866	56469	1.5		

All-Other Conditions, 2012-2016:

MPSMS Adverse Event Type	2012 Deaths in patients with this AE			2012 Deaths in patients without this AE			2013 Deaths in patients with this AE			2013 Deaths in patients without this AE			2014 Deaths in patients with this AE			2014 Deaths in patients without this AE			2015 Deaths in patients with this AE			2015 Deaths in patients without this AE			2016 Deaths in patients with this AE			2016 Deaths in patients without this AE		
	HM	Total	Rate	HM	Total	Rate	HM	Total	Rate	HM	Total	Rate	HM	Total	Rate	HM	Total	Rate	HM	Total	Rate	HM	Total	Rate	HM	Total	Rate	HM	Total	Rate
Adverse Drug Events																														
Digixon AE	0	1	0.0	4	137	2.9	N/A	0	N/A	6	65	9.2	0	1	0.0	2	43	4.7	N/A	0	N/A	3	71	4.2	N/A	0	N/A	3	71	4.2
Hypoglycemic AE	4	164	2.4	30	2036	1.5	2	89	2.2	18	1090	1.7	1	67	1.5	19	874	2.2	7	112	6.3	28	1358	2.1	4	116	3.4	53	1554	3.4
IV Heparin AE	3	22	13.6	4	185	2.2	3	11	27.3	4	100	4.0	2	15	13.3	3	101	3.0	1	12	8.3	4	109	3.7	5	15	33.3	6	132	4.5
LMWH, etc., AE	1	39	2.6	31	1917	1.6	3	21	14.3	16	1224	1.3	3	20	15.0	10	1012	1.0	0	17	0.0	23	1509	1.5	6	29	20.7	29	1801	1.6
Warfarin AEs	1	27	3.7	6	633	0.9	5	16	31.3	5	352	1.4	0	8	0.0	2	235	0.9	3	17	17.6	4	320	1.3	4	17	23.5	2	306	0.7
General Adverse Events																														
HAPU	12	222	5.4	99	9310	1.1	13	120	10.8	55	5166	1.1	7	78	9.0	55	4230	1.3	10	123	8.1	87	5949	1.5	17	151	11.3	143	6963	2.1
Inpatient Falls	1	84	1.2	110	9448	1.2	0	38	0.0	68	5248	1.3	3	34	8.8	59	4274	1.4	4	50	8.0	93	6022	1.5	2	53	3.8	158	7061	2.2
Hospital-Acquired Infections																														
C diff	1	11	9.1	77	6108	1.3	0	8	0.0	40	3403	1.2	0	11	0.0	42	2634	1.6	3	14	21.4	67	3788	1.8	1	14	7.1	118	4419	2.7
CLABSI	1	2	50.0	19	277	6.9	N/A	0	N/A	14	156	9.0	0	1	0.0	5	115	4.3	N/A	0	N/A	15	169	8.9	0	2	0.0	21	210	10.0
CAUTI	1	54	1.9	65	2659	2.4	2	35	5.7	35	1427	2.5	0	15	0.0	30	1105	2.7	1	29	3.4	42	1438	2.9	1	32	3.1	82	1689	4.9
MRSA	0	2	0.0	105	9308	1.1	N/A	0	N/A	68	5172	1.3	0	3	0.0	60	4233	1.4	0	1	0.0	94	5943	1.6	N/A	0	N/A	152	6962	2.2
VRE	0	1	0.0	109	9484	1.1	0	3	0.0	67	5270	1.3	1	2	50.0	60	4290	1.4	N/A	0	N/A	96	6040	1.6	1	1	100.0	158	7091	2.2
VAP	1	5	20.0	7	54	13.0	1	2	50.0	4	25	16.0	0	3	0.0	8	26	30.8	1	4	25.0	14	60	23.3	0	4	0.0	23	63	36.5
Post-Procedure Adverse Events																														
FAPCAP	0	3	0.0	3	139	2.2	0	1	0.0	0	85	0.0	0	3	0.0	1	74	1.4	0	2	0.0	4	120	3.3	N/A	0	N/A	2	127	1.6
Contrast Nephrop.	3	14	21.4	1	146	0.7	0	7	0.0	0	93	0.0	1	9	11.1	0	88	0.0	1	10	10.0	1	124	0.8	0	8	0.0	1	145	0.7
Mech Comp. w/CL	0	16	0.0	33	533	6.2	0	10	0.0	21	308	6.8	0	5	0.0	13	235	5.5	2	11	18.2	40	407	9.8	0	12	0.0	48	488	9.8

All-Other Conditions, 2017-2019:

MPSMS Adverse Event Type	2017 Deaths in patients with this AE			2017 Deaths in patients without this AE			2018 Deaths in patients with this AE			2018 Deaths in patients without this AE			2019 Deaths in patients with this AE			2019 Deaths in patients without this AE			Combined 2012-2019 Deaths in patients with this AE			Combined 2012-2019 Deaths in patients without this AE		
	HM	Total	Rate	HM	Total	Rate	HM	Total	Rate	HM	Total	Rate	HM	Total	Rate	HM	Total	Rate	HM	Total	Rate	HM	Total	Rate
	Adverse Drug Events																							
Digixon AE	0	1	0.0	1	73	1.4	N/A	0	N/A	4	78	5.1	N/A	0	N/A	1	38	2.6	0	3	0.0	24	576	4.2
Hypoglycemic AE	12	117	10.3	46	1803	2.6	6	161	3.7	47	1789	2.6	5	59	8.5	27	1142	2.4	41	885	4.6	268	11646	2.3
IV Heparin AE	1	11	9.1	13	186	7.0	3	12	25.0	11	216	5.1	0	7	0.0	4	120	3.3	18	105	17.1	49	1149	4.3
LMWH, etc., AE	4	31	12.9	30	1991	1.5	2	27	7.4	31	2049	1.5	0	15	0.0	10	1240	0.8	19	199	9.6	180	12742	1.4
Warfarin AEs	1	11	9.1	8	330	2.4	2	16	12.5	5	268	1.9	0	6	0.0	2	145	1.4	16	118	13.6	34	2589	1.3
	General Adverse Events																							
HAPU	19	170	11.2	149	7742	1.9	18	211	8.5	143	7684	1.9	7	142	4.9	70	4662	1.5	103	1,217	8.5	801	51704	1.6
Inpatient Falls	2	61	3.3	166	7851	2.1	6	75	8.0	155	7820	2.0	2	46	4.4	75	4758	1.6	20	441	4.5	884	52480	1.7
	Hospital-Acquired Infections																							
C diff	2	11	18.2	112	4985	2.2	4	12	33.3	113	4944	2.3	0	5	0.0	54	3073	1.8	11	86	12.8	623	33352	1.9
CLABSI	0	1	0.0	36	234	15.4	N/A	0	N/A	17	248	6.9	0	1	0.0	14	155	9.0	1	7	14.3	141	1564	9.0
CAUTI	2	33	6.1	84	1763	4.8	3	33	9.1	81	1799	4.5	0	19	0.0	50	1114	4.5	10	250	4.0	469	12993	3.6
MRSA	0	4	0.0	158	7744	2.0	N/A	0	N/A	159	7743	2.1	N/A	0	N/A	73	4718	1.6	0	10	0.0	869	51822	1.7
VRE	N/A	0	N/A	166	7876	2.1	2	3	66.7	159	7869	2.0	N/A	0	N/A	77	4794	1.6	4	10	40.0	892	52712	1.7
VAP	2	6	33.3	23	76	30.3	1	8	12.5	19	80	23.8	1	9	11.1	11	52	21.2	7	41	17.1	109	436	25.0
	Post-Procedure Adverse Events																							
FAPCAP	0	3	0.0	1	142	0.7	0	6	0.0	7	158	4.4	0	4	0.0	2	74	2.7	0	22	0.0	20	919	2.2
Contrast Nephrop.	0	14	0.0	1	163	0.6	4	22	18.2	4	191	2.1	2	9	22.2	1	104	1.0	11	93	11.8	9	1054	0.9
Mech Comp. w/CL	1	14	7.1	73	599	12.2	4	19	21.1	61	642	9.5	2	13	15.4	35	391	9.0	9	100	9.0	324	3603	9.0

Four Conditions and All-Other Conditions, 2010-2019 (2012-2019 for All-Other Conditions):

Overall Hospital Mortality Rates With and Without Adverse Events						
Year	With AE			Without AE		
	HM	Total	Rate	HM	Total	Rate
	Four Conditions					
2010	514	4934	10.42	1038	28744	3.61
2011	522	4884	10.69	1018	29083	3.5
2012	389	3698	10.52	857	23558	3.64
2013	233	2234	10.43	535	15718	3.4
2014	242	2442	9.91	584	17033	3.43
2015	119	1314	9.06	333	10429	3.19
2016	178	1980	8.99	557	18804	2.96
2017	145	1369	10.59	406	12945	3.14
2018	79	825	9.58	179	6232	2.87
2019	37	413	8.96	74	3647	2.03
2010-2019	2459	24098	10.2	5580	166188	3.36
	All-Other Conditions					
2012	26	588	4.42	85	8944	0.95
2013	20	312	6.41	48	4974	0.97
2014	16	237	6.75	46	4071	1.13
2015	22	349	6.3	75	5723	1.31
2016	33	398	8.29	127	6716	1.89
2017	37	435	8.51	131	7477	1.75
2018	42	524	8.02	119	7371	1.61
2019	13	295	4.41	64	4509	1.42
2012-2019	209	3138	6.66	695	49783	1.40

eTable 18. Observed Length of Stay (LOS) Data for Patients Experiencing and not Experiencing each of the 21 MPSMS Adverse Events ⁴²

Four Conditions, 2010-2015:

MPSMS Adverse Event Type	2010 LOS of patients with this AE		2010 LOS of patients without this AE		2011 LOS of patients with this AE		2011 LOS of patients without this AE		2012 LOS of patients with this AE		2012 LOS of patients without this AE		2013 LOS of patients with this AE		2013 LOS of patients without this AE		2014 LOS of patients with this AE		2014 LOS of patients without this AE		2015 LOS of patients with this AE		2015 LOS of patients without this AE	
	Mean (SD)	Total	Mean (SD)	Total	Mean (SD)	Total	Mean (SD)	Total	Mean (SD)	Total	Mean (SD)	Total	Mean (SD)	Total	Mean (SD)	Total	Mean (SD)	Total	Mean (SD)	Total	Mean (SD)	Total	Mean (SD)	Total
Adverse Drug Events																								
Digixon AE	9.9 (6.4)	8	7.4 (7.2)	1502	8.5 (4.9)	4	7.4 (8.4)	1274	10.0 (4.7)	5	7.8 (7.6)	958	12.0 (5.3)	3	7.3 (8.9)	623	11.0 (1.4)	2	7.4 (6.9)	590	15.0	1	6.8 (6.3)	268
Hypoglycemic AE	9.9 (9.4)	1111	6.3 (6.5)	10279	9.2 (8.7)	1098	5.9 (6.1)	10083	9.9 (8.7)	731	6.1 (6.0)	8137	10.2 (11.9)	498	5.9 (6.1)	5551	9.7 (9.7)	541	5.9 (5.6)	5902	8.6 (8.1)	265	5.2 (5.3)	3459
IV Heparin AE	14.3 (11.7)	309	5.8 (6.8)	2524	13.1 (9.4)	289	5.5 (6.2)	2540	14.1 (11.9)	204	6.1 (7.0)	1890	15.8 (15.1)	145	5.5 (6.1)	1540	12.9 (10.2)	178	5.6 (6.5)	1642	12.0 (8.0)	90	4.5 (5.2)	1353
LMWH, etc., AE	12.8 (9.4)	556	5.3 (5.2)	12217	12.7 (11.5)	565	5.1 (4.9)	12676	12.0 (9.6)	446	5.3 (4.9)	10002	12.6 (10.7)	209	5.1 (5.1)	6703	11.9 (9.2)	241	5.1 (4.9)	7239	10.9 (8.3)	98	4.6 (4.5)	4307
Warfarin AEs	14.6 (11.5)	262	5.5 (5.2)	4870	11.7 (10.9)	263	5.3 (5.1)	4677	12.0 (9.7)	182	5.6 (5.1)	3570	15.9 (18.1)	101	5.7 (5.4)	2353	13.8 (13.4)	96	5.8 (5.9)	2278	13.4 (9.5)	45	5.3 (5.1)	1161
General Adverse Events																								
HAPU	12.2 (10.8)	1408	4.8 (4.6)	30718	11.6 (10.6)	1403	4.6 (4.3)	31024	11.8 (10.2)	1160	4.7 (4.4)	24850	12.3 (12.0)	603	4.6 (4.5)	16581	11.8 (10.4)	632	4.6 (4.3)	18017	10.7 (9.4)	377	4.2 (4.1)	10914
Inpatient Falls	9.6 (8.2)	292	5.1 (5.2)	31834	8.0 (7.0)	289	4.9 (4.9)	32138	9.7 (10.4)	222	5.0 (4.9)	25788	8.1 (6.5)	141	4.9 (5.1)	17043	9.0 (10.8)	171	4.8 (4.7)	18478	10.2 (11.5)	76	4.4 (4.4)	11215
Hospital-Acquired Infections																								
C diff	18.2 (11.0)	90	5.7 (5.7)	23578	17.1 (14.0)	110	5.4 (5.3)	24463	16.3 (13.4)	99	5.4 (5.3)	20332	14.5 (10.7)	60	5.5 (5.6)	12282	17.4 (12.7)	61	5.4 (5.2)	13296	16.0 (14.1)	28	5.1 (4.9)	7302
CLABSI	26.5 (17.8)	20	11.0 (9.1)	2343	28.6 (19.3)	20	10.6 (8.3)	1966	20.1 (9.0)	18	10.7 (8.2)	1730	26.8 (9.7)	4	10.8 (8.2)	1120	21.0 (18.4)	2	10.1 (7.6)	1354	17.5 (2.1)	2	9.8 (7.6)	688
CAUTI	13.2 (13.1)	500	5.8 (5.6)	13738	12.2 (11.4)	445	5.5 (5.3)	14246	12.0 (10.7)	327	5.6 (5.3)	11502	14.4 (14.1)	195	5.7 (5.3)	6678	13.4 (10.6)	192	5.6 (5.4)	7348	13.4 (12.8)	101	5.5 (5.3)	3829
MRSA	24.2 (13.8)	18	5.0 (5.2)	31256	20.3 (11.9)	10	4.8 (4.9)	31583	21.2 (15.1)	9	4.9 (4.8)	25255	9.9 (3.9)	8	4.8 (5.0)	16784	20.7 (10.4)	10	4.8 (4.7)	18271	9.0	1	4.3 (4.4)	11070
VRE	31.9 (17.7)	10	5.1 (5.2)	32003	34.3 (19.6)	4	4.9 (4.9)	32298	29.7 (8.5)	3	5.0 (5.0)	25899	23.4 (10.9)	5	4.9 (5.1)	17099	24.6 (21.7)	5	4.8 (4.8)	18561	53.0	1	4.4 (4.5)	11261
Post-op Pneumonia	17.4 (15.3)	189	5.3 (5.6)	9101	16.2 (12.7)	183	4.9 (5.0)	9797	14.0 (11.0)	157	5.1 (5.1)	8399	20.6 (18.2)	75	5.1 (5.1)	4790	17.1 (13.4)	92	4.9 (4.9)	5542	15.1 (10.3)	46	4.5 (4.8)	2865
VAP	20.9 (13.9)	63	16.2 (11.7)	447	20.2 (17.9)	59	16.5 (12.7)	389	19.0 (11.7)	47	16.1 (12.1)	398	22.2 (14.9)	31	16.2 (11.3)	237	18.9 (11.4)	38	15.8 (12.2)	277	17.9 (10.1)	21	14.2 (9.7)	142
Post-Procedure Adverse Events																								
FAPCAP	5.8 (5.4)	88	5.5 (5.9)	4034	6.3 (4.7)	66	5.2 (5.4)	3552	5.8 (4.8)	59	5.3 (5.7)	2434	6.6 (8.4)	34	5.3 (5.8)	1950	5.5 (4.9)	43	5.3 (5.4)	2108	4.9 (4.4)	42	4.5 (4.3)	1658
AE with Hip Rep	7.1 (5.3)	108	4.1 (2.4)	1318	7.4 (4.7)	120	3.9 (2.7)	1474	7.6 (4.9)	89	3.9 (2.5)	1314	6.5 (3.5)	42	3.7 (2.2)	855	6.5 (4.9)	46	3.3 (2.1)	985	8.4 (4.6)	25	3.2 (2.3)	587
AE with Knee Rep	4.7 (2.3)	104	3.3 (1.4)	2028	5.1 (2.3)	118	3.2 (1.3)	2420	4.7 (2.2)	78	3.2 (1.3)	2066	4.9 (1.8)	28	3.0 (1.1)	1217	4.6 (2.4)	39	2.8 (1.3)	1480	5.1 (3.9)	20	2.7 (1.1)	949
Contrast Nephrop.	9.2 (8.6)	468	4.9 (5.3)	3671	8.5 (6.6)	437	4.5 (4.6)	3324	9.3 (6.7)	287	4.6 (5.0)	2431	10.0 (9.4)	249	4.3 (4.4)	2040	8.5 (6.7)	284	4.4 (4.4)	2271	7.9 (5.9)	203	3.9 (4.3)	1946
Mech Comp. w/CL	14.9 (13.7)	137	11.6 (9.4)	3950	15.7 (11.1)	142	11.2 (9.3)	3556	17.4 (14.9)	109	11.1 (8.6)	3130	18.1 (14.7)	69	11.5 (9.7)	2004	15.2 (11.1)	84	10.8 (8.5)	2335	12.9 (8.6)	32	10.1 (8.5)	1175
Post-op Cardiac AE	18.7 (16.5)	41	5.7 (6.3)	9423	14.8 (10.6)	42	5.2 (5.7)	10145	13.0 (9.2)	49	5.4 (5.6)	8717	20.1 (20.4)	20	5.5 (6.0)	4937	15.4 (8.8)	18	5.2 (5.5)	5697	11.9 (8.6)	14	4.8 (5.2)	2929
Post-op VTE	17.4 (14.1)	37	5.7 (6.4)	9427	16.4 (10.2)	30	5.3 (5.8)	10157	13.3 (10.1)	40	5.4 (5.6)	8728	14.7 (8.0)	25	5.5 (6.1)	4932	15.1 (7.2)	26	5.1 (5.5)	5690	15.0 (11.0)	6	4.8 (5.2)	2937

⁴² Note: Patients that died during their stay are not included in these LOS calculations, therefore the numbers of patients are often not consistent with those in Table S15. Patients “without this AE” are those who were exposed to the AE type but did not experience it; those “with this AE” experienced the AE. All patients are exposed to the MPSMS Fall and HAPU measures, for all other measures less than 100 percent of patients are exposed to the AE measure.

Four Conditions, 2016-2019:

MPSMS Adverse Event Type	2016 LOS of patients with this AE		2016 LOS of patients without this AE		2017 LOS of patients with this AE		2017 LOS of patients without this AE		2018 LOS of patients with this AE		2018 LOS of patients without this AE		2019 LOS of patients with this AE		2019 LOS of patients without this AE		Combined 2010-2019 LOS of patients with this AE		Combined 2010-2019 LOS of patients without this AE	
	Mean (SD)	Total	Mean (SD)	Total	Mean (SD)	Total	Mean (SD)	Total	Mean (SD)	Total	Mean (SD)	Total	Mean (SD)	Total	Mean (SD)	Total	Mean (SD)	Total	Mean (SD)	Total
Adverse Drug Events																				
Digixon AE	N/A	0	7.3 (7.5)	502	N/A	0	7.0 (6.1)	345	N/A	0	6.6 (4.9)	136	N/A	0	6.4 (6.2)	51	10.3 (5.0)	23	7.4 (7.6)	6249
Hypoglycemic AE	9.8 (9.8)	405	5.3 (5.6)	6055	9.7 (11.2)	294	5.5 (5.9)	4200	9.5 (9.9)	168	5.6 (5.1)	2074	11.9 (15.8)	68	6.0 (6.6)	1127	9.7 (9.7)	5179	5.8 (6.0)	56867
IV Heparin AE	16.2 (13.7)	95	5.2 (6.2)	1456	15.8 (15.9)	63	5.3 (6.0)	1159	12.7 (10.3)	45	5.3 (5.5)	755	23.3 (28.1)	20	6.3 (7.5)	399	14.1 (12.1)	1438	5.5 (6.3)	15258
LMWH, etc., AE	14.2 (13.0)	139	4.7 (4.6)	7054	12.9 (9.6)	76	4.8 (5.0)	4739	15.4 (10.6)	35	4.9 (4.7)	2208	13.7 (13.5)	33	5.1 (6.2)	1187	12.6 (10.3)	2398	5.1 (5.0)	68332
Warfarin AEs	15.9 (16.5)	57	5.2 (5.6)	1921	17.7 (19.1)	40	5.5 (5.4)	1218	15.8 (8.5)	16	5.7 (6.3)	496	16.2 (27.0)	18	5.8 (6.1)	227	13.7 (13.0)	1080	5.5 (5.4)	22771
General Adverse Events																				
HAPU	12.1 (11.5)	630	4.3 (4.2)	19419	10.6 (9.1)	411	4.3 (4.6)	13352	11.0 (10.1)	260	4.3 (4.2)	6539	13.6 (15.6)	115	4.3 (4.4)	3834	11.8 (10.7)	6999	4.5 (4.4)	175248
Inpatient Falls	8.7 (10.5)	149	4.5 (4.7)	19900	10.5 (9.8)	109	4.5 (4.9)	13654	9.5 (7.8)	59	4.6 (4.7)	6740	15.1 (20.6)	25	4.5 (5.0)	3924	9.2 (9.4)	1533	4.8 (4.9)	180714
Hospital-Acquired Infections																				
C diff	17.8 (15.3)	60	5.0 (5.2)	14325	20.2 (19.7)	37	5.0 (5.2)	9722	17.7 (15.7)	20	5.2 (5.2)	4648	15.8 (9.1)	6	5.0 (5.8)	3061	17.1 (13.6)	571	5.4 (5.4)	133009
CLABSI	18.0 (5.7)	2	10.8 (9.1)	972	45.5 (49.9)	4	10.4 (9.0)	672	19.0	1	10.4 (8.5)	379	34.0	1	10.5 (6.8)	284	25.9 (18.6)	74	10.6 (8.4)	11508
CAUTI	14.5 (14.0)	150	5.4 (5.5)	6787	13.7 (11.5)	99	5.7 (6.0)	4372	12.6 (11.2)	46	6.0 (5.8)	2155	14.1 (13.1)	22	5.8 (6.7)	1501	13.0 (12.2)	2,077	5.6 (5.5)	72156
MRSA	17.4 (9.5)	7	4.4 (4.7)	19675	35.8 (35.6)	6	4.5 (4.7)	13503	9.7 (6.1)	3	4.6 (4.7)	6700	8.0	1	4.5 (5.1)	3893	20.5 (15.7)	73	4.7 (4.9)	177990
VRE	20.0	1	4.5 (4.8)	19989	60.0 (60.8)	2	4.5 (4.9)	13715	N/A	0	4.6 (4.8)	6771	N/A	0	4.6 (5.3)	3941	31.5 (20.8)	31	4.8 (4.9)	181537
Post-op Pneumonia	15.3 (11.7)	66	4.3 (5.0)	5897	16.2 (20.0)	37	4.3 (4.8)	3850	14.7 (10.1)	27	4.5 (5.1)	1919	20.1 (26.1)	19	4.5 (5.0)	1836	16.4 (14.2)	891	4.8 (5.1)	53996
VAP	25.4 (17.0)	26	15.4 (12.6)	211	24.4 (23.6)	20	14.6 (9.4)	172	21.6 (12.9)	10	12.5 (10.2)	91	18.0 (11.0)	10	18.0 (17.4)	55	20.7 (14.9)	325	15.8 (11.9)	2419
Post-Procedure Adverse Events																				
FAPCAP	4.1 (4.2)	51	4.7 (5.6)	1700	6.0 (6.1)	16	4.9 (7.2)	1103	6.0 (7.8)	31	4.8 (5.3)	704	6.4 (4.7)	9	5.7 (6.5)	252	5.7 (5.5)	439	5.2 (5.7)	19495
AE with Hip Rep	6.1 (5.9)	62	3.2 (2.4)	1243	5.1 (2.7)	31	3.0 (2.1)	802	7.6 (9.5)	20	3.1 (2.6)	430	5.7 (4.7)	14	2.8 (2.4)	504	7.0 (5.1)	557	3.5 (2.4)	9512
AE with Knee Rep	3.8 (1.8)	41	2.5 (1.2)	2112	4.1 (3.1)	32	2.3 (1.1)	1305	3.5 (1.6)	13	2.2 (1.0)	597	4.4 (5.6)	15	2.1 (1.1)	453	4.6 (2.5)	488	2.9 (1.3)	14627
Contrast Nephrop.	8.6 (8.2)	194	3.7 (3.9)	2129	8.8 (11.8)	144	4.0 (5.1)	1558	7.7 (7.5)	118	3.9 (4.0)	959	9.4 (7.3)	50	4.2 (4.4)	396	8.8 (7.9)	2,434	4.3 (4.7)	20725
Mech Comp. w/CL	16.4 (14.3)	59	11.1 (9.6)	1968	15.2 (10.9)	33	10.9 (10.0)	1410	15.5 (13.7)	31	10.6 (8.2)	714	22.0 (18.2)	13	10.9 (9.3)	484	16.0 (13.1)	709	11.1 (9.2)	20726
Post-op Cardiac AE	14.5 (12.8)	13	4.5 (5.5)	6004	18.3 (26.7)	18	4.5 (5.1)	3918	12.9 (11.5)	11	4.7 (5.4)	1961	14.2 (15.6)	12	4.7 (6.0)	1859	15.6 (14.5)	238	5.2 (5.7)	55590
Post-op VTE	23.0 (23.5)	23	4.4 (5.2)	5994	17.4 (10.5)	15	4.5 (5.4)	3921	15.0 (9.4)	5	4.8 (5.4)	1967	12.9 (11.4)	14	4.7 (6.1)	1857	16.2 (12.6)	228	5.2 (5.7)	55603

All-Other Conditions, 2012-2016:

MPSMS Adverse Event Type	2012 LOS of patients with this AE		2012 LOS of patients without this AE		2013 LOS of patients with this AE		2013 LOS of patients without this AE		2014 LOS of patients with this AE		2014 LOS of patients without this AE		2015 LOS of patients with this AE		2015 LOS of patients without this AE		2016 LOS of patients with this AE		2016 LOS of patients without this AE	
	Mean (SD)	Total	Mean (SD)	Total	Mean (SD)	Total	Mean (SD)	Total	Mean (SD)	Total	Mean (SD)	Total	Mean (SD)	Total	Mean (SD)	Total	Mean (SD)	Total	Mean (SD)	Total
Adverse Drug Events																				
Digixon AE	8.0	1	7.1 (6.9)	133	N/A	0	6.0 (5.0)	59	17.0	1	5.6 (3.7)	41	N/A	0	6.2 (6.2)	68	N/A	0	6.7 (7.0)	68
Hypoglycemic AE	8.7 (10.2)	160	4.7 (4.7)	2006	7.1 (5.6)	87	4.7 (5.9)	1072	7.4 (8.4)	66	4.2 (3.8)	855	7.4 (8.9)	105	4.6 (4.9)	1330	9.4 (14.0)	112	4.5 (4.5)	1501
IV Heparin AE	11.9 (11.9)	19	5.7 (5.1)	181	15.1 (6.5)	8	6.3 (7.4)	96	12.2 (7.4)	13	4.3 (3.4)	98	13.0 (7.5)	11	5.6 (4.8)	105	12.6 (11.2)	10	6.5 (9.1)	126
LMWH, etc., AE	9.7 (6.7)	38	4.7 (5.2)	1886	14.4 (8.5)	18	4.5 (4.2)	1208	11.9 (8.2)	17	4.1 (5.0)	1002	12.9 (9.4)	17	4.3 (4.3)	1486	13.3 (10.0)	23	4.4 (4.6)	1772
Warfarin AEs	11.2 (5.6)	26	5.1 (4.4)	627	15.6 (9.3)	11	5.7 (5.2)	347	15.3 (9.9)	8	4.7 (4.0)	233	9.4 (7.9)	14	5.3 (6.2)	316	9.5 (4.3)	13	5.1 (4.8)	304
General Adverse Events																				
HAPU	9.7 (10.9)	210	3.7 (3.9)	9211	10.7 (12.4)	107	3.7 (3.8)	5111	10.0 (9.1)	71	3.5 (3.8)	4175	9.8 (9.6)	113	3.7 (3.8)	5862	12.2 (13.8)	134	3.7 (3.8)	6820
Inpatient Falls	7.9 (13.4)	83	3.8 (4.1)	9338	8.2 (9.5)	38	3.8 (4.2)	5180	10.1 (19.2)	31	3.6 (3.7)	4215	6.6 (4.6)	46	3.8 (4.1)	5929	7.4 (5.6)	51	3.8 (4.3)	6903
Hospital-Acquired Infections																				
C diff	13.8 (7.6)	10	4.0 (4.6)	6031	20.4 (34.7)	8	3.9 (4.0)	3363	11.0 (6.2)	11	3.9 (4.3)	2592	18.6 (18.5)	11	4.2 (4.3)	3721	13.4 (13.6)	13	4.3 (4.9)	4301
CLABSI	8.0	1	7.7 (6.4)	258	N/A	0	8.5 (9.0)	142	27.0	1	8.4 (7.6)	110	N/A	0	8.2 (8.6)	154	36.5 (41.7)	2	9.5 (9.9)	189
CAUTI	11.7 (16.4)	53	3.8 (4.3)	2594	9.8 (6.9)	33	3.9 (4.4)	1392	9.0 (5.8)	15	3.8 (3.9)	1075	13.1 (9.1)	28	4.2 (4.5)	1396	11.5 (6.5)	31	4.4 (5.6)	1607
MRSA	15.5 (2.1)	2	3.7 (3.9)	9203	N/A	0	3.8 (4.2)	5104	14.0 (11.3)	3	3.6 (4.0)	4173	29.0	1	3.8 (4.0)	5849	N/A	0	3.8 (4.3)	6810
VRE	22.0	1	3.8 (4.1)	9375	10.0 (4.6)	3	3.8 (4.2)	5203	10.0	1	3.6 (4.0)	4230	N/A	0	3.8 (4.1)	5944	N/A	0	3.9 (4.2)	6933
VAP	9.0 (2.0)	4	12.7 (7.8)	47	10.0	1	15.4 (18.4)	21	8.7 (9.8)	3	12.0 (7.6)	18	14.3 (7.6)	3	12.2 (10.5)	46	50.0 (29.3)	4	14.9 (12.4)	40
Post-Procedure Adverse Events																				
FAPCAP	2.3 (0.6)	3	5.1 (7.2)	136	1.0	1	4.6 (5.1)	85	11.3 (7.6)	3	4.7 (4.4)	73	3.0 (1.4)	2	5.2 (6.1)	116	N/A	0	6.1 (7.9)	125
Contrast Nephrop.	9.8 (12.6)	11	4.3 (4.6)	145	9.7 (7.7)	7	3.7 (4.2)	93	5.9 (3.1)	8	4.4 (4.4)	88	5.1 (3.2)	9	4.6 (5.7)	123	9.1 (8.7)	8	4.5 (5.0)	144
Mech Comp. w/CL	9.1 (6.0)	16	8.5 (8.4)	500	14.1 (10.9)	10	8.3 (9.2)	287	15.4 (10.7)	5	8.2 (6.8)	222	10.3 (3.7)	9	8.5 (7.9)	367	14.6 (17.2)	12	9.4 (10.1)	440

