

A Model Business Case for LiveData OR-Dashboard with Active Time Out™

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A. Overview

The objective of this document is to develop a model business case for the financial impact of OR-Dashboard on a hospital. This is accomplished by drawing on the results of research, including an article recently published in the *New England Journal of Medicine* linking the implementation of a surgical safety checklist with reduction in complication rates, and by using data on the financial impact of post-surgical complications. Additionally, so as to not disregard the overall impact of OR-Dashboard, we briefly examine the potential financial contribution of its other features.

We begin with a brief introduction to LiveData OR-Dashboard and immediately introduce the problem: it is difficult to justify the cost of patient safety solutions due to the difficulty in quantifying the problem of medical error and patient safety in general. In the case of OR-Dashboard, this is resolved by concentrating the analysis on one specific feature, Active Time Out™. A summary of the method and the results are then presented.

The remainder of the document is devoted to the presentation and discussion of the relevant details. We begin with a review of some of the literature on surgical safety checklists and their impact, and then show how to calculate the impact of reduced complications on a hospital's profit margin. We next examine how OR-Dashboard with ATO can improve on the results obtained with a paper-based safety checklist. This sets the stage for the calculation of the impact of OR-Dashboard on a hospital's margin under different assumptions regarding the progress in a hospital's implementation of a surgical safety checklist. We close with a brief discussion of the financial impact of other features of OR-Dashboard.

A.1 Background: LiveData OR-Dashboard

LiveData OR-Dashboard is a wall-mounted in-room display of relevant case/patient information gathered from existing disparate sources. OR-Dashboard is designed to support the establishment of work practices that are essential to ensuring patient safety such as good teamwork, a high level of situational awareness, and effective communications.

It accomplishes this by providing the OR team with direct access to critical information precisely when needed and by prompting team members to perform the correct activity at the appropriate point in the case. Along with OR-Dashboard, LiveData provides software for relaying case updates via reports and real-time alerts beyond the OR. The software thus constitutes a comprehensive management system for Time Outs, enabling administrators and clinicians to discover and resolve process failures before they create a problem for the patient, hospital or both.

One of the distinctive features of OR-Dashboard is Active Time Out. As described in detail in Section D, Active Time Out (ATO) is a system designed to assist the OR team in managing the important surgical pauses or briefings before induction of anesthesia, before incision and before the patient leaves the operating room. The objective of the surgical pause, or Time Out, is to give the OR team the opportunity to review and discuss vital information regarding the patient, the procedure, the team itself and surgical equipment. Anecdotally, however, it appears that existing Time Out processes in most hospitals are neither well executed nor well structured, thus placing patients at risk. In this document we refer to this scenario as an “unmanaged checklist process.”

In contrast with an unmanaged process, OR-Dashboard with ATO is specifically designed to ensure effective Time Outs by systematically prompting and guiding the OR team through Joint Commission- and World Health Organization-compliant surgical safety checklists: a designated team leader uses an interactive clicker to check off and record, one by one, each checklist item displayed on the screen, ensuring full participation in and completion of the process. Relevant information necessary to complete each step is automatically displayed beside each checklist item, increasing the ease and convenience of using the ATO feature, and further ensuring that items are actively reviewed, not simply checked off by rote.

A.2 Problem statement and objective

Because quantifying the financial impact of patient safety is difficult, justifying expenditure for solutions like OR-Dashboard is troublesome. Surgeons, nursing directors, OR managers and administrators who would like to implement OR-Dashboard thus face a challenge when attempting to translate the system’s benefits into financial terms when preparing a business case. The purpose of this document, then, is to prepare a model business case for the use of prospective and existing LiveData customers. It is focused on OR-Dashboard’s ATO feature and – as will be seen – its contribution to the reduction of surgical complications. Since credible data on the financial impact of post-surgical complications exists, a value can be placed on the implementation of OR-Dashboard with ATO. The value of other OR-Dashboard features then serves to contribute to increasing its impact.

A.3 Solution: Summary of model business case

Although surgical safety checklists have been credited with improving team communications and patient safety,^{1,2} the first report linking the implementation of a surgical checklist with a reduction in complication rates appeared in the January 2009 issue of the *New England Journal of Medicine*.³ The study, which was sponsored by the

World Health Organization (WHO), concluded that a simple checklist designed to promote team communication and consistency of care was associated with a decrease in the rate of post-surgical complications from 9.3% to 6.6% in high-income countries.

