

Measuring Hospital-Acquired Complications Associated With Low-Value Care

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IMPORTANCE Studies of low-value care have focused on the prevalence of low-value care interventions but have rarely quantified downstream consequences of these interventions for patients or the health care system.

OBJECTIVE To measure immediate in-hospital harm associated with 7 low-value procedures.

DESIGN, SETTING, AND PARTICIPANTS A cohort study with a descriptive analysis using hospital admission data from 225 public hospitals in New South Wales, Australia, was conducted from July 1, 2014, to June 30, 2017. All 9330 episodes involving 1 of 7 low-value procedures were evaluated, including endoscopy for dyspepsia in people younger than 55 years (3689 episodes); knee arthroscopy for osteoarthritis or meniscal tears (3963 episodes); colonoscopy for constipation in people younger than 50 years (665 episodes); endovascular repair of abdominal aortic aneurysm in asymptomatic, high-risk patients (508 episodes); carotid endarterectomy in asymptomatic, high-risk patients (273 episodes); renal artery angioplasty (176 episodes); and spinal fusion for uncomplicated low back pain (56 episodes). Sixteen hospital-acquired complications (HACs) were used as a measure of harm associated with low-value care.

MAIN OUTCOMES AND MEASURES For each low-value procedure, the percentage associated with any HAC and the difference in mean length of stay for patients receiving low-value care with and without HACs were calculated.

RESULTS Across the 225 hospitals and 9330 episodes of low-value care, rates of HACs were low for low-value endoscopy (4 [0.1%] episodes; 95% CI, 0.02%-0.2%), knee arthroscopy (18 [0.5%] episodes; 95% CI, 0.2%-0.7%), and colonoscopy (2 [0.3%] episodes; 95% CI, 0.0%-0.9%) but higher for low-value spinal fusion (4 [7.1%] episodes; 95% CI, 2.2%-11.5%), endovascular repair of abdominal aortic aneurysm (76 [15.0%] episodes; 95% CI, 11.1%-19.7%), carotid endarterectomy (21 [7.7%] episodes; 95% CI, 5.2%-10.1%), and renal artery angioplasty (15 [8.5%] episodes; 95% CI, 5.8%-11.5%). For most procedures, the most common HAC was health care-associated infection, which accounted for 83 (26.3%) (95% CI, 21.8%-31.5%) of all HACs observed. The highest rate of health care-associated infection was 8.4% (95% CI, 5.2%-11.4%) for renal artery angioplasty. For all 7 low-value procedures, median length of stay for patients with an HAC was 2 times or more the median length of stay for patients without a complication. For example, median length of stay was 1 (interquartile range [IQR], 1-1) day for knee arthroscopy with no HACs but increased to 10.5 (IQR, 1.0-21.3) days for patients with an HAC.

CONCLUSIONS AND RELEVANCE These findings suggest that use of these 7 procedures in patients who probably should not receive them is harming some of those patients, consuming additional hospital resources, and potentially delaying care for other patients for whom the services would be appropriate. Although only some immediate consequences of just 7 low-value services were examined, harm related to all low-value procedures was noted, including high rates of harm for certain higher-risk procedures. The full burden of low-value care for patients and the health system is yet to be quantified.

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Initiatives such as Choosing Wisely¹ have increased awareness of low-value care through publication of top 5 lists of tests and interventions whose use should be questioned. These clinician-constructed and endorsed recommendations define when interventions are not expected to provide a net benefit to patients or may even cause net harm—that is, they define when care is low value. Various measurement projects use these lists as a basis for estimating rates of low-value care.²⁻¹⁰ Downstream consequences are recognized as an important component of the low-value care research agenda,¹¹ yet measurement work to date only estimates the prevalence and costs associated with the index low-value care interventions (ie, the specific test or procedure). The next frontier is to extend these studies to quantify the downstream consequences of low-value care for patients and the health care system, including downstream harm and costs that accrue due to index low-value care events.

