A NEW VISION FOR CALIFORNIA'S HEALTHCARE SYSTEM:

Integrated Care with Aligned Financial Incentives

Appendix X. Healthcare-Associated Infections (Initiative Memorandum)

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See "Appendix IV: Introduction to Appendices V-XI" for brief background on this Appendix.

Executive Summary

Healthcare-associated infections (HAIs) are infections that patients develop during the course of receiving treatment for other conditions. HAIs are the most common complication of hospital care, occurring in approximately one in every 20 patients. Because almost all facilities in California already have a plan in place for preventing HAIs, this policy option would provide financial support to improve staff training and ensure the full implementation of these existing plans. Our model assumes an intervention to target five common HAIs: Central line-associated blood stream infection, methicillin-resistant Staphylococcus aureus, Clostridium difficile infection, vancomycin-resistant Enterococci and surgical site infection. Under the "Current Developments" scenario, we estimate a 22% decline in HAIs over 10 years, and then estimate the resulting reduction in healthcare expenditures. For the "Forum Vision" scenario, the decline in HAI rates is estimated to be 40% over 10 years.

The cumulative reduction in spending from 2013 to 2022 will be as high as $660 million in current-year dollars under the Forum Vision scenario, depending on the cost of the intervention. Under the mid-level assumption for the Forum Vision, there is about a $300 million reduction. Under the Current Developments scenario, there is a $190 million reduction when a lower intervention cost is assumed ($28.5 million). But the cost of the intervention exceeds the reduction in spending by $540 million when a higher intervention cost ($85.5 million) is considered.

The Underlying Situation

HAI infections are caused by a wide variety of bacteria, fungi and viruses. They can occur in hospitals or outpatient surgery centers, as well as in other healthcare facilities, such as community clinics or dialysis centers, along with long-term care facilities such as nursing homes and rehabilitation centers.[1]

One important recent development involving HAIs was the 2008 decision by Centers for Medicare and Medicaid Services (CMS) to stop paying for certain "preventable complications," including HAIs.[2] Many states, including California, are required to report HAIs occurring in hospitalized patients. California's public reporting law requires that all California general acute care hospitals report the incidence of HAIs to the California Department of Public Health (CDPH). Despite this law, public health authorities found in 2011 that facilities failed to report as many as a third of the infections that they should have.[3] Another study found that a majority of these hospitals failed to report HAI rates consistently.[4] Public health

[1] California Department of Public Health (2009-2010).
[2] Milstein (2009).
[3] California Department of Public Health (2012).
[4] Halpin, et al. (2011).

authorities attribute underreporting to confusion resulting from the complex instructions involving identifying which infections are caused by hospital practices.[5]

Current efforts in California to prevent HAIs include multiple initiatives to train infection prevention professionals, including a program to train HAI-focused epidemiologists and to implement an HAI Prevention Collaborative.[6] At the federal level, there are efforts to increase the use of the complex National Healthcare Safety Network (NHSN), which is a surveillance system managed by the Division of Healthcare Quality Promotion at the Centers for Disease Control and Prevention. In 2012, the Affordable Care Act provided funding for a program to train clinicians in targeting infections as a team, implementing prevention strategies through culture change, sharing experiences between facilities, measuring progress as a group and providing feedback to clinicians and staff.[7]

Previous Studies

Systematic review of the literature estimates the average U.S. costs for HAI, including human suffering, at between $28 billion and $45 billion per year.[8] The wide variation is a result of the different methods used in conducting the economic analyses. Different studies may use different patient populations and study settings; or track different infections; or include only hospitalization cost; or those costs as well as outpatient expenses. Previous studies suggest that in assessing the economic impact if HAIs, it is also important to consider patients' underlying severity of illness and comorbid conditions, as well as their length of stay in the hospital prior to acquiring the infection.

Studies examining the specific cost estimate attributable to HAIs have found HAIs to be extremely expensive, and that it would be beneficial for hospitals to invest in programs to successfully control them.[9] Previous studies have examined the effectiveness of preventing specific HAIs, such as methicillin-resistant Staphylococcus aureus (MRSA)[10] and central line-associated bloodstream infection (CLABSI).[11] They found that programs with surveillance, contact precautions and culture change were associated with a decrease in infections. The studies also highlighted the importance of adequately staffed HAI prevention and control programs.[12]

Proposed Initiative

We estimate the reduction in healthcare expenditures in California from a policy option to target the following five HAIs that are required to be reported:

[5] Jewett (2012).
[6] Centers for Disease Control and Prevention (2012).
[7] Ibid.
[8] Scott (2009).
[9] Anderson, et al. (2007); Muto, et al. (2002); Stone (2009).
[10] Jain, et al. (2011)..
[11] Goeschel, et al. (2008); Pronovost, et al. (2011).
[12] Marschall, et al. (2008).