Since data exists on the impact of surgical complications on a hospital's profitability,⁴ we can therefore estimate how the introduction of LiveData OR-Dashboard with ATO into the surgical setting will affect the profit margin of an average¹⁴ U.S. hospital as follows:

1. Multiply the number of surgical patients by the reduction in the complication rate to arrive at the number of complications eliminated
2. Multiply the result by the financial impact of an average complication.

By invoking the features of ATO, we show that introducing OR-Dashboard will not only reduce the complication rate from 9.3% to 6.6%, but will maintain the rate at the lower level. Calculations demonstrate that the financial impact of OR-Dashboard with ATO on the average hospital comes to an annual profitability increase of approximately \$482,000, year after year. This result is based on the assumption that hospitals are reimbursed for patients who suffer post-surgical complications, which is typically the case today. However, as recent CMS reimbursement policy changes indicate,⁵ if payors should eventually decline **all** reimbursement for complications, hospitals that implement OR-Dashboard with ATO would add about \$700,000 annually to the bottom line.

For the average hospital, implementation of OR-Dashboard, including training, costs in a range such that most hospitals should expect a full return on investment by the end of the first year.

Because of the advantages of ATO over existing hospital checklist processes, we believe that post-surgical complications are likely to decrease beyond the 6.6% benchmark figure. Unlike a paper checklist, which is simply a memory aid by means of listing items to be verified, ATO is a management system for implementing and ensuring full compliance with the surgical safety process as well as its durability over time. Now durability is an important issue. In fact, the WHO-sponsored study³ explicitly drew attention to the issue and noted that it merited further study.

B. Impact of surgical safety checklists on reducing post-surgical complications

The possibility of substantially reducing surgical complications by implementing a set of carefully scripted Time Outs drew worldwide attention early in 2009 when the clinicians who participated in the World Health Organization's Safe Surgery Saves Lives program reported their results.³ They found that the implementation of "a 19-item surgical safety checklist designed to improve team communication and consistency of care" was associated with a substantial reduction in morbidity and mortality. Eight hospitals, located in carefully selected locations around the world, participated in the study, which was confined to inpatients 16 years of age or older undergoing non-cardiac surgery. Patients were tracked after the procedure to the earliest of the following end points:

C. Financial benefit of reduced complications

To calculate the financial impact of reducing post-surgical complications on the bottom line of the average US hospital, we require the following variables:

- The pre- and post-checklist post-surgical complication rates
- The difference in the financial impact of patients with and without post-surgical complications
- The number of inpatient surgeries performed

We then apply the variables to demonstrate the financial advantage of reducing post-surgical complications for the average hospital.

C.1 Determine the pre- and post-checklist complication rates

Since our goal is to calculate the financial impact of the ATO feature of OR-Dashboard in the average US hospital, we asked whether the 9.3% post-surgical complication rate – before the implementation of a checklist – is appropriate. To answer this question, we searched recent literature, and found that rates vary substantially from study to study. For example, the incidence of surgical adverse events that caused death, disability or prolonged hospital stay among 15,000 randomly selected non-psychiatric discharges in Colorado and Utah hospitals during 1992 was found to be 3.1%.¹¹ Of these, approximately 50% were deemed preventable. A study of 161,004 surgeries during 2001 and 2002¹² revealed a 2.85% rate of “Patient Safety Indicators.” However, since the method used in that study did not use NSQIP categories, it is not possible to compare the complication rates to those reported in the WHO study³. By contrast, a 2004 study of 1008 patients in a single private hospital that classified complications according to the NSQIP categories showed a complication rate of 13.3%.⁴

Given the range of results as well as methods used in the studies, we concluded that the best solution was to use 9.3% as the average hospital’s pre-checklist complication rate, with death excluded. To be consistent, we used 6.6% as the complication rate attainable after the implementation of a checklist.

