Opportunities to Improve the Value of Outpatient Surgical Care

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ABSTRACT

OBJECTIVES: Nearly 57 million outpatient surgeries—invasive procedures performed on an outpatient basis in hospital outpatient departments (HOPDs) or ambulatory surgery centers (ASCs)—produced annually in the United States account for roughly 7% of healthcare expenditures. Although moving inpatient surgeries to outpatient settings has lowered the cost of care, substantial opportunities to improve the value of outpatient surgery remain. To exploit these remaining opportunities, we composed an evidence-based care delivery composite for national discussion and pilot testing.

STUDY DESIGN: Evidence-based care delivery composite.

METHODS: We synthesized peer-reviewed publications describing efforts to improve the value of outpatient surgical care, interviewed patients and clinicians to understand their most deeply felt discontents, reviewed potentially relevant emerging science and technology, and observed surgeries at healthcare organizations nominated by researchers as exemplars of efficiency and effectiveness. Primed by this information, we iterated potential new designs utilizing criticism from practicing clinicians, health services researchers, and healthcare managers.

RESULTS: We found that 3 opportunities are most likely to improve value: 1) maximizing the appropriate use of surgeries via decision aids, clinical decision support, and a remote surgical coach for physicians considering a surgical referral; 2) safely shifting surgeries from HOPDs to high-volume, multi-specialty ASCs where costs are much lower; and 3) standardizing processes in ASCs from referral to recovery.

CONCLUSIONS: Extrapolation based on published studies of the effects of each component suggests that the proposed 3-part composite may lower annual national outpatient surgical spending by as much as one-fifth, while maintaining or improving outcomes and the care experience for patients and clinicians. Pilot testing and evaluation will allow refinement of this composite.

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Outpatient surgeries—surgical and nonsurgical invasive procedures performed on an outpatient basis in hospital outpatient departments (HOPDs) or freestanding ambulatory surgery centers (ASCs)—are a fast-growing segment of healthcare,[1-4] fueled by improved pain management, less invasive surgical techniques, patient convenience, and lower cost.[5] However, their growth also carries risks, such as more pain and longer recovery times than patients expect,[6] unplanned subsequent hospital admissions,[7] and overuse.[8]

To help US clinicians and healthcare organizations respond constructively to rising incentives to improve value, we used a method adapted from biomedical technology innovation to design an innovative care delivery "composite" offering the greatest potential to improve value to US patients and their healthcare sponsors.[9]

METHODS

A year-long, 3-person team of postdoctoral clinicians and management scientists, supported by senior mentors from clinical practice, health services research, and healthcare management, was recruited via a national search to create the new care composite. The team conducted site visits to understand costs, quality, and patient experience at 3 institutions, all nominated by health services researchers to reflect today's high-value "frontier" in the United States and globally. During these visits, the team compared care delivery methods for a single surgical procedure and created detailed process maps. They also observed care more broadly at several additional sites selected via "convenience" samples (eg, based on established relationships between the authors and the administrators of those facilities) to represent mainstream care.

At all sites, the team sought to elicit the most deeply felt unmet needs of patients, family members, and clinicians; they intended the site selection to be as inclusive as they could design by a mix of "frontier" and "convenience" samples. In addition, the team did not rely on observations directly unless these ob-

TAKE-AWAY POINTS

- Outpatient surgeries account for roughly 7% of annual US healthcare expenditures. There are substantial opportunities to lower national spending while improving quality and patients' experience of outpatient surgical care.
- We found that 3 opportunities are most likely to improve value: 1) maximizing the appropriate use of surgeries via decision aids, clinical decision support, and a remote surgical coach for physicians considering a surgical referral; 2) safely shifting surgeries from hospital outpatient departments to high-volume, multi-specialty ambulatory surgery centers (ASCs) where costs are much lower; and 3) standardizing processes in ASCs from referral to recovery.
- Extrapolation based on published studies of the effects of each component suggests that the proposed 3-part composite may lower annual national outpatient surgical spending by as much as one-fifth while maintaining or improving outcomes and the care experience for patients and clinicians.

servations were also supported by literature and/or approved by experts in the area. Yet, the team acknowledges that there is always the possibility that different site selection might have influenced the model construction.

The team conducted a literature review of efforts to improve the quality, patient experience, and total cost of outpatient surgical care. Via a series of seminars with individuals regarded as global or national leaders in their fields, the team considered the applicability of relevant emerging science and technologies. Using these diverse exploration methods, the team discerned several correctable major shortfalls in value (**Figure 1**).

Over the next 6 months, the team iterated a proposed innovative care composite to correct these shortfalls, with the goal of identifying the opportunities most likely to improve value. Diverse senior mentors continuously challenged or encouraged the team's design[10] and its national impact projections. This process expanded the team's consideration of the "adjacent possible"[9]—innovations used for other medical conditions, such as medical and surgical homes, and by other industries, such as an automated check-in process for surgery that is similar to airline passenger check-ins and screenings. After 6 months of continuous refinement, the team converged on a composite new "care model," along with an estimate of its likely impact on annual US health spending after accounting for implementation and operating costs (**eAppendix**, available at **www.ajmc.com**).