- Central Line-Associated Bloodstream Infection (CLABSI)
- Methicillin-Resistant Staphylococcus Aureus (MRSA) Bloodstream Infection
- Vancomycin-Resistant Enterococci (VRE) Bloodstream Infection
- Clostridium Difficile Infection (C. difficile, C. diff, CDI, CDAD)
- Surgical Site Infection (SSI)

Each of these infections can be difficult to treat with conventional medicines and all of them cause significant morbidity and mortality. Because almost all hospitals in California already have departments of Infection Prevention and Control, this policy option would provide financial support to improve staff training and to ensure implementation of the interventions. Interventions will vary by facility, and clinicians should be actively involved in implementing infection control measures.[13] The funding would provide additional resource to support otherwise unaffordable prevention products, such as data mining programs, automated hand hygiene monitoring technology and UV light units for environmental disinfection. An intervention may also include the implementation of an auditing process to improve reporting and surveillance. For facilities that already have well-developed interventions, the funding could be applied to any areas that would aid with HAI prevention.[14]

Modeling Approach and Assumptions

Under the Current Developments scenario, we estimate an annual 2.5% reduction in healthcare expenditures for each participating hospital from reducing the five listed HAI infections. Under the Forum Vision, the assumption is for a 5% annual reduction.

We estimate that the reporting facilities cover 86% of all inpatient beds in California.[15] In 2010, CDPH reported that about 80% of facilities reported complete facility-wide data on CLABSIs, and 88% reported complete data on MRSA and VRE blood stream infections.[16] We assume that all of the reporting facilities would be willing to participate in implementing the interventions. We estimated the cost of these interventions from existing literature describing both general hygiene and training programs as well as more intense prevention strategies, such as data mining, UV light units, and culturing and isolating infected patients.

Because there are existing state funds for HAI prevention initiatives, our policy option would add to these resources. In 2012, for example, $670,000 was available to California through the Affordable Care Act.[17] We assume that the impact of the additional funding will vary by facility, given that some may have already implemented many of the prevention protocols or achieved lower infection rates.

[13] Goeschel, et al. (2008).
[14] Individual facilities will have discretion in how they use the funding, whether it be to expand existing programs or to buy surveillance technology to improve data collection.
[15] California Department of Public Health (2009-2010).
[16] California Department of Public Health (2012).
[17] Centers for Disease Control and Prevention (2012).

Number of affected patients

Table 1 shows the number of HAI cases, as reported by the CDPH.[18] For status quo numbers, we assume that without the intervention, there would be no reduction in the number infections by 2022.

For our model, we assume that all general acute care hospitals with more than 60 inpatient beds will implement an HAI prevention program, for a total of 370 facilities.[19]

Table 1. Number of HAI and Estimated Cost of Infection in California for One Reporting Year (2011)[20]

HAIs	Number of cases	Associated cost per infection[21]
CLABSI	3,163	$33,400[22]
MRSA	869	$9600[23]
CDI	13,968	$9200[24,25]
VRE	831	$33,500[26]
SSI[27]	1,395	$24,200[28]

Intervention Penetration Rates

The objectives of Healthy People 2020 include reducing CLABSI and MRSA infection by 70%.[29] After reviewing the feasibility of reducing HAIs in California, we set a goal for 2022 of reducing CLABSIs, MRSAs and three additional HAIs by 22% under the Current Developments scenario and by 40% for the Forum Visions scenario.

Intervention Cost

When we estimate the cost per facility, we considered the number of inpatient beds. We estimate that the average cost of the intervention for facilities with fewer than 200 beds will be half of what it would be for facilities with more than 200 beds.[30] We estimate that in California, there are 170 facilities with fewer than 200 beds and 200 facilities with more than 200 beds.[31] The lower cost estimate for the intervention is between $50,000 and $100,000, and the upper cost estimate is between $150,000 and $300,000.