Low-value care is often discussed in terms of costs, but it is also a patient safety issue, and framing the discussion around harm and safety may increase both physician and patient buy-in to reducing low-value care.^{12,13} Harm associated with low-value procedures can be assessed indirectly from estimated rates of both low-value care and overall rates of hospital complications.¹⁴ However, low-value care is driven partly by physicians' bias toward taking action despite risks¹⁵ and the tendency to overestimate benefit and underestimate harm.^{16,17} Because direct measurement links specific harms to individual use of a procedure, it should have a stronger influence to counter these biases¹⁵ compared with indirect estimates, such as overall rates of hospital complications. Reporting harm directly associated with low-value care emphasizes to both physicians and patients that these procedures have risks and helps

Key Points

Question Do patients who are admitted to the hospital for a low-value procedure (ie, those that would not be expected to require admission) develop hospital-acquired complications?

Findings In this cohort study and descriptive analysis of 9330 episodes of low-value use of 7 procedures (ranging from 56 low-value spinal fusions to 3963 low-value knee arthroscopies), depending on the procedure, between 0.2% and 15.0% of patients receiving these low-value procedures developed at least 1 of 16 hospital-acquired complications, the most common being health care-associated infection.

Meaning Use of these 7 low-value procedures is harming patients, consuming additional hospital resources, and potentially delaying care for other patients for whom the services would be appropriate.

raise conversations about whether the procedures are appropriate, which is a major aim of Choosing Wisely.¹

A recent study of the prevalence and costs of low-value care for 27 procedures in public hospitals in New South Wales identified between 4487 and 8986 hospital episodes as low value (9.95%-19.93% of episodes involving these procedures) in 2016-2017⁸ but did not examine downstream consequences of this low-value care. Some researchers have examined the testing and consultation cascade and associated harms specific to individual low-value screening procedures.^{18,19} However, to our knowledge, this is the first application of a standard list of complications to measure adverse consequences across a range of low-value procedures. In this study, we extended the methods in this field to examine immediate in-hospital complications associated with 7 low-value proce-

Table 1. Definitions of Low-Value Care^a

Low-Value Procedure	Narrower Definition of Low-Value Care	Recommended Care
Arthroscopic lavage and debridement of knee for osteoarthritis or degenerative meniscal tears (CWA, EVOLVE, CWUS, NICE)	Knee arthroscopy in patients with diagnosis of gonarthrosis, no diagnosis of ligament strain or damage, and no diagnosis of septic (pyogenic) arthritis; minimum age, 55 y; both sexes included	Weight loss; physical/occupational therapy; pain relief medications
Carotid endarterectomy for asymptomatic, high-risk patients with limited life expectancy (CWA, EVOLVE, CWC, CWUS)	Carotid endarterectomy with no stroke or focal neurologic symptoms recorded in the episode and ASA code 4-5 or age ≥75 y and ASA code 3; minimum age, 18 y; both sexes; exclude emergency admissions and admissions from the emergency department	Best medical therapy
Colonoscopy for constipation in people aged <50 y (CWC)	Colonoscopy in a person aged <50 y with diagnosis of constipation and no diagnoses of anemia, weight loss, family or personal history of cancer of digestive system, or personal history of other diseases of the digestive system in previous 12 mo; minimum age, 18 y; maximum age, 49; both sexes	Investigations not usually needed in absence of alarm symptoms
Endoscopy for dyspepsia for people aged <55 y (CWC)	Endoscopy in a person aged <55 y with diagnosis of dyspepsia and no diagnoses of dysphagia, iron deficiency anemia, other nutritional anemia, abnormal weight loss, personal or family history of cancer of digestive system, or personal history of peptic ulcer disease in the previous 12 mo; minimum age, 18; maximum age, 54 y; both sexes	Test for and, if present, treat <i>Helicobacter pylori</i> ; if treatment not needed and symptoms remain, try proton pump inhibitors
Endovascular repair of infrarenal abdominal aortic aneurysm (CWC)	Endovascular repair of aneurysm, with diagnosis of abdominal aortic aneurysm in the episode and ASA code 4-5 or age ≥75 y and ASA code 3; minimum age, 18 y; both sexes; exclude emergency admissions and admissions from the emergency department	No intervention
Renal artery angioplasty or stenting (Health Policy Advisory Committee on Technology ²¹)	Angioplasty/stenting with diagnosis of renovascular hypertension, atherosclerosis of renal artery, hypertensive kidney disease, or hypertensive heart and kidney disease in the episode and no diagnosis of fibromuscular dysplasia or pulmonary edema; minimum age, 18 y; both sexes	Multifactorial medical therapy
Spinal fusion for low back pain (CWA, CWC)	Spinal fusion with diagnosis of low back pain with no mention of sciatica, spondylolisthesis, spinal abnormality, or pain in legs in previous 12 mo; minimum age, 18 y; both sexes	Conservative treatment

Abbreviations: ASA, American Society of Anesthesiologists; CWA, Choosing Wisely Australia; CWC, Choosing Wisely Canada; CWUS, Choosing Wisely United States; EVOLVE, Royal Australasian College of Physicians EVOLVE initiative;

NICE, UK National Institute of Health and Care Excellence.