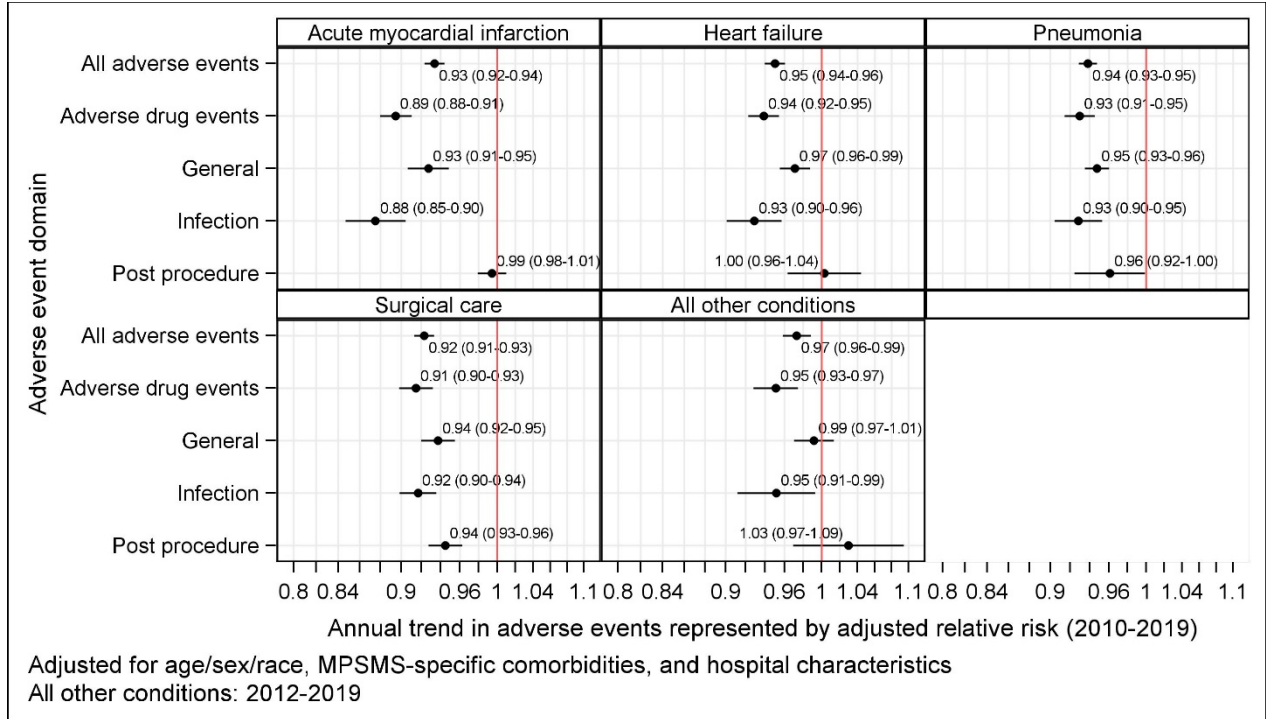
All-Other Conditions, 2017-2019:

MPSMS Adverse Event Type	2017 LOS of patients with this AE		2017 LOS of patients without this AE		2018 LOS of patients with this AE		2018 LOS of patients without this AE		2019 LOS of patients with this AE		2019 LOS of patients without this AE		Combined 2012-2019 LOS of patients with this AE		Combined 2012-2019 LOS of patients without this AE	
	Mean (SD)	Total	Mean (SD)	Total	Mean (SD)	Total	Mean (SD)	Total	Mean (SD)	Total	Mean (SD)	Total	Mean (SD)	Total	Mean (SD)	Total
Adverse Drug Events																
Digixon AE	9.0	1	6.5 (8.0)	72	N/A	0	7.1 (7.3)	74	N/A	0	6.2 (7.7)	37	11.3 (4.9)	3	6.6 (6.7)	552
Hypoglycemic AE	8.0 (9.5)	105	4.7 (4.8)	1757	8.6 (8.8)	155	4.8 (4.7)	1742	7.9 (7.5)	54	4.7 (5.3)	1115	8.2 (9.7)	844	4.6 (4.8)	11378
IV Heparin AE	12.0 (11.7)	10	5.6 (5.0)	173	17.1 (12.8)	9	7.0 (8.1)	205	8.3 (5.8)	7	6.3 (5.7)	116	12.7 (9.8)	87	6.0 (6.5)	1100
LMWH, etc., AE	14.0 (10.5)	27	4.4 (4.6)	1961	10.2 (8.3)	25	4.5 (4.6)	2018	12.3 (9.6)	15	4.8 (6.4)	1230	12.1 (8.8)	180	4.5 (4.9)	12562
Warfarin AEs	9.0 (4.3)	10	5.4 (5.6)	322	10.8 (8.8)	14	6.5 (6.4)	263	9.5 (4.9)	6	5.5 (4.5)	143	11.1 (7.2)	102	5.4 (5.2)	2555
General Adverse Events																
HAPU	10.2 (9.4)	151	3.8 (4.0)	7593	10.3 (9.4)	193	3.8 (3.9)	7541	10.8 (12.8)	135	3.9 (4.4)	4592	10.4 (11.0)	1114	3.7 (3.9)	50903
Inpatient Falls	7.3 (6.0)	59	3.9 (4.3)	7685	7.2 (6.3)	69	3.9 (4.2)	7665	9.5 (10.4)	44	4.1 (4.9)	4683	7.9 (10.0)	421	3.8 (4.2)	51596
Hospital-Acquired Infections																
C diff	11.7 (8.0)	9	4.4 (4.6)	4873	14.9 (13.4)	8	4.5 (4.6)	4831	17.2 (7.6)	5	4.5 (5.6)	3019	14.8 (15.5)	75	4.2 (4.6)	32729
CLABSI	63.0	1	9.1 (8.6)	198	N/A	0	8.5 (7.7)	231	17.0	1	10.6 (11.5)	141	31.3 (26.7)	6	8.8 (8.6)	1423
CAUTI	11.8 (11.2)	31	4.3 (4.9)	1679	9.8 (7.4)	30	4.5 (4.8)	1718	13.3 (8.7)	19	4.6 (5.4)	1064	11.3 (10.6)	240	4.2 (4.6)	12524
MRSA	11.8 (2.2)	4	3.9 (4.3)	7586	N/A	0	3.9 (4.2)	7584	N/A	0	4.1 (4.9)	4645	14.9 (7.6)	10	3.8 (4.2)	50953
VRE	N/A	0	3.9 (4.3)	7710	63.0	1	4.0 (4.2)	7710	N/A	0	4.1 (5.0)	4717	20.8 (21.4)	6	3.9 (4.2)	51820
VAP	18.0 (5.7)	4	11.1 (9.2)	53	17.0 (10.9)	7	11.5 (9.6)	61	34.6 (19.4)	8	13.4 (9.6)	41	23.0 (19.4)	34	12.6 (10.5)	327
Post-Procedure Adverse Events																
FAPCAP	6.0 (5.6)	3	5.2 (6.8)	141	7.8 (12.6)	6	5.6 (6.9)	151	6.0 (4.3)	4	7.2 (11.5)	72	6.2 (7.6)	22	5.4 (7.2)	899
Contrast Nephrop.	12.1 (15.4)	14	3.5 (3.1)	162	9.7 (8.3)	18	4.3 (5.7)	187	22.9 (26.2)	7	4.4 (6.1)	103	10.3 (12.5)	82	4.2 (4.9)	1045
Mech Comp. w/CL	20.6 (15.3)	13	9.0 (8.2)	526	10.1 (10.6)	15	9.2 (8.0)	581	14.5 (10.0)	11	9.8 (9.7)	356	13.3 (11.6)	91	8.9 (8.6)	3279

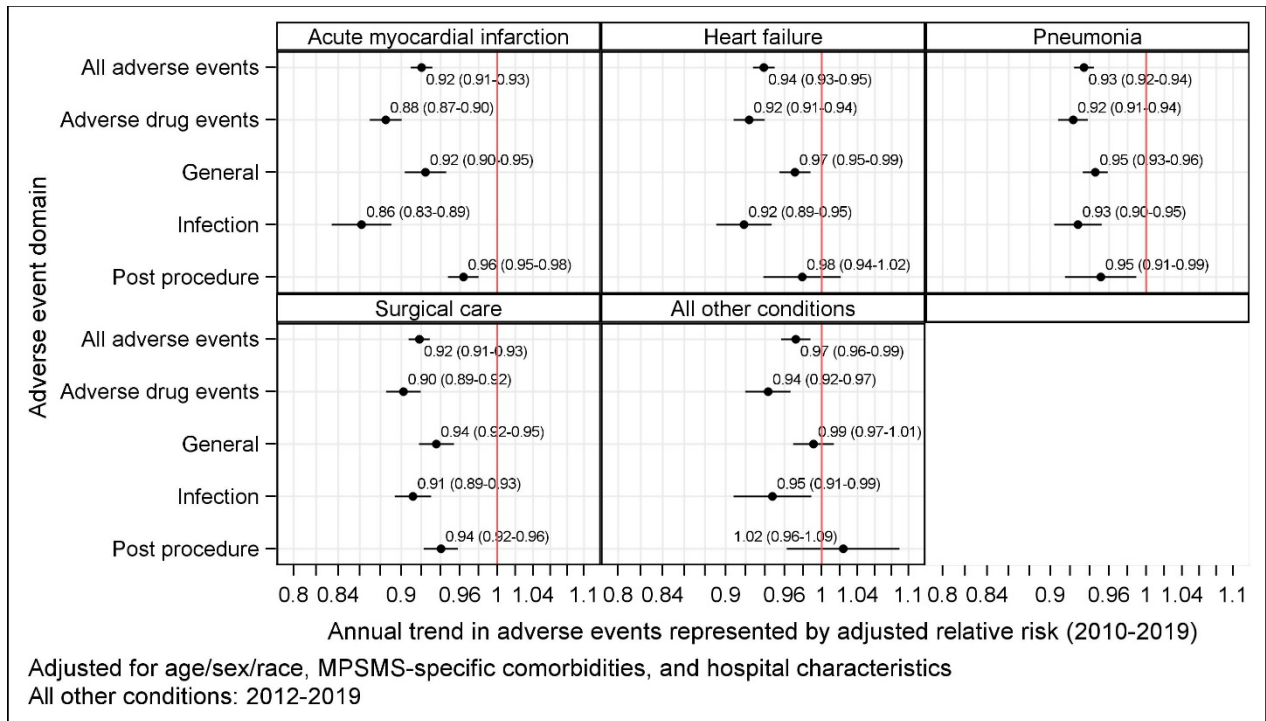
Four Conditions and All-Other Conditions, 2010-2019 (2012-2019 for All-Other Conditions):