C.2 Determine the financial impact of surgical complications

The “cost” of a complication appears to vary widely, in part because the term “cost” is often not carefully defined. The term has been used for the claim submitted by the hospital to a payor, for the reimbursement paid to the hospital, or for the incremental cost incurred by the hospital in treating a patient’s complications. Furthermore, regardless of the definition one chooses, there is an additional factor that must be considered: Some complications consume significantly more resources than others. In the present analysis we are interested in determining the impact of a typical set of complications on a hospital’s financial position – the set of complications that one would expect to observe over a sufficiently long interval. The set would include examples of all complications experienced by a broad distribution of patients.

Fortunately, a study that comes very close to meeting these criteria has been performed⁴ using data from a single medical center and covering a two-year period ending in December 2002. It reveals that the average, risk-adjusted reimbursement for surgical patients with complications was \$7,645 higher than for patients without complications (2002 dollars). However, the increase in reimbursement associated with complications was substantially less than the increase in a hospital's costs. As a result, the average margin dropped from \$3,288 without complication to \$755 with complications, a difference of \$2,533. The above figures, expressed in 2009 levels, based on annual indexes for "Hospital and related services"¹³ are shown in Table 1.

Table 1

Hospital costs and reimbursement for surgical patients with and without complications (from Reference 4 – Dimick et al.) adjusted to 2009 levels

	Costs: resources used by the hospital (2009 dollars)	Reimbursement: amount paid to the hospital (2009 dollars)	Hospital profit margin (2009 dollars)
Without complications	\$18,403	\$23,915	\$5,512
With complications	\$35,465	\$36,730	\$1,266
Difference ("With complications" – "Without complications")	\$17,062	\$12,815	-\$4,246

C.3 Determine the number of inpatient surgeries in an average hospital

Since we will be using 9.3% and 6.6% as the pre- and post-checklist complication rates, and since we now have estimates for the financial impact of a complication, it remains to determine the number of inpatient surgeries performed in an average US hospital. We concentrate on inpatient surgeries because the above complication rates and financial data are based on that category alone. While we recognize that ambulatory surgeries, a growing fraction of all surgeries, also result in complications, we assume that both the complication rates and financial impact per complication will be lower than for inpatient surgeries. Thus, by ignoring ambulatory surgeries, we are ensuring that our financial estimate will be a conservative one - representing the lower limit.

We estimate that the average US hospital has six operating rooms, and performs approximately 4,200 inpatient procedures annually.¹⁴ Thus, if the average hospital has a 9.3% rate of complications, then the average hospital experiences approximately 390 post-surgical complications annually.

C.4 The benefit of reduced complications on hospital profit margin

If the average hospital could reduce its complication rate from 9.3% to 6.6% **and maintain the complication rate at the lower level**, the same average hospital could add about \$482,000 to its bottom line, year after year. The benefits of reducing complication rates would be substantially more significant if payors denied reimbursement for complications.

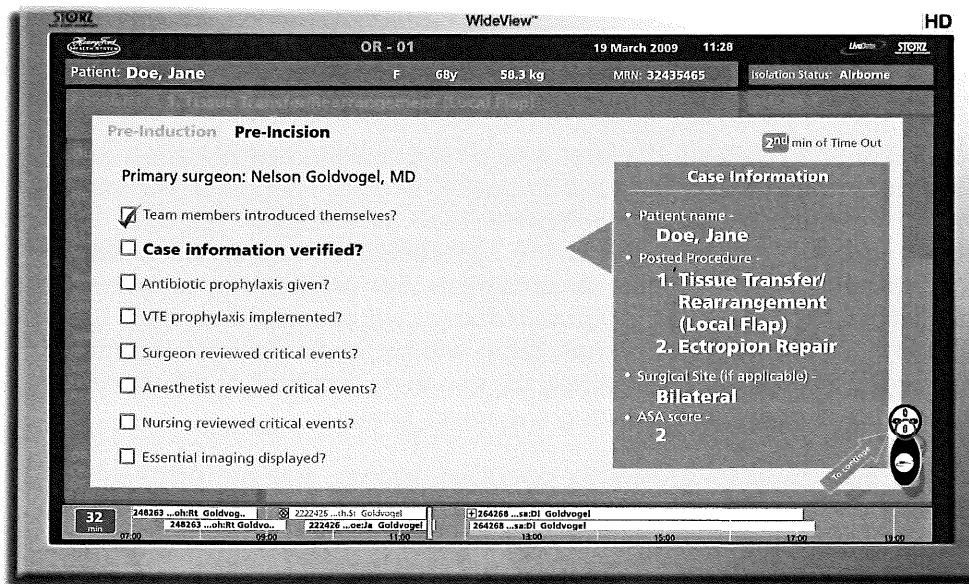
While this appears to be an extreme assumption, CMS has already started denying reimbursement for certain post-surgical complications, including retention of a foreign object,⁵ and more denial categories may be expected. If payors were to decline reimbursement for **all** complications, the hospital would lose \$12,815 for each complication because it would only be reimbursed at the "no complication" rate. Under this assumption, the benefit of reducing the complication rate from 9.3% to 6.6% would nearly triple to about \$1,450,000 annually.