^a Adapted from Badgery-Parker et al (eTable 1 in the Supplement).⁸

dures for which patients receiving appropriate care would not usually be hospitalized.

Methods

Data and Setting

We used patient admission data from the Health Information Exchange database of the New South Wales Ministry of Health. Australia has a population of 25 million; New South Wales is its most populous state, with an estimated residential population of 7.6 million in 2015 served by 225 public hospital facilities (including small community hospitals and residential aged-care facilities that do not provide the procedures reported herein).²⁰ The New South Wales Population and Health Services Research Ethics Committee approved this study with waiver of informed consent.

The Health Information Exchange database includes information on every admission at a public hospital in New South Wales. The data include patient demographics (eg, age, sex), details of the episode (eg, start and end dates, emergency status), diagnoses (coded in *International Classification of Diseases, Tenth Revision, Australian Modification* after the patients have been discharged), and procedures performed. The data set also includes a condition-onset flag that indicates whether each diagnosis was present on admission or arose during the hospitalization. We used this flag to determine whether a complication was associated with the hospital admission. Because this flag was not well recorded in the New South Wales hospital data before 2014, we restricted the analysis to the period from July 1, 2014, to June 30, 2017, and combined the 3 years for analysis.

Low-Value Care

We identified low-value care for 7 procedures as described previously, with slight modification. These procedures included endoscopy for dyspepsia in people younger than 55 years; knee arthroscopy for osteoarthritis or meniscal tears; colonoscopy for constipation in people younger than 50 years; endovascular repair of abdominal aortic aneurysm (EVAR) in asymptomatic, high-risk patients; carotid endarterectomy in asymptomatic, high-risk patients; renal artery angioplasty; and spinal fusion for uncomplicated low back pain (Table 1).^{8,9} In summary, we translated recommendations describing when the procedure is low value (from *Choosing Wisely* or other sources²¹⁻²⁶) into measures of low-value care based on variables in the data set (eg, age, sex, or diagnoses). We then extracted records for the low-value episodes from the Health Information Exchange.

For this study, we only included episodes in which the relevant procedure was recorded as the principal procedure, which is usually the procedure for which the patient was admitted to the hospital. In a previous report,⁸ the procedure was accepted in any procedure field. Restricting to the principal procedure was intended to exclude episodes during which the patient would have been in the hospital even if not receiving the procedure.

The 7 procedures we selected (from 27 measures) are those for which recommended care would not be expected to require hospital admission, so the patient is in the hospital only

Box: Hospital-Acquired Complications

The terms *hospital-acquired complications* or *hospital-acquired conditions* (HACs) refer to conditions that arise during a hospital stay and should usually be preventable with appropriate high-quality care.

In recent years, there has been increased interest in measuring and preventing HACs, particularly in the United States. The Agency for Healthcare Research and Quality has developed various tools to assist US hospitals in reducing HACs.²⁷ In addition, the Patient Protection and Affordable Care Act implemented the Hospital-Acquired Condition Reduction Program, which reduces Centers for Medicare & Medicaid Services payments to hospitals in the worst-performing quartile on an index of HACs.²⁸

In Australia, the Australian Commission on Safety and Quality in Health Care (ACSQHC) has developed a list of 16 HACs based on clinician advice and evidence regarding preventability and effect on patients and hospital resources.²⁹ Australia's Independent Hospital Pricing Authority has proposed reducing payments for episodes involving these HACs.³⁰

The ACSQHC HAC list was developed through a clinician-driven process. This process involved review of the literature and hospital incident reports to identify complications that have a high effect, which were then discussed by a clinical reference group to produce a list based on criteria of preventability, patient and hospital effect, and clinical priority. The initial list was then tested in a proof-of-concept study in 15 hospitals. The results of this study were used to refine the list, resulting in the final list of 16 HACs.