The resulting 3-component composite is displayed in the **Table** and is summarized by the words REFINE, RE-SET, and REPLICATE: the "Triple-R." The Table also displays evidence pertaining to the quantitative impact of each component. The next section summarizes rough estimates of the impact on the annual national outpatient surgical spending from combining all 3 components after 5 foundation-building years of implementation, learning, refinement, and competency-building. These estimates are speculative since the proposed combination of elements and their national scaling are unprecedented.

RESULTS

REFINE: Maximize Appropriate Use of Outpatient Surgeries

Approximately 30%[11-15] of all elective surgeries may be inappropriate, which is defined as surgeries in which the expected health benefits offer no clear advantage over less risky alternatives.[16] Perverse financial incentives may contribute to inappropriate use,[8,17,18] as can poor alignment between a patient's overall condition, goals of care, and desired outcomes.[11,12,19-21] Referring providers—generally, primary care providers—often lack adequate time and support to assure better alignment.[22,23] In addition, effective communication to patients of likely benefits and risks occurs in only 20% of cases,[24] often resulting in unrealistic patient expectations.[25] Addressing the appropriateness of a surgical referral in primary care is one way to avert surgical overuse. We discerned several combinable solutions intended to be implemented by primary care providers prior to surgical referral.

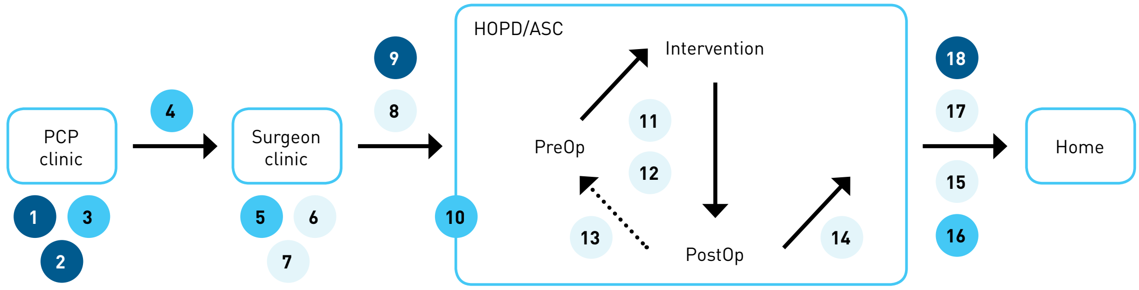
Interactive patient decision aids. These reduce surgical use for conditions associated with multiple clinically appropriate treatment options by as much as 20% and improve patient satisfaction,[26] yet only 10% to 30% of eligible patients receive them.[27] Roughly 500 ready-to-implement and validated decision aids are available for most high-volume outpatient surgeries, such as cataract, cholecystectomy, hernia, and spine surgeries.[28]

Clinical decision support. Within an electronic health record, clinical decision support can help clinicians apply guidelines, thus increasing the appropriateness of surgeries that clinicians recommend.[29,30] For example, when 120 procedures at risk for overuse, as identified by the Choosing Wisely[31] campaign, were translated into clinical decision support tools by Cedars-Sinai Medical Center, utilization decreased by as much as 18%.[32] Clinical decision support tools may reduce complications[33] and increase patient satisfaction. Automated clinical decision support tools can facilitate awareness of Appropriate Use Criteria[34] and are more effective when endorsed via consensus among an organization's clinicians.[35]

Case coaching. Patient decision aids and clinical decision support are insufficient to delineate an appropriate decision in approximately 8% of cases.[36] In such instances, referring providers could be supported by a remotely located surgeon, who does not benefit financially from the referral, to serve as a "case coach" to verify the adequacy and appropriateness of the proposed program of care. For example, an e-consult service adopted by a number of integrated systems, such as the Veterans Health Administration, have decreased subsequent referrals for specialist care by 20% to 40%.[36-39]

We estimate the potential net national reduction in annual US health spending from successful implementation of the REFINE

FIGURE 1. Current Care Model With Gaps in Cost and Quality for Outpatient Surgery and Unmet Patient and Provider Needs



PCP

1. Lack of adequate time
2. Lack of adequate support
9. Fragmentation
18. Lack of communication with specialist

PATIENT

3. Underinformed about treatment options available; limited time with PCP
4. Wait time
5. Test results not available/repeat tests
10. Inconveniences of HOPD settings
16. Underinformed about postoperative pain, recovery, and outcomes

SPECIALIST

6. Conservative treatment options not exhausted
7. Disconnected from PCP/patient's full medical and social history
8. Scheduling
11. Lack of consistent supplies
12. Inefficiencies in care delivery
13. Lack of consistent postoperative care delivery
14. Inefficiencies in discharge process
15. Unplanned hospital admissions
17. Lack of communication with PCP

ASC indicates ambulatory surgery center; HOPD, hospital outpatient department; PCP, primary care provider; PostOp, postoperative; PreOp, preoperative.

element at $7.4 billion, or 3.5% of total annual spending on outpatient surgeries.