D. OR-Dashboard with ATO: a surgical safety Time Out management system

Can OR-Dashboard with ATO help to achieve better results than existing Time Out processes? We believe that the answer is "yes" because ATO is more than an electronic version of a paper checklist; it is a technological tool supporting full compliance with all surgical safety procedures: Briefing, Time Out, and Debriefing. An example of just one item on the checklist, confirmation of patient's case, is shown in Figure 2.

Figure 2

A customized checklist displayed on OR-Dashboard



OR-Dashboard’s ATO and an unmanaged checklist process can be compared using the following features: convenience, team orientation and real-time monitoring and feedback. Table 2 summarizes the comparison.

Table 2

Comparison of OR-Dashboard with an unmanaged (paper-based) checklist process

Feature	Unmanaged Checklist	LiveData ATO
Convenience		
Checklist items are accessible	+	++
Support information is accessible	--	++
The complete Time Out activity is supported: Initiate, Conduct, Verify, Sign Off, Record, Feedback	+	++
Checklist includes only items relevant to case	--	++
Team Orientation		
Checklist is visible to entire team	--	++
Support information is visible to entire team	--	++
Team is in close physical proximity during Time Out	+	++
Staff names and roles are visible to entire team	--	++
Real-time monitoring and feedback		
Status of checklist items is reported during Time Out	--	++
Feedback on quality of process is provided after Time Out	--	++
Periodic reports are delivered —e.g. % of cases with high-quality Time Outs	--	++

D.1 Convenience of ATO ensures durability of checklist process over time

Studies by Metzger and Fortin¹⁵, Cabana et al.² and Heath and Luff¹⁶ all indicate that simplicity and convenience are primary to the success of adopting and maintaining new practices. In their review of barriers to adoption of guidelines and clinical practices, Cabana et al. show that factors such as physician belief in the impossibility of following

guidelines or insufficient time to do so directly evolve from the difficulty and inconvenience of an existing tool.

D.2 ATO ensures good teamwork, the key to reducing surgical complications

It is noteworthy that the first item in the WHO Time Out (prior to incision) calls for all team members to introduce themselves and describe their role in the procedure, which is the first step toward establishing good teamwork. Operating rooms are often characterized as high stress, high risk environments where effective team work is a critical contributor toward eliminating preventable errors, and thus reducing post-surgical complications. The elements of teamwork—shared vision, effective coordination of effort, and good communication—have the greatest impact on patient care during surgery¹. However, the foundation for effective teamwork is laid down before surgery begins, during the surgical safety Time Out. Several studies such as Makary et al.¹⁷, Lingard et al.¹⁸, Sexton et al.¹⁹ have directly examined the impact of operating room briefings on teamwork and patient safety. All three studies conclude that performing a surgical safety Time Out prior to the procedure contributes significantly to team interaction and increased patient safety.

D.3 ATO real-time feedback and monitoring ensure ongoing effectiveness of checklists

Feedback, as observed by O'Connor et al.²⁰, is a powerful tool in helping shape and maintain individual and team behavior. Providing the clinical team with immediate feedback about their performance helps motivate and guide them toward a comprehensive and thorough safety Time Out. O'Connor and his team found, for example, that hospital mortality after coronary artery bypass surgery dropped 25% within 6 months at one New England hospital following implementation of a mortality feedback system for surgeons. Similar results were observed by Khuri et al.²¹, who found a 40% improvement in observed morbidity following the establishment of NSQIP at the VA. Khuri and his team believed that feedback of information to providers and managers was the primary contributor to the improvement.