- Pressure injury
- Falls resulting in fracture or intracranial injury
- Health care-associated infection
- Surgical complications requiring unplanned return to operating theater^a
- Unplanned intensive care unit admission^a
- Respiratory complications
- Venous thromboembolism
- Renal failure
- Gastrointestinal bleeding
- Medication complications
- Delirium
- Persistent incontinence
- Malnutrition
- Cardiac complications
- Third- and fourth-degree perineal laceration during delivery
- Neonatal birth trauma

^a Unplanned return to operating theater, which is used in surgical complications requiring the unplanned return to theater category, and unplanned admission to intensive care unit are not currently collected in Australian hospital administrative data sets. Specifications for these complications have been developed because the relevant data items may be available and used within hospitals.

to receive the low-value procedure (Table 1). Together with our requirement that the low-value procedure be the principal procedure, this protocol allowed us to attribute harm to the unnecessary hospitalization. We developed narrower and broader definitions of low-value care^{8,9}; in this study, we only discuss results for the narrower definitions.

Harm Associated With Low-Value Care

As our measure of harm associated with low-value care, we used the hospital-acquired complications (HACs) developed

Table 2. Rates of HACs for 7 Low-Value Procedures, 2014-2015 to 2016-2017

Low-Value Procedure ^a	No. of Low-Value Episodes	Low-Value Episodes With Any HAC, n (%) [95% CI]	Total HACs per 100 Low-Value Episodes, % (95% CI)	Total HACs per 100 Low-Value Bed-Days, % (95% CI)	Difference in Mean LOS, d Days (95% CI) ^b	
					Unadjusted	Adjusted ^c
Endoscopy for dyspepsia	3689	4 (0.1) [0.02 to 0.2]	0.1 (0.02 to 0.2)	0.1 (0.02 to 0.2)	7.9 (6.2 to 9.6)	1.1 (-0.2 to 2.5)
Knee arthroscopy	3963	18 (0.5) [0.2 to 0.7]	0.6 (0.3 to 0.9)	0.4 (0.2 to 0.6)	13.8 (12.3 to 15.4)	4.7 (3.7 to 5.7)
Colonoscopy for constipation	665	2 (0.3) [0.0 to 0.9]	0.3 (0.0 to 0.9)	0.1 (0.0 to 0.3)	14.3 (1.0 to 27.6)	7.0 (0.3 to 14.0)
EVAR	508	76 (15.0) [11.1 to 19.7]	19.7 (15.2 to 25.4)	3.3 (2.6 to 4.1)	7.9 (6.2 to 9.7)	2.2 (0.5 to 3.8)
Carotid endarterectomy	273	21 (7.7) [5.2 to 10.1]	9.5 (6.3 to 13.1)	2.2 (1.7 to 3.0)	12.1 (10.3 to 13.8)	7.9 (6.1 to 9.7)
Renal artery angioplasty	176	15 (8.5) [5.8 to 11.5]	15.9 (8.9 to 25.0)	2.3 (1.5 to 3.0)	21.5 (17.2 to 25.9)	7.5 (3.6 to 11.4)
Spinal fusion	56	4 (7.1) [2.2 to 11.5]	10.7 (2.2 to 22.6)	1.1 (0.3 to 2.3)	29.8 (23.0 to 36.6)	31.7 (23.4 to 40.4)

Abbreviations: EVAR, endovascular repair of abdominal aortic aneurysm; HAC, hospital-acquired complication; LOS, length of stay.

^a See Table 1 for full definitions of low-value care.

^b Difference in mean LOS is (mean LOS per episode with any HAC) – (mean LOS per episode with no HAC). For example, the unadjusted mean LOS for patients

receiving low-value endoscopy was 12.4 days longer for those who developed an HAC than for those with no HACs.

^c Adjusted for age, sex, Charlson comorbidity index score, and diagnostic related group of the episode.

by the Australian Commission on Safety and Quality in Health Care (Box).²⁹ The HACs are 16 complications that would usually have an effect on patient care and hospital resources and may be reduced, but not necessarily eliminated, by appropriate risk mitigation strategies; thus, they can be used for monitoring safety and quality of care. For our study, use of the HACs means we are not quantifying all adverse consequences of low-value care but instead are restricting to consequences that are likely under the control of the treating hospital.