Overall LOS With and Without Adverse Events				
Year	With AE		Without AE	
	Mean (SD)	Total	Mean (SD)	Total
Four Conditions				
2010	10.2 (9.0)	4420	4.3 (3.8)	27706
2011	9.6 (8.8)	4362	4.2 (3.5)	28065
2012	10.1 (8.7)	3309	4.3 (3.7)	22701
2013	10.3 (9.7)	2001	4.2 (3.6)	15183
2014	9.9 (8.9)	2200	4.1 (3.4)	16449
2015	9.1 (8.1)	1195	3.9 (3.5)	10096
2016	10.0 (9.9)	1802	4.0 (3.5)	18247
2017	10.0 (10.0)	1224	4.0 (3.7)	12539
2018	9.2 (8.8)	746	4.0 (3.6)	6053
2019	10.9 (11.5)	376	3.9 (3.5)	3573
2010-2019	9.9 (9.1)	21639	4.1 (3.6)	160608
All-Other Conditions				
2012	8.8 (9.7)	562	3.5 (3.4)	8859
2013	9.1 (9.4)	292	3.5 (3.5)	4926
2014	9.0 (10.4)	221	3.4 (3.1)	4025
2015	8.6 (7.9)	327	3.6 (3.6)	5648
2016	9.7 (10.8)	365	3.5 (3.4)	6589
2017	9.3 (8.9)	398	3.7 (3.7)	7346
2018	8.8 (8.3)	482	3.7 (3.6)	7252
2019	10.4 (11.7)	282	3.7 (3.9)	4445
2012-2019	9.1 (9.6)	2929	3.6 (3.5)	49088

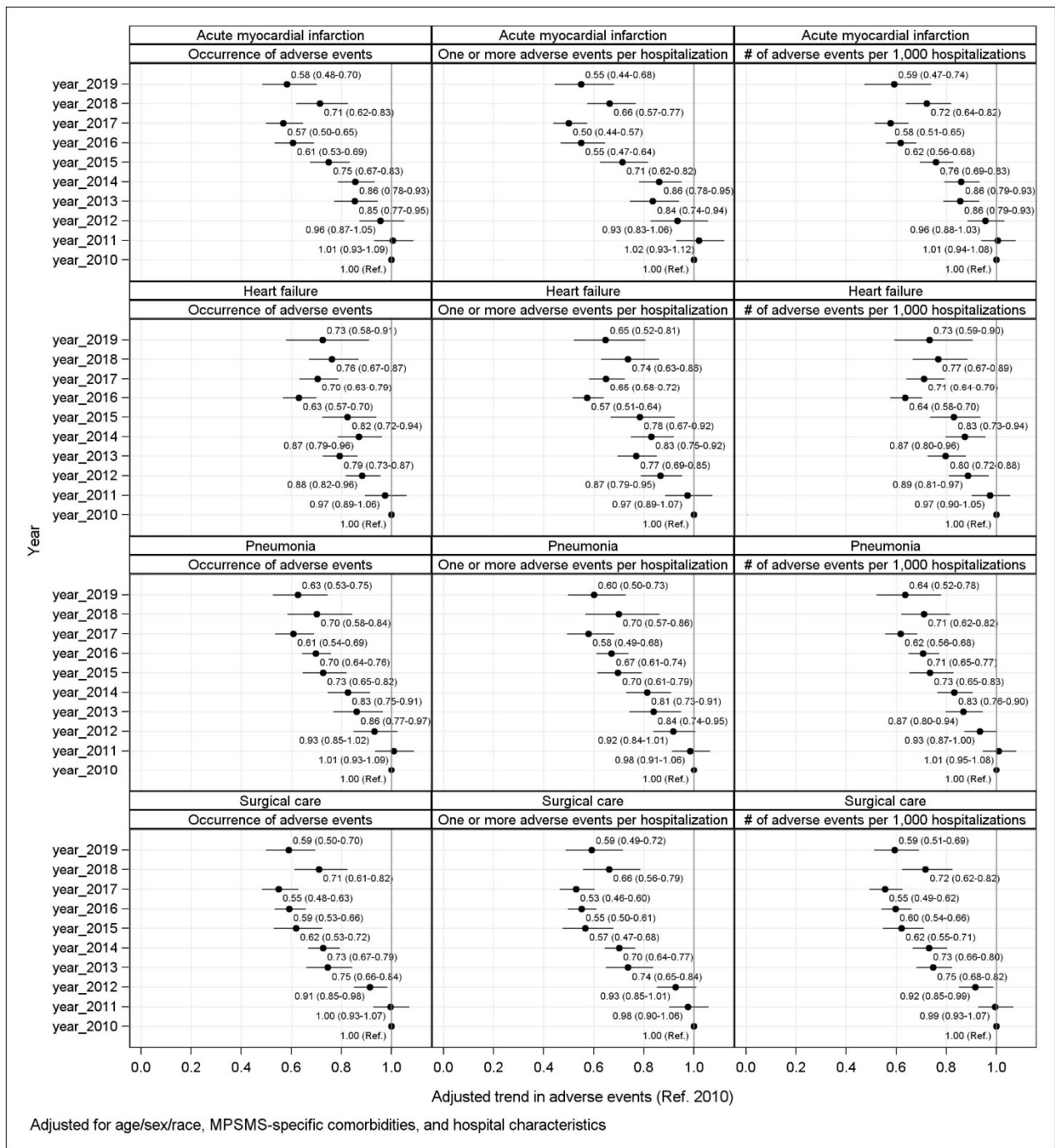
eFigure 1A. Risk-Adjusted Annual Trend in the Rate of Occurrence of Adverse Events for Which Patients Were at Risk for Five Patient Groups for All Adverse Events and for Four Adverse Event Domains, 2010-2019 (2012-2019 for All-other Conditions)



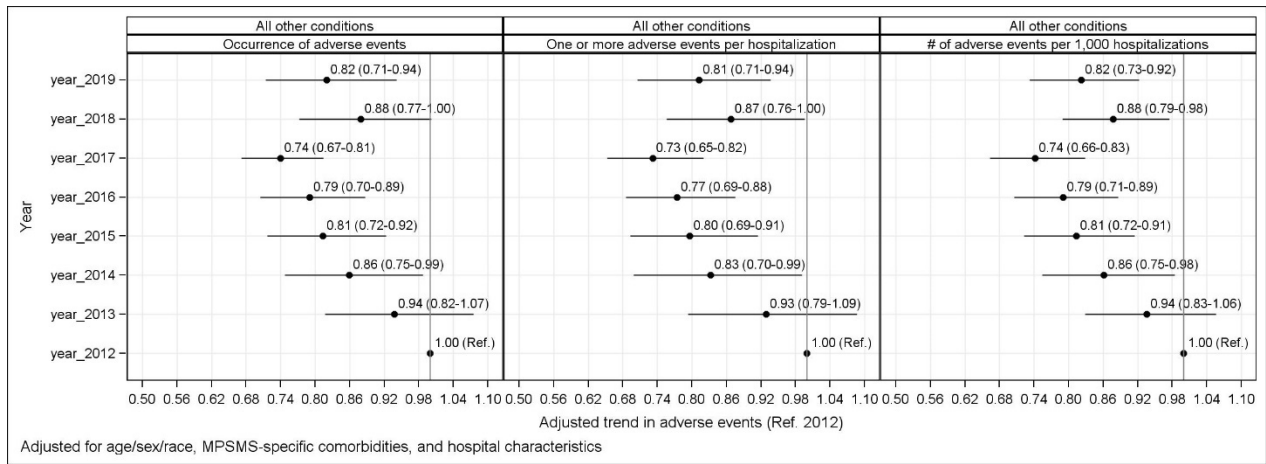
eFigure 1B. Risk-Adjusted Annual Trend in the Proportion of Patients with One or More Adverse Events for Five Patient Groups for All Adverse Events and for Four Adverse Event Domains, 2010-2019 (2012-2019 for All-other Conditions)