Taken together, the design characteristics of ATO are expected to positively affect the quality and therefore the benefits associated with Time Out. Furthermore, these design characteristics are expected to help the clinical team attain and maintain a high quality Time Out over time, ensuring the durability of the gains achieved. The following section describes the financial impact that such added benefits will have on the average US hospital.

E. Financial impact of OR-Dashboard with ATO on a hospital's profit margin

In estimating the financial impact of OR-Dashboard with ATO on a hospital, it is important to recognize that some hospitals, which have not implemented a surgical safety checklist, will use OR-Dashboard with ATO for that purpose. Others, where a checklist process has already been instituted, will rely on OR-Dashboard with ATO to maintain complication rates at the initial low level they may have first attained. Others, which constitute a third category, will rely on OR-Dashboard to reduce complication rates below 6.6%.

E.1 Hospitals implementing checklists using OR-Dashboard with ATO

Based on the results of the WHO study³, the average hospital initiating a surgical safety checklist process can expect to reduce the complication rate from 9.3% to 6.6%. As argued in the previous section, a hospital implementing OR-Dashboard with ATO can expect to achieve at least the same reduction. Therefore, its margin should increase by \$482,000 if reimbursement for complications continues. If it does not, the hospital's profit margin would increase threefold, as shown in Table 3.

Table 3

Annual margin improvement resulting from implementation of OR-Dashboard with ATO for an average US hospital (6 ORs, 4,200 inpatient cases per year) that did not have an effective surgical safety checklist in place prior to ATO

	Scenario 1: Hospital is reimbursed for complications	Scenario 2: Hospital is not reimbursed for care associated with complications
Reduction in complication rate from 9.3% to 6.6%	\$482,000	\$1,450,000

E.2 Hospitals that implement OR-Dashboard with ATO to prevent complication rates from backsliding

If a hospital has already implemented a checklist process, the advantage of implementing OR-Dashboard is incremental, but nevertheless significant. As described in section D, ATO improves durability: ATO can prevent the complication rate from gradually retreating to the pre-checklist level of 9.3%, say to 7.9%, or halfway back. Under this assumption, implementation of OR-Dashboard would be equivalent to driving the complication rate from 7.9% to 6.6%, and maintaining it there.

As long as payors continue to reimburse providers for patients who suffer complications, the effect on the average hospital would be to raise its annual profit margin by about \$232,000 (1.3% x 4,200 x \$4,246). If the payors were to decline payment for complications, the benefit of implementing OR-Dashboard with ATO would rise to about \$700,000 annually, as shown in Table 4.

Table 4

Annual margin improvement attributable to OR-Dashboard with ATO for an average US hospital (6 ORs, 4,200 inpatient cases per year) that did have an existing surgical safety checklist prior to implementing OR-Dashboard with ATO

	Scenario 1: Hospital is reimbursed for complications	Scenario 2: Hospital is not reimbursed for care associated with complications
Maintaining a 6.6% complication rate (versus a retreat to 7.9%)	\$232,000	\$700,000

E.3 Hospitals that implement OR-Dashboard to achieve a further reduction in the complication rate

Because ATO supports full compliance with all surgical safety procedures, we hypothesize that it can stimulate further reductions in the complication rate, as shown in Table 5.

Table 5

Incremental improvement in profit margin attributable to ATO for an average US hospital (6 ORs, 4,200 inpatient cases per year) that did have an existing surgical safety checklist prior to implementing OR-Dashboard with ATO

	Scenario 1: Hospital's profit margin for patients with complications is \$4,246 lower than for patients without	Scenario 2: Hospital is not reimbursed for care associated with complications; loses \$12,815 per complication
Stimulates incremental 10% - 20% additional reduction in complications beyond level attainable with paper checklist	\$125,000 to \$232,000	\$377,000 to \$700,000

If, in addition to helping complication rates stay at their low (6.6%) level, OR-Dashboard stimulates a small incremental reduction in complication rate, say from 6.6% to 5.9% (a 10% incremental effect), then the total annual benefit for the hospital would rise to about \$357,000. It would rise to about \$464,000 in the case of a 20% incremental improvement, if payors continue to reimburse for complications. And finally, if all reimbursements for complications were eliminated, the annual benefit would range from \$1,077,000 to \$1,400,000. Thus, whether an average hospital goes from having no surgical safety checklist to ATO, or from an unmanaged (paper-based) checklist to ATO, the benefit could be as high as \$1.4 million annually.