Statistical Analysis

We conducted a descriptive analysis of the number of HACs associated with the low-value procedures in the inpatient setting. Because patients who receive recommended care do not appear in our data, we have no comparison group. For each of the 7 low-value procedures, we calculated the percentage of low-value episodes with at least 1 HAC, the total number of HACs per 100 low-value episodes, and the total number of HACs per 100 bed-days for low-value episodes. We also calculated the numbers of each HAC per 100 low-value episodes. We estimated 95% CIs using a percentile bootstrap method accounting for clustering of episodes within hospitals.³¹

To indicate the outcome of HACs, we also calculated the difference in mean bed-days between low-value episodes with and without HACs and used linear regression modeling to produce estimated differences in length of stay adjusted for sex, age, Charlson comorbidity index score, and diagnosis related group. The significance level, determined with 2-tailed testing, is $P < .05$. Statistical analysis was conducted with R, version 3.5.0 (R Foundation for Statistical Computing).

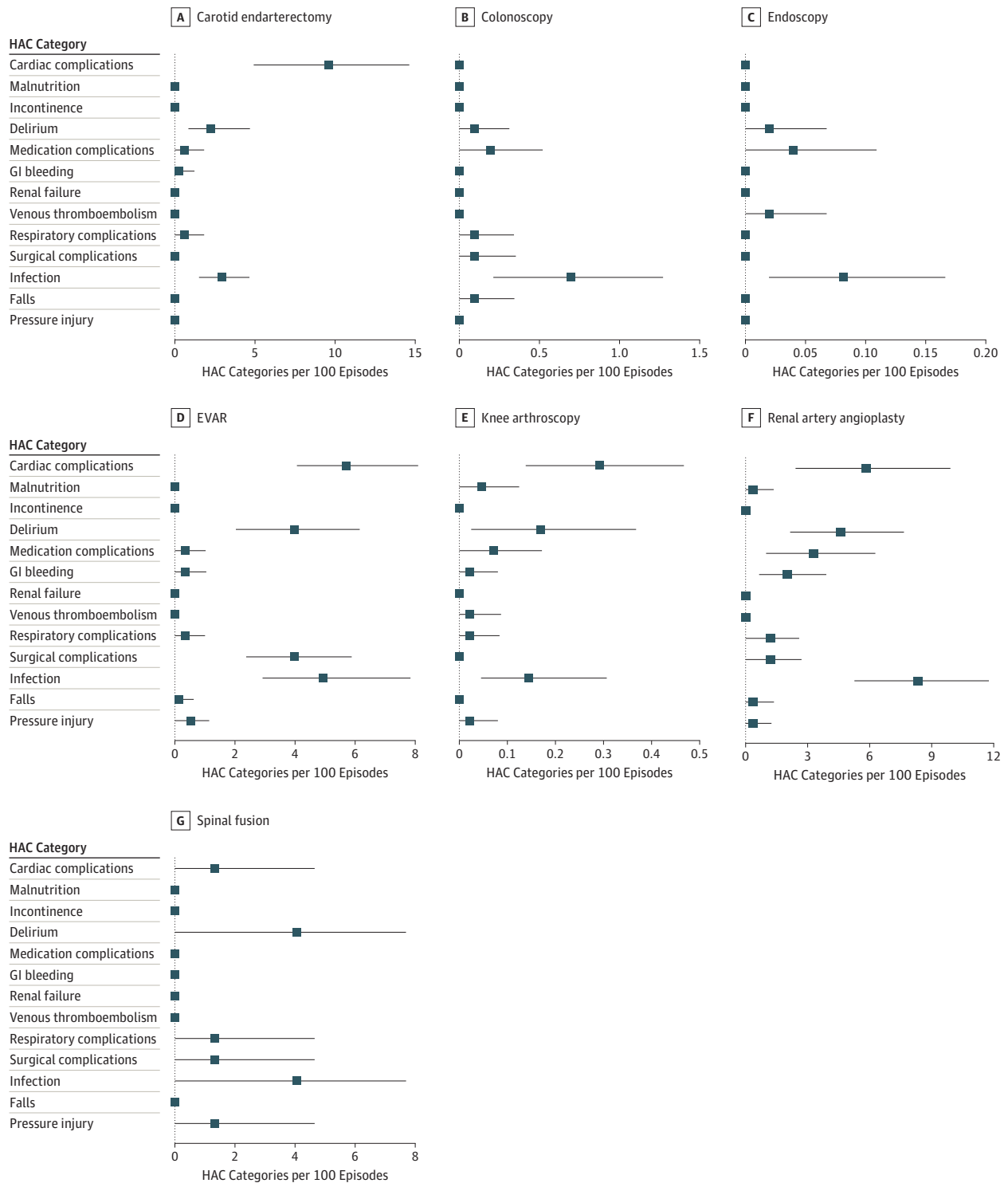
Results

We identified 9330 episodes involving any of the 7 low-value procedures across the New South Wales public hospital system (Table 2): 3689 episodes of endoscopy for dyspepsia in people younger than 55 years; 3963 episodes of knee arthroscopy

for osteoarthritis or meniscal tears; 665 episodes of colonoscopy for constipation in people younger than 50 years; 508 episodes of EVAR in asymptomatic, high-risk patients; 273 episodes of carotid endarterectomy in asymptomatic, high-risk patients; 176 episodes of renal artery angioplasty; and 56 episodes of spinal fusion for uncomplicated low back pain. The percentage of low-value episodes with any HAC ranged from 0.1% (4 episodes; 95% CI, 0.02%-0.2%) for endoscopy to 15.0% (76 episodes; 95% CI, 11.1%-19.7%) for EVAR (Table 2). For carotid endarterectomy and EVAR, in which low-value care specifically involves high-risk patients, we found high HAC rates: 1 in 7 low-value EVARs (76 [15.0%] episodes; 95% CI, 11.1%-19.7%) and 1 in 13 low-value carotid endarterectomies (21 [7.7%] episodes; 95% CI, 5.2%-10.1%) were associated