RE-SET: Safely Shift More Surgeries to Ambulatory Surgery Centers

Site-shifting. Despite similar outcomes, the same surgeries performed on low-risk patients in HOPDs cost much more to produce than in ASCs.[8] Today, over half of US outpatient surgeries take place in HOPDs.[40] This amount can be safely changed by shifting a large number of surgeries from HOPDs to ASCs, as already occurs in other medically advanced nations.[41] Based on the payment differential between sites,[42] the Washington Ambulatory Surgery Center Association estimated that CMS could save $25 billion over a 10-year period with such a shift.[40] We predict there may be additional savings due to differences in procedure and recovery duration.[8,43]

Expanded ASC hours. Expanding ASC operating room hours to 18 hours a day, 7 days a week would substantially boost throughput in multi-specialty ASCs. Human factors research suggests that such a shift could be safely implemented. The expansion of hours has been tested in other labor- and process-driven industries, such as aviation,[9] and in healthcare settings in both wealthy and poor countries. Narayana Health in India performs coronary artery bypass graft surgery with low mortality rates for less than $2000,[44] in part by spreading fixed costs over a larger patient base through expanded hours of operation.[45] Similar cost reductions can be achieved in the United States.[46] Because cognitive function and performance diminishes between the hours of midnight and 6 AM,[47] 18 hours per day may be the maximum expansion of operating room hours without jeopardizing clinical outcomes. Research on volume-outcome relationships suggests that outcomes may also improve (Table).[45,48,49]

We estimate net national reduction in annual US health spending from the RE-SET element to be $26.2 billion, or 12.5% of annual current US spending on outpatient surgeries.

REPLICATE: Standardize and Integrate Care Across an Episode

Inefficient processes, slow adoption of evidence-based practice, and fragmentation of care are thought to account for as much as 30% of US healthcare spending.[50] Standardizing today's ASC processes for those that demonstrate the highest level of value and integrating them across the entire surgical episode can further boost the value of US surgical care.[51] Because ASCs avoid urgent circumstances and high-risk patients, they are especially well-suited for care-process standardization. Standardized care can incorporate 3 elements and extend from the point of referral to recovery.[52,53]

TABLE. Strategies to Improve Value of Outpatient Surgical Care

Strategy	Components of Successful Interventions	Successful Implementation by National/International Exemplars	Impact on Patient Experience, Population Health, and per-Capita Cost of Care
REFINE: Maximize the appropriate use of surgical care	‣ Interactive patient decision aids[26,28] ‣ Clinical decision support[29-34] ‣ Case coaching for referring provider[36-39]	‣ Decision aids at University of Ottawa ‣ Clinical decision support at Cedars-Sinai ‣ E-consult services at Veterans Health Administration ‣ E-consult services at Los Angeles County Healthcare System	↓ Surgical utilization for conditions associated with multiple clinically appropriate treatment options by 20%[26] ↓ Utilization of unnecessary surgeries by 18%[32] ↓ Subsequent specialist visits by 20%-40% and wait times[36-38] ↓ Complications by 2%-5%[33] ↑ Patient–provider communication and patient satisfaction[26] ↓ Spending by $7.4B (3.5%) by the end of year 5
RE-SET: Safely shift some surgeries to ASCs	‣ Transition 40% of HOPD cases to ASCs[40,41] ‣ Expand ASC operative functioning up to 18 hours per day, 7 days per week [44,46,47]	‣ Transitioning HOPD cases to ASCs at the British Association of Day Surgery, United Kingdom ‣ Expanded hours at Narayana Health, India ‣ Focused factory at Shouldice Hospital, Canada	↑ Procedure volume of about 15%[46] ↑ Timeliness of care and ↓ mortality due to higher volume by 25%-40%[45,48,49] ↓ Per-patient cost due to higher volume[45] ↑ Patient experience and convenience[5,64] ↓ Spending by $26.2B (12.5%) by the end of year 5
REPLICATE: Standardize and integrate care across an episode	‣ Clinical decision-making algorithms[54] ‣ Checklists[55-57] ‣ Medical tune-up[55-57] ‣ Postdischarge follow-up ‣ Up-front discharge planning[58,59] ‣ Turnover teams[60] ‣ Patient dashboards ‣ Automated check-in[62] and preadmission assessment[63] ‣ Standardized nonlabor inputs[61]	‣ Clinical algorithms at Intermountain Health Care ‣ Checklists and medical tune-up at Strong for Surgery ‣ Up-front discharge planning at Stanford Health Care ‣ Turnover teams at Aravind Eye Clinic, India ‣ Preadmission assessment at One Medical Passport ‣ Standardized nonlabor inputs at Seattle Children's Hospital	↓ In-hospital complications (OR, 0.58) ↑ Documentation (OR, 13.65) ↓ Hospital costs by 18%[54] ↓ Supply costs by about 20%[61] ↓ Postoperative complications with patient pre-optimization[56,57] ↓ Postoperative hospitalization[56,57] ↓ Spending by $6.3B (3%) by the end of year 5