F. Discussion

F.1 Harvesting the financial benefits of reduced complications

If payors decline reimbursement for complications, the pain is felt directly and immediately by the hospital because revenue declines. However, as long as payors continue to reimburse for complications, the advantage of reducing post-surgical complications on the bottom line is more subtle. Hospitals that maintain an average level of surgical productivity will realize the benefits of reducing complications, while those that fall below normal productivity ranges may not. [See Appendix 2]

F.2 Financial impact of other features of OR-Dashboard

In some installations, OR-Dashboard displays the time elapsed during a turnover. This represents a valuable indicator for OR teams seeking to improve OR throughput. In combination with other actions,²² this could help the hospital routinely add one or more short cases to the regular schedule. The financial benefit is substantial: Adding just one additional 60-minute case every day, can lead to an annual incremental margin of \$500,000 provided that the hospital is capacity-limited and is able to attract additional surgeries to fill the capacity made available by increasing OR throughput.

The improved communication among members of the OR team, which encourages them to speak up when they develop a concern for the patient's safety, is expected to contribute to improving nurse satisfaction and, thus, to reducing turnover among OR nurses. Although recruitment and training of an OR nurse is relatively expensive because of the lengthy training period, it can be shown that the financial impact attributable to this effect, while small in comparison with the other effects being considered, is another potential impact of OR-Dashboard.

Additionally, we cannot neglect the impact OR-Dashboard has in ensuring SCIP and Joint Commission compliance to initiatives such as antibiotic administration, improved communication among team members, and improved accuracy of patient identification, among others.

F.3 Importance of a well-conceived and well-executed implementation process

Although OR-Dashboard with ATO represents an improvement over a paper-based checklist process, it constitutes a sufficiently significant change in practice that its introduction is unlikely to proceed without resistance from some staff members. Hospitals wishing to ensure an effective implementation should be prepared, therefore, to devote appropriate resources and time to plan the implementation, to conduct training, to assess compliance and to overcome resistance. Expenses associated with this effort should reduce first-year benefits only.

G. Conclusion

By concentrating on OR-Dashboard's ATO feature and by capitalizing on the recently published article showing an association between the implementation of a surgical checklist and a reduction in post-surgical complications, we have developed a model business case for LiveData's OR-Dashboard. For hospitals that elect to use the system to implement Time Outs and the associated checklist, the annual margin impact ranges from about \$482,000 to approximately three times that value, depending upon assumptions about payor reimbursement policies. For hospitals that have already implemented a checklist process and are seeking to either ensure durability of the effect or to achieve a further, incremental, reduction in complication rates, the financial benefits are also substantial and support the business case for investing in OR-Dashboard.