with HACs. Low-value renal artery angioplasty (15 [8.5%] episodes; 95% CI, 5.8%-11.5%) and spinal fusion (4 [7.1%] episodes; 95% CI, 2.2%-11.5%) were also associated with high HAC rates. Endoscopy (4 [0.1%] episodes; 95% CI, 0.02%-0.2%), knee arthroscopy (18 [0.5%] episodes; 95% CI, 0.2%-0.7%), and colonoscopy (2 [0.3%] episodes; 95% CI, 0.0%-0.9%) showed lower HAC rates (Table 2).

The additional burden to patients who incurred an HAC was significant. Although patients undergoing low-value endoscopy without an HAC spent a mean of 1.4 days in the hospital, the 4 patients with HACs spent a mean of 7.9 (95% CI, 6.2 to 9.6) additional days in the hospital (or 1.1; 95% CI, -0.2 to 2.5 days after adjusting for age, sex, Charlson comorbidity index score, and diagnosis related group). Similarly, patients who had a low-value knee arthroscopy and developed an HAC spent a mean 13.8 (95% CI, 12.3 to 15.4) more days in the hospital than similar patients with no HACs (Table 2). For all 7 low-value procedures, median length of stay for patients with an HAC was at least 2 times the median length of stay for patients without an HAC. For example, median length of stay was 1 (interquartile range [IQR], 1-1) day for knee arthroscopy with no HAC but increased to 10.5 (IQR, 1.0-21.3) days for patients with an HAC. Similarly, median length of stay for endoscopy increased from 1 (IQR, 1-1) day for patients without an HAC to 4 (IQR, 2.8-10.5) days for patients with an HAC.

Figure. Hospital-Acquired Complications (HACs) Associated With 7 Low-Value Procedures in New South Wales Public Hospitals



Counts per 100 low-value episodes are shown for 13 of the 16 individual HACs for each procedure: carotid endarterectomy (A), colonoscopy (B), endoscopy (C), endovascular repair of abdominal aortic aneurysm (EVAR) (D), knee arthroscopy (E), renal artery angioplasty (F), and spinal fusion (G). Two HACs (perineal laceration; neonatal birth trauma) are not relevant to any of these

procedures, and 1 HAC (unplanned admission to intensive care unit) is not measurable in our data. Note that the horizontal scale varies between panels. Error bars indicate 95% percentile bootstrap CIs accounting for clustering of episodes by hospital. GI indicates gastrointestinal.