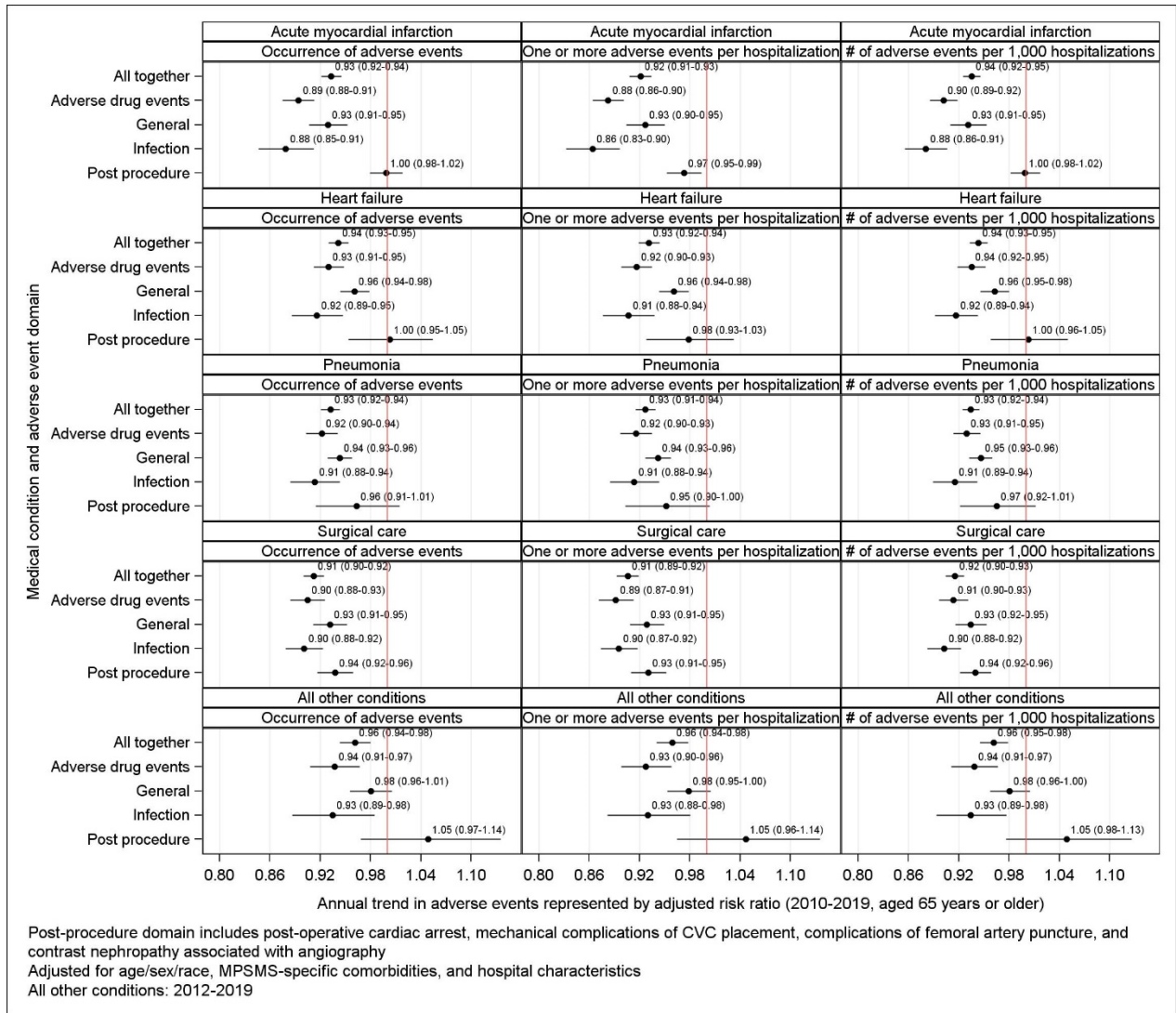
eFigure 2A. Adjusted Annual Changes in Adverse Events by Year and Four Conditions (Referred to 2010)



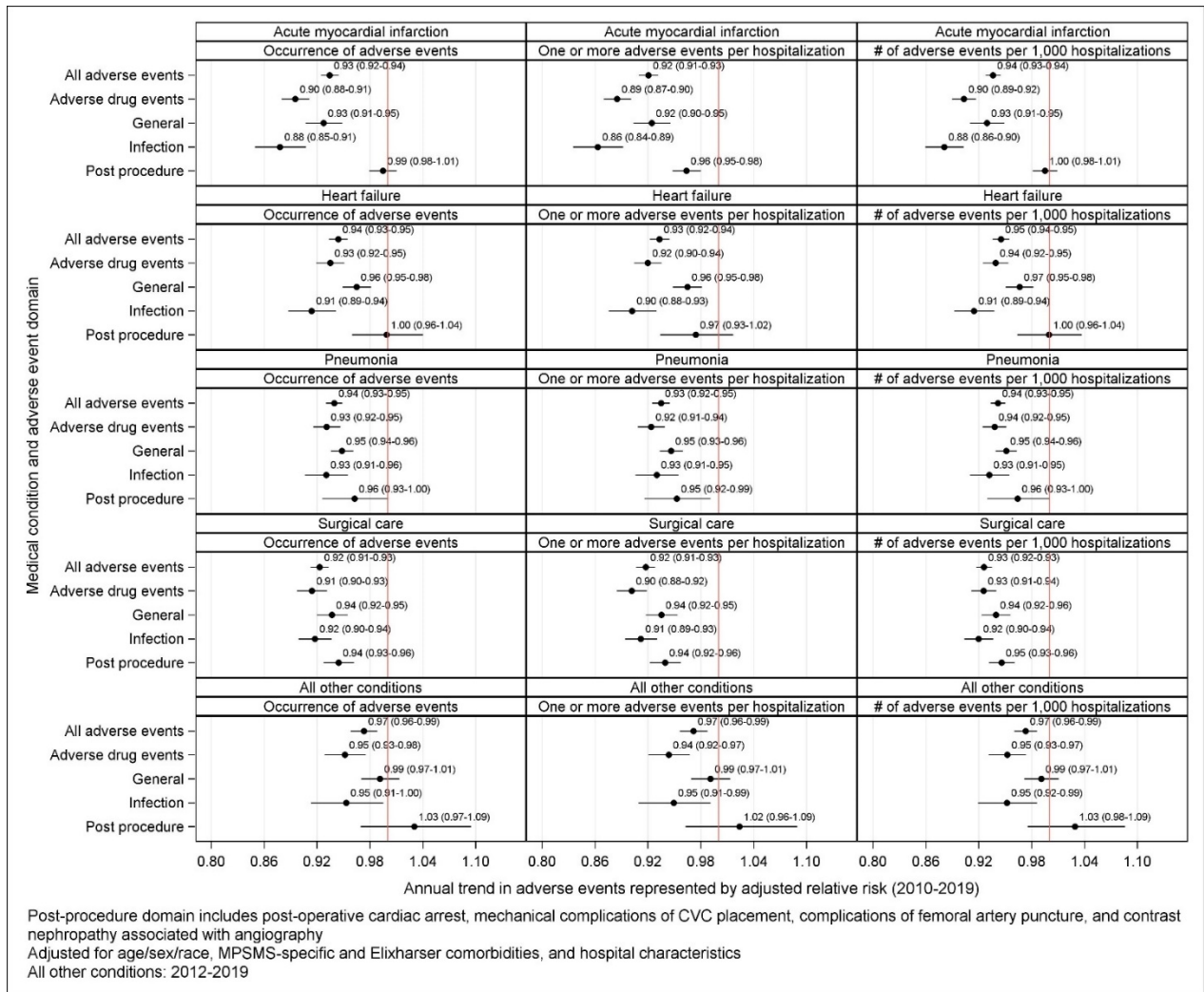
eFigure 2B. Adjusted Annual Changes in Adverse Events by Year (Referred to 2012, All-Other Conditions)



eFigure 3. Patients 65 years old and over only: Risk-Adjusted Annual Change in Adverse Events by Clinical Domains and Overall, 2010-2019 (2012-2019 for “All-Other Conditions”)

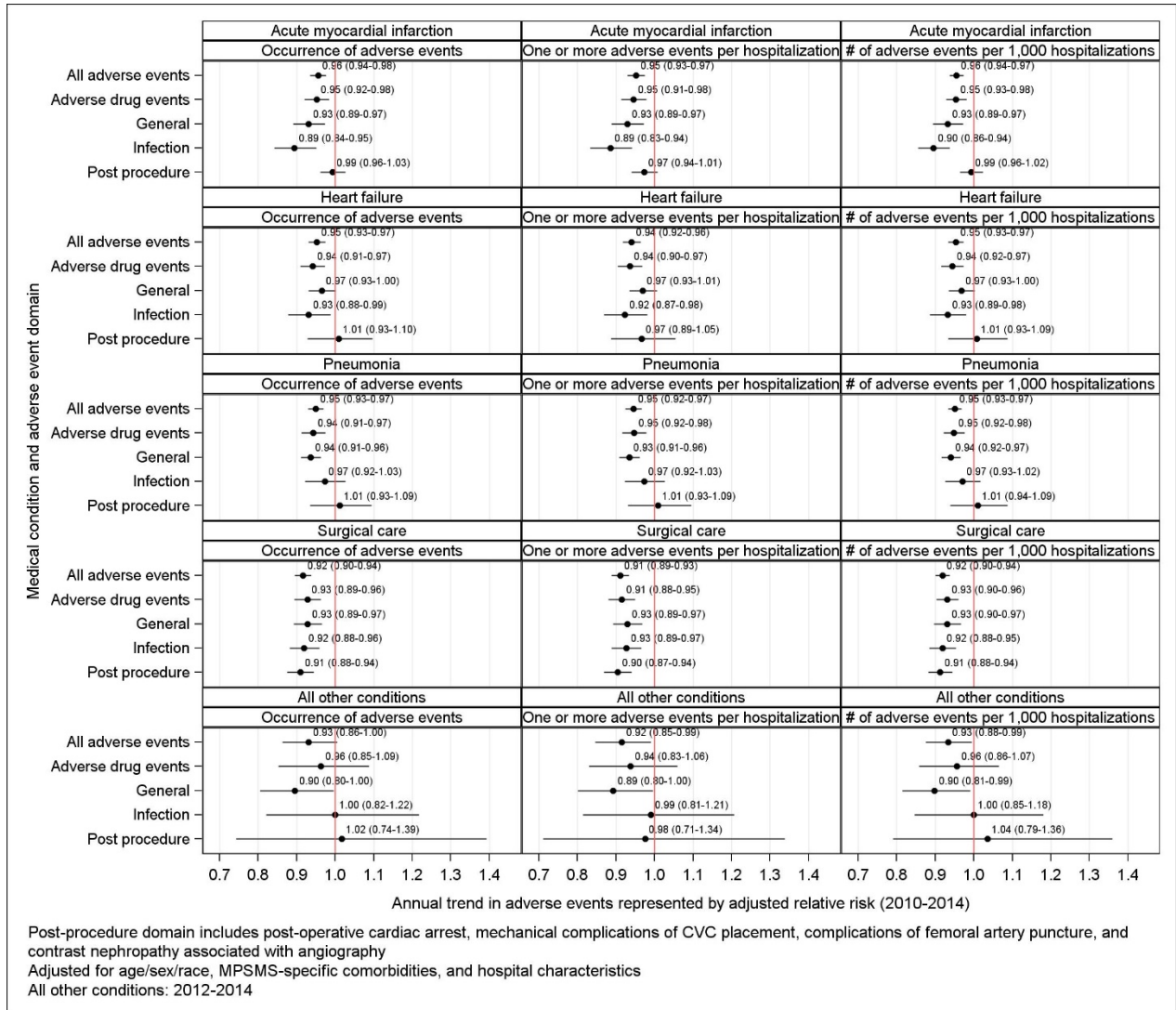


eFigure 4. Risk-Adjusted Annual Change in Adverse Events by Clinical Domains and Overall (including Elixhauser comorbidities (2012-2019 for “All-Other Conditions”))