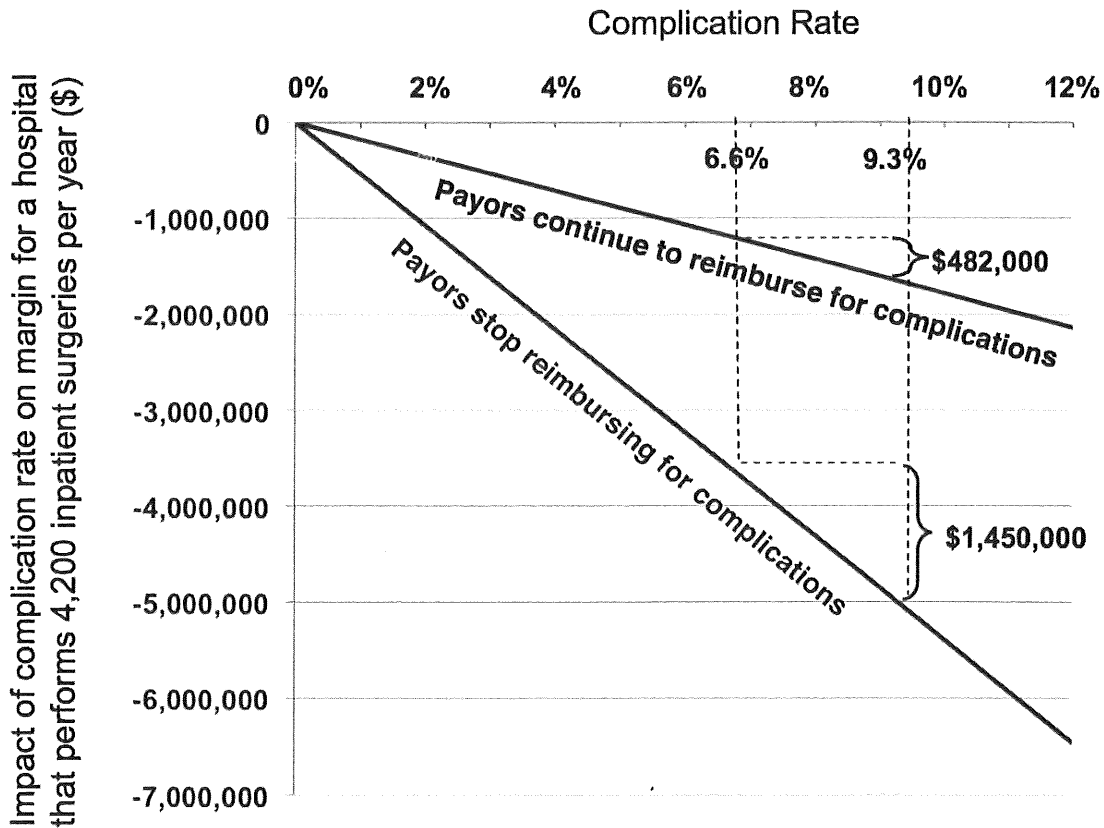
H. Appendices

Appendix 1 Complication Rate Scenarios

Figure A1 shows the decline in margin (in 2009 dollars) as a function of complication rate for an average six-room hospital, performing 4,200 inpatient cases annually. Two scenarios are presented: (a) the payors continue to reimburse for complications and (b) reimbursement for all complications is denied. The Figure also demonstrates how to estimate the financial benefit to the average hospital of reducing the complication rate.

Figure A1

Financial impact of complication rate on the annual profit margin of an average US hospital (6 ORs, 4,200 inpatient cases annually)



Figures A2 and A3 may be used to estimate the financial impact of reducing complications for hospitals with 6, 10, 20 and 30 ORs. Figure A2 is based on the assumption that payors continue to reimburse for complications, while Figure 4 is based on the assumption that they will not. As shown in Figure A2, a reduction in complication rates from 9.3% to 6.6% in a 20-OR hospital, results in a margin improvement of about \$1.6 million.

Figure A2

Financial impact (in 2009 dollars) of complications on a hospital's annual profit margin if payors continue to reimburse providers for complications