For most procedures, the most common HAC was health care-associated infection, which accounted for 83 (26.3%; 95% CI, 21.8%-31.5%) of all 315 HACs observed. The highest rates of health care-associated infection were 8.4% (95% CI, 5.2%-11.4%) for renal artery angioplasty and 5.0% (95% CI, 2.9%-8.0%) for EVAR (Figure). Cardiac complications were relatively common for carotid endarterectomy (9.7%; 95% CI, 4.8%-14.5% per 100 low-value episodes), EVAR (5.7%; 95% CI, 4.1%-8.3% per 100 low-value episodes), and renal artery angioplasty (5.9%; 95% CI, 2.6%-9.6% per 100 low-value episodes). Delirium was most common for EVAR (4.0%; 95% CI, 2.1%-6.0% per 100 low-value episodes), spinal fusion (4.1%; 95% CI, 0.0%-7.6% per 100 low-value episodes), and renal artery angioplasty (4.6%; 95% CI, 2.1%-7.5% per 100 low-value episodes). We observed similar patterns when we used the broader definitions of low-value care (eTable 1 and eTable 2 in the Supplement).

Discussion

Low-value care carries the potential for harm. In this study, we identified HACs in 0.2% to 15.0% of low-value episodes, depending on the procedure. These procedures probably should not have been provided.

To simplify interpretation of the results, we selected 7 procedures in which the recommended care for the patient subgroup should not usually involve hospital admission and restricted the selection to episodes in which the procedure was recorded as the reason for admission. Thus, HACs should be attributable to the procedure in these cases—patients are admitted to the hospital for an unnecessary procedure and develop a complication. Although HACs are also possible when these procedures are used as recommended, appropriate care offsets this risk with the potential benefit, while low-value care carries no expectation of net benefit.

Endoscopy, colonoscopy, and knee arthroscopy had low HAC rates because these procedures are relatively safe. Yet there were complications that occurred with these procedures beyond any usually associated burden, discomfort, and cost. Although patients receiving these procedures might expect a same-day or overnight stay, those with HACs had substantially longer stays: an unadjusted mean of 13.8 additional days for knee arthroscopy and an additional 7.9 days for endoscopy. However, we cannot specifically attribute the additional length of stay to the HACs.

In high-risk patients, the risks of carotid endarterectomy or EVAR outweigh the potential benefit of treating stenosis or

an aneurysm that is not currently causing problems.^{32,33} In our cohorts, 1 in 13 carotid endarterectomies and 1 in 7 EVARs were associated with HACs. Cardiac complications, delirium, and infection were common in both of these groups, with gastrointestinal bleeding and surgical complications also occurring in patients who underwent EVAR.

Limitations

In this study, we have extended measurement of low-value care using routine data to also quantify some immediate downstream consequences of low-value care; however, there are limitations. Our use of HACs underestimates harm associated with these procedures. First, we looked only at HACs within the low-value episode and did not examine subsequent hospital admissions or follow-up management in the primary care setting. Second, the list of HACs was chosen based on their outcome associated with patient care and the possibility for hospitals to ameliorate the risk of the HAC occurring by appropriate preventive care.²⁹ Some patients, especially those identified as high risk in the carotid endarterectomy and EVAR indicators, may have developed other complications, so the true harm associated with these low-value procedures is likely to be higher.

Conclusions

As research in measuring low-value care progresses, we should gain a fuller understanding of the consequences of low-value care to patients by considering morbidity, mortality, readmissions, and patient-reported outcomes. We should compare consequences between patients receiving appropriate and low-value care to gain an understanding of the additional burden of low-value care. Further research should also consider the consequences for the health care system of providing low-value care, including the financial costs of both the low-value care and any subsequent admissions and issues such as waiting lists being lengthened by including patients who are not expected to benefit. Finally, more work must be done to measure harm resulting from low-value care to the degree it affects patients financially, psychologically, and psychosocially.

Although we restricted this study to 7 low-value procedures and measured only some immediate in-hospital complications associated with these procedures, we found high rates of harm in some cases, with substantial additional lengths of stay. The full burden of low-value care for patients and the health care system is yet to be quantified.

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