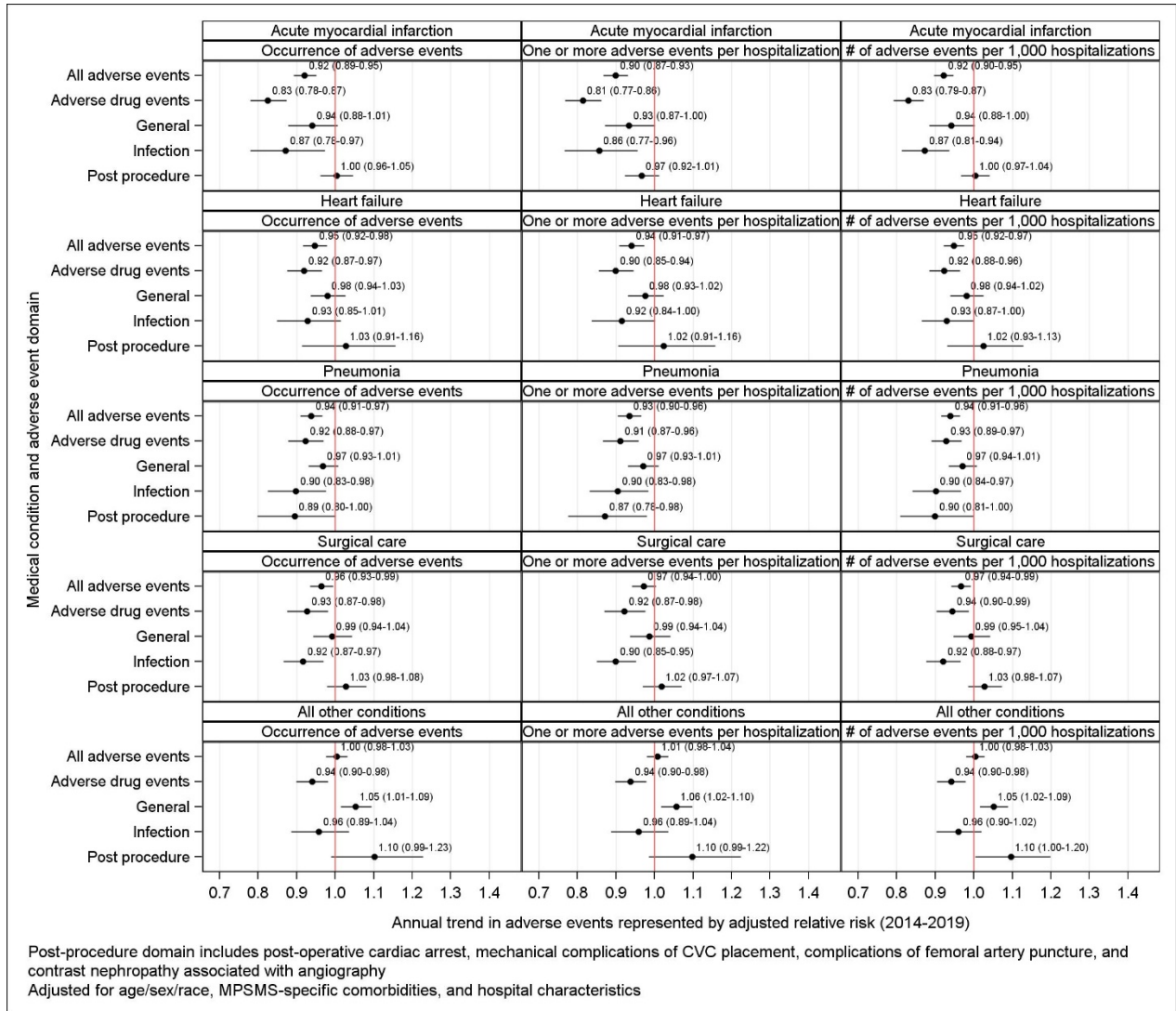


eFigure 5. Risk-Adjusted Annual Change by Clinical Domains and Overall (2010-2014 and 2014 to 2019)

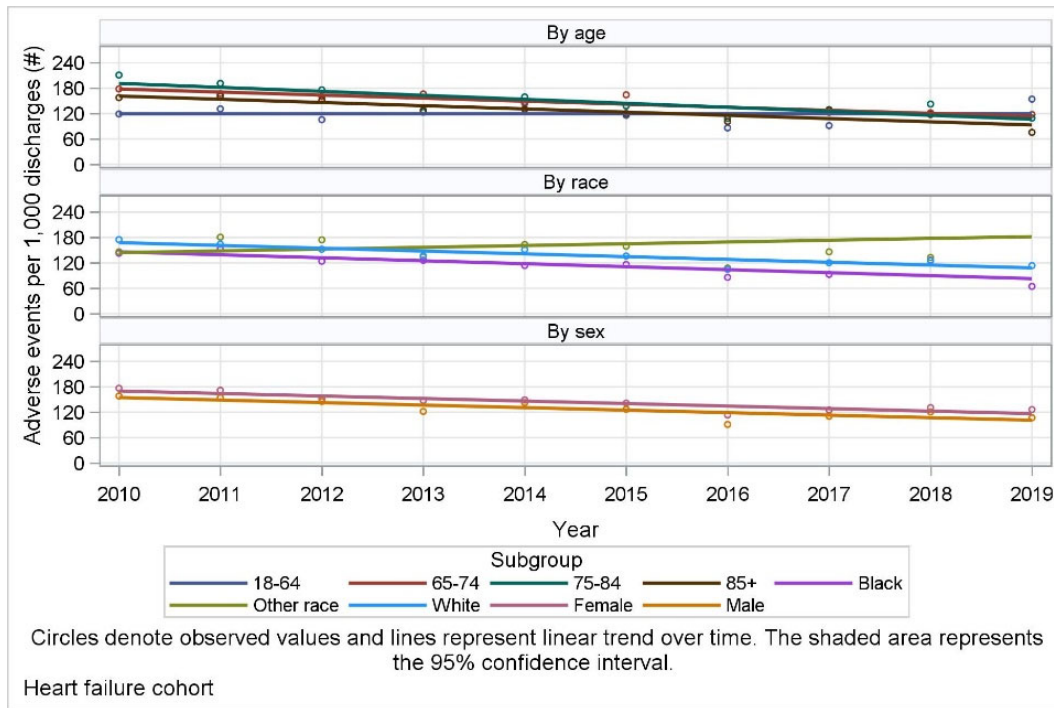
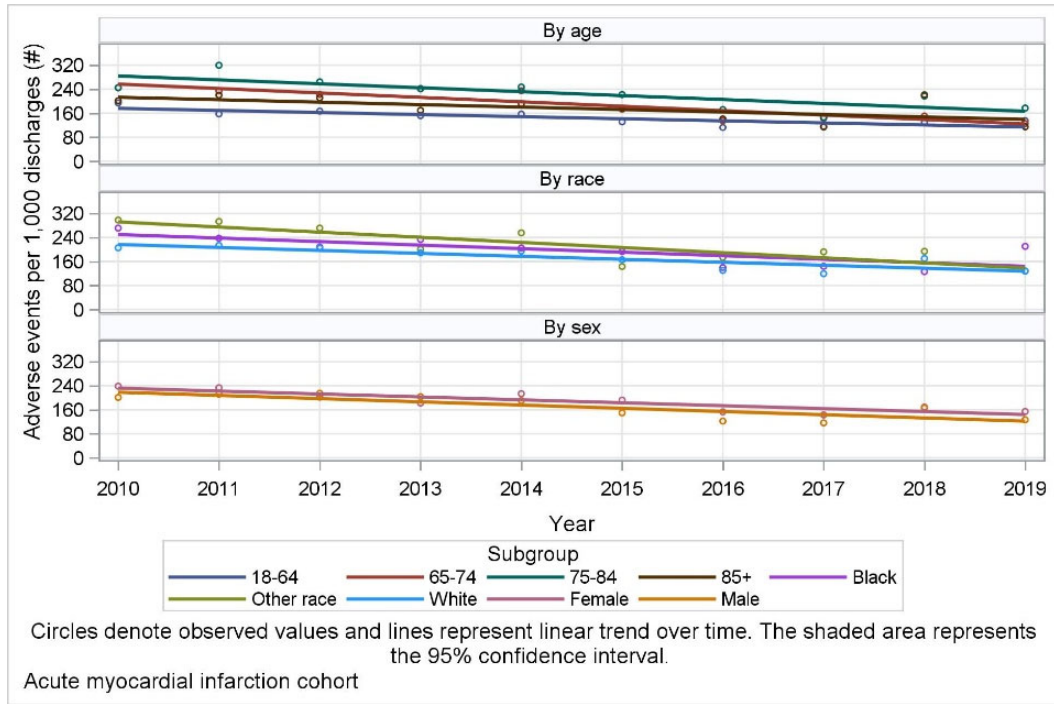
2010-2014 only:

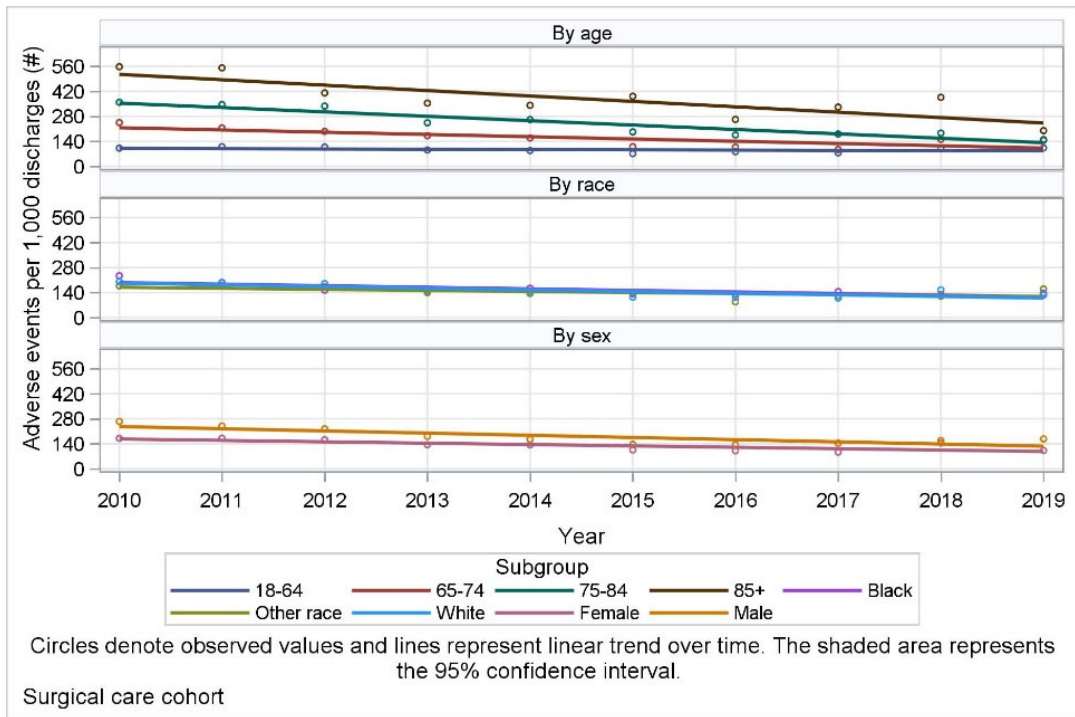
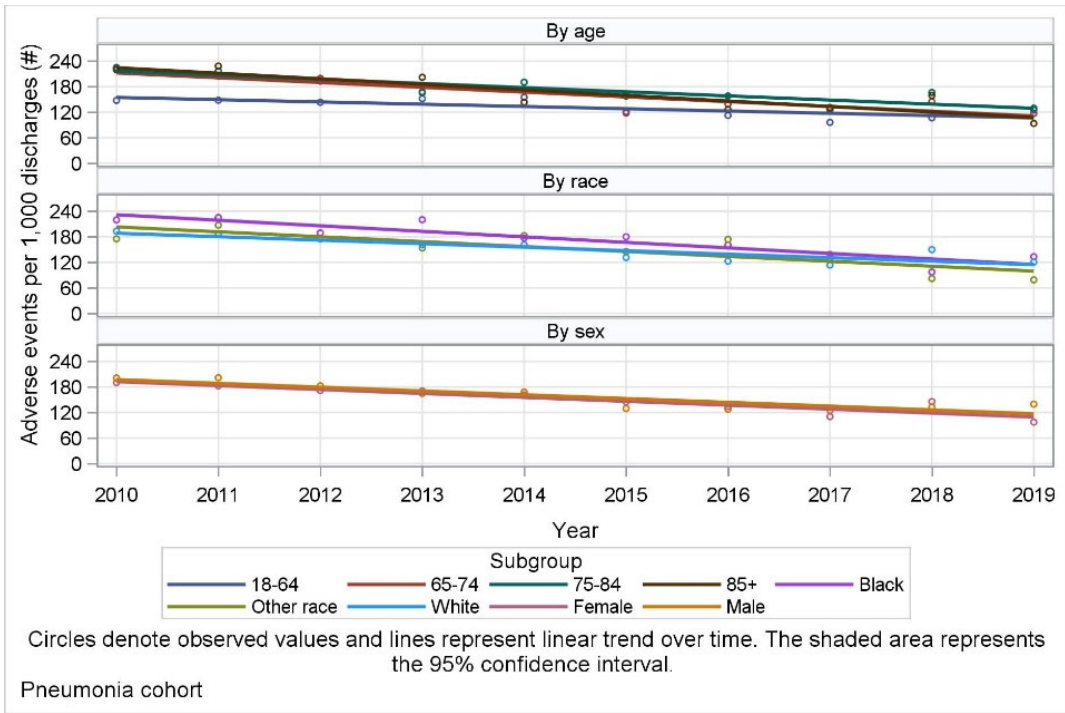


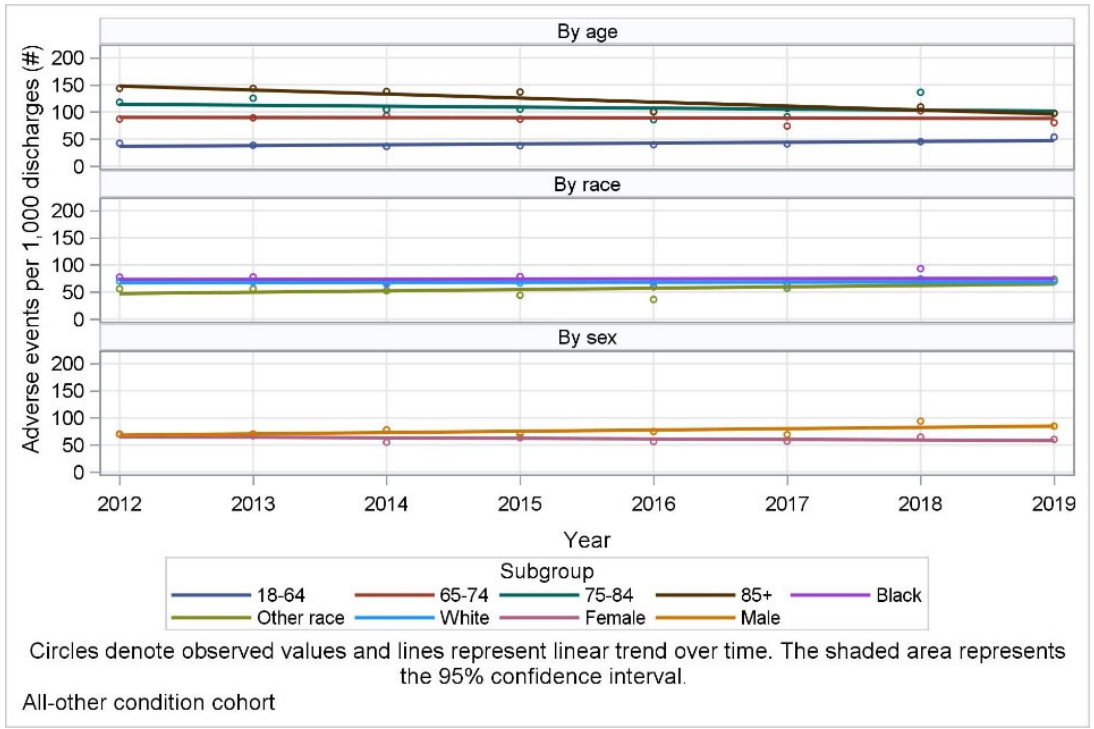
2014 to 2019 only:



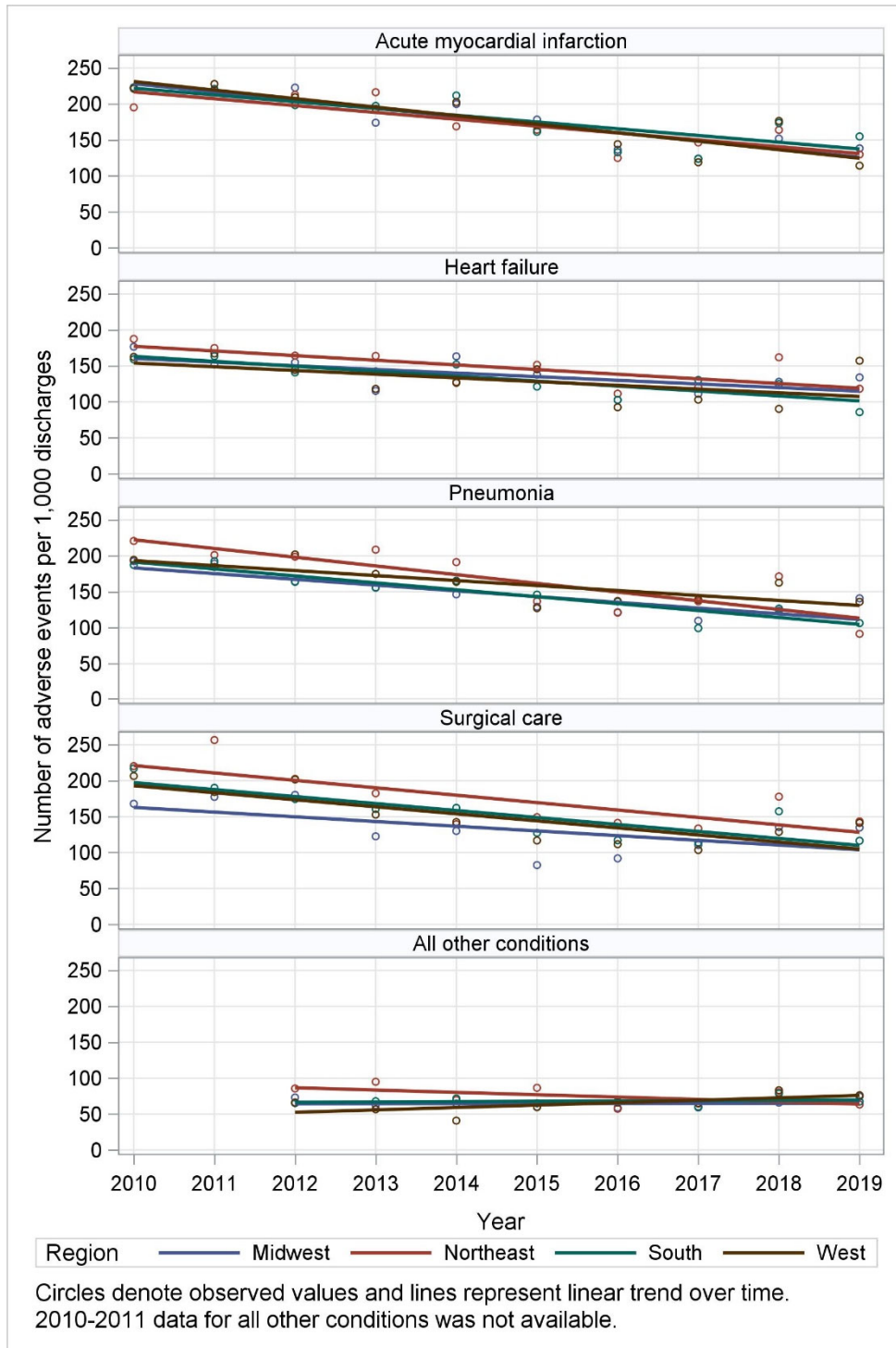
eFigure 6. Observed Change in Number of Adverse Events per 1,000 Discharges by Age, Race, and Sex (gender), for the Five Patient Demographical Groups







eFigure 7. Observed Change in Number of Adverse Events per 1,000 Discharges by Region of the United States (as defined by US Census Bureau) and by Patient Groups



eFigure 8. Risk-Adjusted Annual Change in Adverse Events by Regions of the United States and Condition