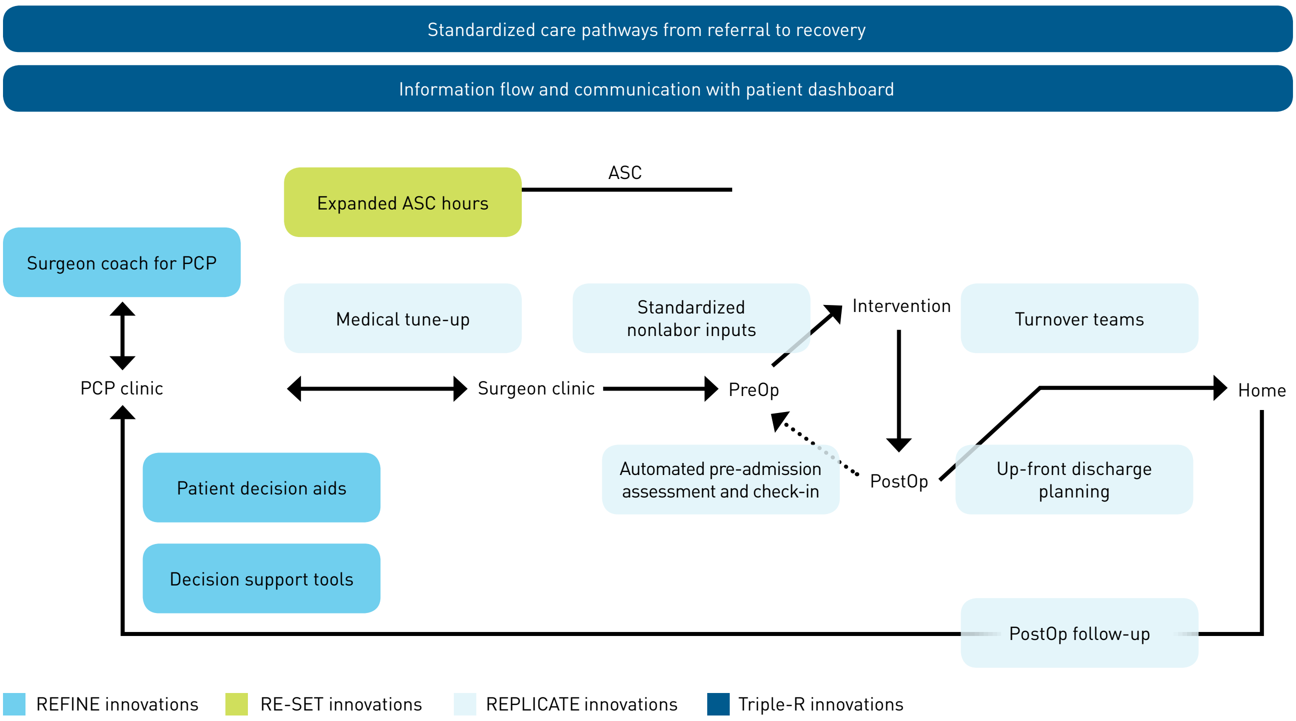
"↓" indicates decrease; "↑", increase; ASC, ambulatory surgery center; B, billion; HOPD, hospital outpatient department; OR, odds ratio.

Clinical algorithms. These are structured, multidisciplinary plans of care that integrate clinical guidelines and protocols adjusted to fit local environments and workflow capabilities. These algorithms improve outcomes and yield an average cost savings of 18%.[35,54] Checklists may ensure the use of clinical algorithms. A number of off-the-shelf options currently exist for preoperative checklists, such as those generated by organizations like Strong for Surgery,[55] which focuses on patients' preoperative behavior.[55-57] Additional clinical algorithms should be designed to optimize care transitions for postdischarge care.

Standard workflows and nonlabor inputs. Clinical algorithms yield to standardized workflows that, in turn, allow lower-cost clinical team members to perform work that is currently performed by more costly health professionals. Standard workflows extend outside the procedure to encompass tasks, such as discharge planning[58,59] and turnovers to reduce operating room down time.[60] Standardizing nonlabor inputs, such as surgical supplies, based on comparative effectiveness and price, reduces the cost of surgery and allows for volume-based price discounts from suppliers. It also simplifies purchasing and reduces the time and effort needed to tailor supplies to surgical team preferences. Such standardization may lead to cost savings of roughly 20%[61] and improve the quality of care by reducing variation in equipment and supplies that support staff members must master, thus reducing errors attributed to unfamiliarity.