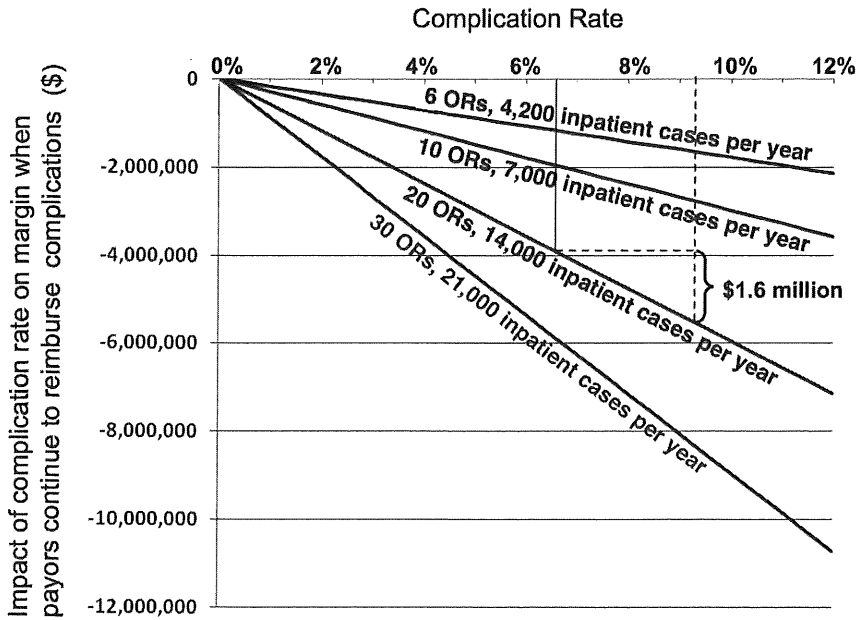
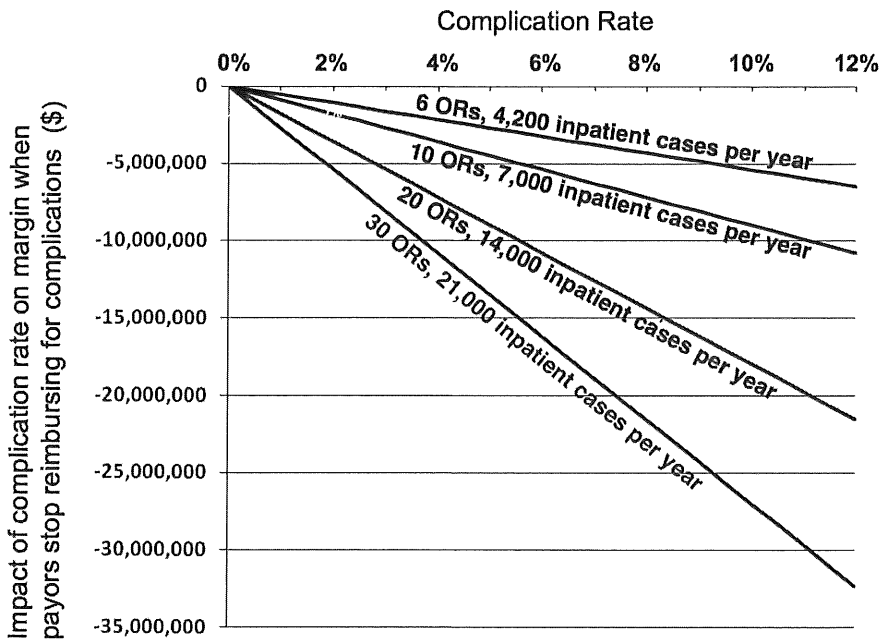


Figure A3

Financial impact (in 2009 dollars) of complications on a hospital's annual profit margin if payors stop reimbursing providers for complications



Appendix 2 Harvesting the financial benefits of reduced complication rates

The effect of a reduced complication rate on the hospital is more subtle: Some staff members will be less busy because the burden of caring for patients with complications will be reduced. However, if the hospital does not fill its beds with more patients without complications – and thus, patients with longer stays are not being replaced by more patients without complications – the hospital’s financial position will only improve by an amount equal to the costs of medication and other variable costs associated with complications. In such a case, the hospital committed to improving its financial position by reducing complications will need to develop plans for reassigning staff whose load has been lightened.

Table A1 illustrates the situation for the average hospital as the complication rate drops from 9.3% to 6.6% **and the hospital continues to perform 4,200 inpatient surgeries annually**. As the complication rate drops, total reimbursement falls by approximately \$1.0 million. However, unless staff levels are reduced, the hospital will not be able to harvest the full financial benefits because costs will drop only by an amount equal to the variable amount associated with complications.

Table A1

Consequences of reducing complication rates on the margin of an average hospital performing 4,200 inpatient surgeries per year (2009 dollars)

	Complication rate		Difference
	9.3% (Pre-checklist)	6.6% (Post-checklist)	
Revenue (\$ million)	105	104	-1
Cost (\$ million)	84	84 – VC	-VC
Margin (\$ million)	21	20 + VC	-1 + VC

And, thus, the calculated margin of \$482,000 (shown in Figure A1) will not be realized. Instead, as shown in Table A1, the margin will decrease. Fortunately, this situation can be remedied by increasing the number of surgeries by less than 1.5%, or about 1 additional case per week, to achieve the pre-checklist reimbursement level.

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 - ⁶ Details on the NSQIP protocol and the list of complications may be found at http://surgery.ucsd.edu/Portals/0/documents_chapter4.pdf, accessed June 18, 2009
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