Continuous monitoring and adjustment of clinical algorithms and workflows. Additional reduction in variation can further boost the yield from algorithms and standard workflows by continuously

FIGURE 2. Proposed Care Model for Outpatient Surgery



ASC indicates ambulatory surgery center; PCP, primary care provider; PostOp, postoperative; PreOp, preoperative.

analyzing deviations and making further refinements. As clinician confidence builds in algorithms, information technology tools, such as patient dashboards, automated check-in,[62] and preadmission assessment,[63] can ease care pathway implementation and improve the clinician and patient experience of care.

We estimate that net annual US savings associated with the REPLICATE element could approach $6.3 billion, or 3% of annual spending on outpatient surgeries after a 5-year implementation and refinement period.

DISCUSSION

Major opportunities remain to improve the value of US outpatient surgical care (**Figure 2**). To capitalize on these opportunities, we gathered evidence from diverse sources. The validity of our forecast for lowering the cost of better surgical care hinges on the quality and transferability of the evidence that we sourced. Pilot-testing of the Triple-R will reveal synergies and friction points among component parts.

Some elements of the composite, such as the expanded hours of operation, extend beyond directly relevant evidence and rely instead on successes in plausibly similar circumstances. When operationalizing such elements, it is important to consider context-dependent implementation hurdles; for example, expanding hours in the ASC context may present implementation challenges in incorporating provider and staff preferences for certain work hours. Furthermore, some of the reported efficiency in ASCs[8,42,43] may be due to incentives to finish cases quickly because staffing is not performed in shifts. Thus, adding shifts may paradoxically lengthen case and turnaround times. Incentives, such as bonus payments for off-hour shifts, may mitigate this issue. Expanded hours may also pose challenges to incorporating patient preferences. In previous studies of other procedures, patients have opted for inconvenient hours if the wait time for therapy was shorter.[64] However, understanding patient preferences and tradeoffs in elective surgery would be valuable; additionally, discounted pricing for unfavorable times may be considered.

We estimate that the potential for annual nationwide savings is roughly $40 billion net of implementation costs, or 19% of current annual spending on outpatient surgeries and more than 1% of total annual US healthcare spending. To achieve such savings, the Triple-R uses disruptive elements that would require structural and cultural shifts in the healthcare system. One such element is shifting procedures to ASCs despite current economic incentives to keep them in HOPDs. Our composite is designed with value-based payment, tiered networks, and reference pricing in mind, where such a tradeoff is indeed financially encouraged. However, even in other types of systems, market competition may ultimately work in favor of ASCs due to the low price, better convenience, and better quality. In addition, shifting higher turnover cases to ASCs will open up the capacity at HOPDs and allow them to streamline inputs and specialize their labor and care. Even with the shift, HOPDs will continue to produce a significant percentage of outpatient procedures (eg, complex procedures or procedures on medically complex patients).

The Triple-R focuses broadly on all outpatient procedures, but not all procedures will generate the same value. Future pilot studies will most likely focus on a smaller group of specialties. Although this choice will be site-dependent, there may be specialties and procedures that are likely to generate relatively more value from the application of our composite, due to, for example, a high volume of outpatient surgeries that can safely be moved to ASCs within the specialty. Our preliminary analysis suggests that certain procedures within the specialty areas of orthopedics, ophthalmology, plastic surgery, gastrointestinal, and gynecology may be good candidates for future pilot testing.

Results from pilot testing and scaling the proposed composite will hinge on each organization's culture and management capabilities. Therefore, local operational and cultural factors must be a part of any implementation. The composite is designed to target levers with the highest opportunity to lower per capita healthcare spending safely. For example, even though there are opportunities to increase the value of care in HOPDs, ambulatory surgery represents a larger cost-reduction opportunity, and therefore has been chosen as the focus of the composite. Having said that, elements of REPLICATE can be used at HOPDs to increase efficiency and improve outcomes, while elements of REFINE apply to all outpatient procedures independent of surgical location.

CONCLUSIONS

Extrapolation, based on published studies of the effects of each component, suggests that the proposed 3-part composite may lower annual national outpatient surgical spending by as much as one-fifth, while maintaining or improving outcomes and the care experience for patients and clinicians. We have begun partnerships with healthcare organizations to assess the impact of the REFINE–RE-SET–REPLICATE composite. As clinicians and their organizations face increasing use of value-based payments, tiered networks, and reference pricing,[65] its successful implementation and refinement may help secure their financial viability.

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eAppendix. Estimated Cost Savings

We calculated cost savings from the US health system perspective based on:

1. Maximizing appropriate use of outpatient surgeries by interactive decision aids, clinical decision support, and case coaching for referring provider (Section II);
2. Safely shifting more surgeries to ambulatory surgery centers that operate under expanded hours (Section III); and
3. Standardizing and integrating care across an episode with clinical algorithms that use standardized nonlabor inputs (Section IV).

The measure of cost savings is reduced spending by payers. Cost estimates derive from medical literature and national databases including both public and private US payers. Whenever there were multiple resources available, we chose the most conservative estimates for cost savings in order to keep our prediction a lower bound on the potential cost reduction of the new care model. We note that since we report costs, rather than value, we did not account for increased convenience for patients and providers explicitly in our calculations, which may further contribute to underestimation of value.

Because we aimed to streamline all outpatient surgeries rather than a specific procedure or disease, we applied evidence from diverse sources. Furthermore, there were instances where data were not readily available. For example, there is no overall estimate in the literature for increase in lifetime cost due to surgery versus conservative therapy. In this case, we used several outpatient surgeries for which such estimates were readily available to extrapolate an average cost increase for the overall sample. Similarly, the literature on costs and benefits of expanded hours is scant; therefore, we calculated the costs and benefits using several assumptions in the healthcare operations management literature.

We assume that the number of outpatient surgeries will stay the same over the next 5 years. Clearly this is a restrictive assumption as more inpatient surgeries are moving to outpatient settings. However, as the number of outpatient surgeries increase, the benefit of our new care model will only increase; therefore, once again, we err on the conservative side.

We did not apply discounting in order to avoid double counting as some included references already use discounting. We did not perform sensitivity analysis as the scope of our new care model (outpatient surgeries rather than a specific procedure or disease) made such an analysis either too complex to be implemented in the time frame of the study or irrelevant due to overly simplifying assumptions. Thus, the validity of our forecast hinges on the quality and transferability of evidence we relied on. When applied to one specialty or group of specialties, cost savings may deviate from our predictions.

I. Baseline Spending on Outpatient Surgical Care ≈ $209 billion

Number of outpatient surgeries performed annually, N = 57 million procedures[1]

Average charge for outpatient surgery, C = $3,673 per procedure[2]

Annual US spend on outpatient surgery = $N \times C \approx$ $209 billion.

II. Predicted Net Spend Reduction with REFINE by the End of the 5th Year of Implementation ≈ $7.4 billion

II. 1 Predicted savings by maximizing appropriate use of outpatient surgery:

Number of inappropriate outpatient surgeries

= 30%[3–8] × N = 17.1 million procedures.

Increase in lifetime cost due to surgery versus conservative therapy

≈ 37%[9–12] × C ≈ $1,360.

Potential spend savings = (30% × N) × (37% × C) ≈ $23 billion.

Utilizing evidence-based practices inherent in decision aids and clinical decision support may more appropriately align patient decisions with the most beneficial course of treatment. Case coaching will also lead to reduction in overuse. It is conservatively estimated that over a five-year horizon patient decision aids, clinical decision support, and case coaching may collectively reduce overuse by 50%[13,14]; about 20% of this reduction is attributable to patient decision aids, 26% to decision support tools, and the remaining 4% to the neutral surgeon coach.[1] Therefore, a total of 8.6 million surgeries may be eliminated over 5 years, leading to a

Spend reduction by REFINE = 50% × Potential spend savings ≈ $11.6 billion.

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[1] In order to understand the sensitivity of our savings estimate to the reduction in surgical overuse, we repeated our calculations with lower reduction in overuse. If we assume a 40% reduction, the savings from REFINE will be $5 billion, as opposed to $7.4 billion. If we assume a 30% reduction, the savings from REFINE will be $2.6 billion, as opposed to $7.4 billion.

II. 2 Cost of implementing REFINE innovations:

No solution is without its own inherent costs. Implementation costs should thus be accounted for in determining the savings associated with the above-mentioned innovations. Our model assumes that the decision support tools and patient decision aids are to be implemented at the referring provider (generally primary care providers) sites, which are addressed in federal electronic medical record (EMR) requirements. Thus, based on the literature, we estimate the implementation cost for patient decision aids and clinical decision support on the already existing EMR to be nominal,[15] although we acknowledge that some adopting systems may still need to cover the EMR implementation costs.

We predict remote surgeon coaching for referring provider will be used for 8% of patients[16], and based on existing second opinion services[17], we estimate the cost to be $200 per case coaching:

$$
\begin{aligned}
\text{Cost of implementing REFINE} &= (57 \text{ million procedures} \times 8\% \times \$200 \text{ per case}) \\
&+ (55 \text{ million procedures} \times 8\% \times \$200 \text{ per case}) \\
&+ (53.6 \text{ million procedures} \times 8\% \times \$200 \text{ per case}) \\
&+ (51.9 \text{ million procedures} \times 8\% \times \$200 \text{ per case}) \\
&+ (50.1 \text{ million procedures} \times 8\% \times \$200 \text{ per case}) \\
&\approx \$4.2 \text{ billion.}
\end{aligned}
$$

Note that the number of surgeries decrease by about 1.7 million surgeries every year as we estimate that our innovations will eliminate about 8.6 million surgeries over 5 years. By the end of 5 years, we predict the number of outpatient surgeries to be 48.4 million per year.

II. 3 Predicted <u>net</u> savings by maximizing appropriate use of outpatient surgery:

$$
\begin{aligned}
&\text{Spend reduction by REFINE} - \text{Cost of implementing REFINE} \\
&\quad = \$11.6 \text{ billion} - \$4.2 \text{ billion} \approx \$7.4 \text{ billion,}
\end{aligned}
$$

which accounts for 3.5% of $209 billion spent on outpatient surgery annually.

III. Predicted Net Spend Reduction with RE-SET by the End of the 5th Year of Implementation

≈ $26.5 billion

III. 1 Predicted savings by safely shifting more surgeries from HOPDs to ASCs:

According to the Washington Ambulatory Surgery Center Association (WASCA) working paper[18], Centers for Medicare & Medicaid Services (CMS) may save $25 billion over a ten-year period by moving procedures from hospital outpatient departments (HOPDs) to freestanding ambulatory surgical centers (ASCs), averaging $2.5 billion annually. Considering that CMS bears 47% of the national costs[19] and we can reduce costs by 5.5% (prior to implementation costs) with our REFINE innovations, and further assuming that reductions in private sector will be 60% of CMS reductions, the estimated savings by safely shifting more surgeries from HOPDs to ASCs over the next five years are as follows:

Predicted savings by safely shifting surgeries from HOPDs to ASCs

= $12.5 billion (1 + 53%/47% × 0.6)× (100% – 5.5%) ≈ $19.8 billion.

III. 2 Predicted savings by expanding ASC hours:

The second element of RE-SET is expanded hours: facilities operating up to 18 hours per day and 7 days per week. Assuming it costs $2,500,000 to build an ASC operating room[20] (OR), the daily cost of depreciation (over 10 years) when facilities are utilized 5 days per week is $1,000. Assuming 8 cases per day with the current 12 hours per day, overhead per case is $125. When facilities are utilized 7 days per week, the cost of depreciation is $714 per day. Assuming 12 cases per day with expanded 18 hours, overhead per case is $60. The difference in overhead is $65 per case. Assuming every operation is performed in this surgical setting,

Spend reduction by expanding ASC hours

= (49% × 55 million procedures × $65 per case)
+ (53% × 53.6 million procedures × $65 per case)
+ (57% × 51.9 million procedures × $65 per case)
+ (61% × 50.1 million procedures × $65 per case)
+ (66% × 48.4 million procedures × $65 per case)
≈ $9.6 billion.

In this calculation, the first term in each parenthesis is the projected percentage of outpatient surgeries in ASCs due to the first component of RE-SET. The second term is the remaining number of outpatient procedures after appropriate use of surgeries are maximized by REFINE innovations.

III. 3 Cost of implementing RE-SET innovations:

We note that when they are utilized more effectively, current ASCs have enough capacity to accommodate these additional procedures:

Number of ASC ORs required for the current volume

$$= (57 \text{ million} \times 45\%) \div (250 \text{ days/year} \times 8 \text{ surgeries/day})$$

$$\approx 12{,}825 \text{ ORs},$$

Number of ASC ORs required for the projected volume (with expanded hours)

$$= (57 \text{ million} \times 66\%) \div (350 \text{ days/year} \times 12 \text{ surgeries/day})$$

$$\approx 8{,}957 \text{ ORs},$$

Therefore, the only implementation cost for RE-SET is for expanding ASC hours. Expanded hours necessitate increased labor and bonuses for the added shift.[21] Salary information for surgeons, operating room nurses, surgical physician assistants, anesthesiologists and surgical/scrub technicians were queried from online salary databases. We estimated a total annual salary of $616,000 for operating room personnel. We then applied a 15% bonus to account for incentives required to work a third shift.[21] Assuming 1,400 additional surgeries can be scheduled per operating room with expanded hours, the additional cost due to bonus is $66 per surgery.

$$\begin{aligned}\text{Cost of expanding ASC hours} = {} & (49\% \times 55 \text{ million procedures} \times 33\% \times \$66 \text{ per case}) \\ & + (53\% \times 53.6 \text{ million procedures} \times 33\% \times 66 \text{ per case}) \\ & + (57\% \times 51.9 \text{ million procedures} \times 33\% \times 66 \text{ per case}) \\ & + (61\% \times 50.1 \text{ million procedures} \times 33\% \times 66 \text{ per case}) \\ & + (66\% \times 48.4 \text{ million procedures} \times 33\% \times 66 \text{ per case}) \\ \approx {} & \$3.2 \text{ billion.}\end{aligned}$$

Indeed, the added hours of a third shift were calculated into the overall labor costs. This approach assumes no additional hiring by operating room management of any labor units, but rather utilizes the current workforce by shifting them among facilities. However, there may be differences in the quality of staff working in HOPDs and ASCs, which may affect efficiency of care and patient outcomes. Therefore, we suggest an in-job training of 2 weeks for every nurse shifted to ASCs. When combined with our five-year implementation and refinement period, this training program will be an effective strategy in mitigating quality problems that may rise due to differences in staff experience. We estimate a one-time cost of under

$150 million for this training program, which is nominal cost and hence not included in our calculations.

III. 4 Predicted <u>net</u> savings of safely shifting more surgeries to ASCs with expanded hours:

Spend reduction by RE-SET − Cost of implementing RE-SET

= \$19.8 billion + \$9.6 billion – \$3.2 billion ≈ \$26.2 billion,

which accounts for 12.5% of \$209 billion spent on outpatient surgery annually.

IV. Predicted Net Spend Reduction with REPLICATE by the End of the 5th Year of Implementation ≈ \$7 billion

IV. 1 Predicted savings by streamlining care processes and standardizing inputs:

The interventions embedded within REPLICATE seek to standardize beyond the mere episode of care surrounding the procedure, weaving concepts within REFINE and RE-SET to provide a smooth transition of care within and between traditional segments of the care pattern. The first element of REPLICATE is standardized and integrated care, allowing for rapid efficiency of care delivery; standardization of "work" performed by providers and ancillary staff, including establishing turnover teams; and upfront discharge planning prior to the intervention.

The literature estimates an 18%[22] reduction in spending due to standardized and integrated care with clinical algorithms. Assuming we can capture 25% of these potential benefits by the end of 5 years:

Predicted savings by clinical algorithms = (5% × 18% × \$98.8 billion)

+ (5% × 18% × \$102.8 billion)

+ (5% × 18% × \$106.4 billion)

+ (5% × 18% × \$109.5 billion)

+ (5% × 18% × \$113.9 billion)

≈ \$4.8 billion,

where the third term in each parenthesis is the cost of surgeries at ASCs after REFINE and RE-SET innovations, which we calculate as

$\bar{C}$ =(*C* – Total net savings by REFINE – Total net savings by moving procedures to ASCs)

× (Projected percentage of surgeries in ASCs)

– Total net savings by expanded hours.

Assuming supply costs are 20% of the total cost[23] and standardized nonlabor input decreases the costs by 3%[24] per year over the next 5 years, the savings by standardized nonlabor input are as follows:

Predicted savings by standardizing nonlabor inputs = (3% × 20% × $98.8 billion)
+ (3% × 20% × $102.8 billion)
+ (3% × 20% × $106.4 billion)
+ (3% × 20% × $109.5 billion)
+ (3% × 20% × $113.9 billion)
≈ $3.2 billion.

IV. 2 Cost of implementing REPLICATE innovations:

We estimated the total number of operating rooms needed to cover all ASC surgeries as 8,957 in Section III. We believe a team of a consultant and three improvement specialists per 10 operating rooms can implement REPLICATE innovations. We estimated the improvement specialist cost at $95,847, which is the average registered nurse salary in the US. The average salary of a consultant is $288,000. We assumed that the consultant's involvement would decrease to half in the second year, and by the 3rd year of implementation, only the improvement specialists would be needed:

Cost of implementing REPLICATE = (3 * $95,847 + $288,000) × (8,957 ÷ 10)
+ (3 * $95,847 + 0.5 * $288,000) × (8,957 ÷ 10)
+ 3 * (3* $95,847) × (8,957 ÷ 10)
= $1.7 billion.

IV. 3 Predicted <u>net</u> savings by REPLICATE:

Spend reduction by REPLICATE − Cost of implementing REPLICATE
= $8.0 billion – $1.7 billion = $6.3 billion.

V. Predicted Net Spend Reduction with the New Care Model by the End of the 5th Year of Implementation ≈ $39.9 billion

Net spend reduction by the new care model
= Net spend reductions by REFINE + RE-SET + REPLICATE
≈ $7.4 billion + $26.2 billion + $6.3 billion ≈ $39.9 billion,

which is 19% of the current $209 billion spend on outpatient surgery.[2]

[2] In order to understand the sensitivity of our savings estimate to the magnitude of reduction in surgical overuse in REFINE, we repeated our net savings calculations for RE-SET and REPLICATE for different reduction values in

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overuse. Recall from Footnote 1 that, if we assume a 40% reduction in overuse the savings from REFINE will be $5 billion and if we assume a 30% reduction, the savings from REFINE will be $2.6 billion. The net savings from RE-SET and REPLICATE will increase by $0.5 billion when reduction in overuse is 40%. Therefore, the net decrease will be $1.9 billion and our new savings estimate for the framework will roughly be $38 billion net of implementation costs, or 18% of current annual spending on outpatient surgeries and more than 1% of total annual US healthcare spending. The net savings from RE-SET and REPLICATE will increase by $0.8 billion when reduction in overuse is 30%. Therefore, the net decrease will be $4 billion and our new savings estimate for the framework will roughly be $36 billion net of implementation costs, or 17% of current annual spending on outpatient surgeries and still more than 1% of total annual US healthcare spending.

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