[18] California Department of Public Health (2012).
[19] Extrapolated from the number of facilities reporting HAIs; California Department of Public Health (2011).
[20] Ibid.
[21] Associated costs were estimated from various sources and converted to 2012 dollars using the Consumer Price Index growth rate.
[22] Pronovost, et al. (2006); Warren, et al. (2006).
[23] From communications with the Infection Prevention and Control Quality and Safety Department at Kaiser Permanente. Cost estimates are based on published data for California.
[24] Scott (2009).
[25] From communications with the Infection Prevention and Control Quality and Safety Department at Kaiser Permanente. Cost estimates are based on published data for California.
[26] Muto, et al. (2002).
[27] Surgical site infections are reported for cardiac, gastrointestinal, and orthopedic procedures.
[28] Anderson, et al. (2007); Scott (2009).
[29] Healthy People 2020 (2011).
[30] A survey involving infection control cost showed that facilities with more than 220 beds spent, on average, twice as much as facilities with fewer than 220 beds; Anderson et al. (2007).
[31] Office of Statewide Health Planning & Development (2010-2011).

The cost of the intervention:
Lower cost: (170 facilities x $50,000) + (200 facilities x $100,000) = $28,500,000
Upper cost: (170 facilities x $150,000) + (200 facilities x $300,000) = $85,500,000

We assume that all facilities with more than 60 beds will implement the intervention and will have the associated intervention cost. We estimate that there are 370 acute care hospitals in California with more than 60 beds.[32] This is approximately equal to the number of California facilities that report HAIs.

Estimated Reduction in Expenditure

The status quo spending amount assumes that the number of HAIs will remain unchanged. The reduction in expenditure is estimated from the annual HAI reduction of 2.5% (Current Developments scenario) or 5% (Forum Vision scenario).

The cost estimates in Table 1 consider only the direct costs, and may underestimate the true cost of specific HAIs. The direct cost reflects the cost associated with increased length of hospital stay, but excludes other costs, such as the cost of readmission or costs involving rehabilitation or lost wages.

The lower bound estimates assume a higher cost of implementing an intervention ($85.5 million) and the upper bound estimates assume that the cost will be lower ($28.5 million). We project that these costs will grow at the per capita healthcare growth rate.

The reduction in expenditures is the status quo expenditures minus the sum of projected expenditures (under Current Developments or Forum Vision scenarios) and intervention cost (lower and upper bound estimates).

Estimated Impact

Table 2 shows that under the Current Developments scenario, the total reduction in spending will be $190 million in current-year dollars from 2013 to 2022 under the lower intervention cost assumption. The cost exceeds the reduction in spending by $540 million when a higher intervention cost is assumed in the lower bound estimate. In 2022, the cost of the intervention exceeds the reduction in spending under the lower bound assumption, resulting in an increase in spending of about $20 million. In the same year, the upper bound assumption shows that there is a reduction in spending of about $70 million.

Table 3 shows that under the Forum Vision scenario, the cumulative reduction in spending could be as much as $660 million from 2013 to 2022, which is about 0.02% of total state healthcare expenditures. This assumes the infection rate will be reduced by 5% annually. The lower bound Forum Vision estimate shows an increase in spending of about $70 million from 2013 to 2022. The mid-level assumption shows

[32] Ibid.

that the cumulative reduction in spending from 2013 to 2022 will be $300 million, or about 0.01% of total healthcare expenditures.

Estimated Healthcare Expenditure (2013-2022)

Table 2: Healthcare Expenditure Reduction Estimates Under the Current Developments Scenario, 2013-2022

	2013		2022		2013 - 2022		
	Lower	Upper	Lower	Upper	Lower	Mid	Upper
Status Quo Expenditures (billions)	$327.6		$572.2		$4,387.1		
Expenditure Reduction (billions)	-$0.08	-$0.02	-$0.02	$0.07	-$0.54	-$0.18	$0.19
Expenditure Reduction (%)	-0.02%	-0.01%	-0.004%	0.01%	-0.01%	-0.004%	0.004%

Table 3: Healthcare Expenditure Reduction Estimates Under the Forum Vision Scenario, 2013-2022

	2013		2022		2013 - 2022		
	Lower	Upper	Lower	Upper	Lower	Mid	Upper
Status Quo Expenditures (billions)	$327.6		$572.2		$4,387.1		
Expenditure Reduction (billions)	-$0.07	-$0.01	$0.07	$0.16	-$0.07	$0.30	$0.66
Expenditure Reduction (%)	-0.02%	-0.004%	0.01%	0.03%	-0.002%	0.01%	0.02%

Discussion

Experts suggest that HAI infection rates can be lowered by infection prevention and control policies and practices, such as assuring that staffing levels are adequate and staff members are well trained. Also important is effective hand hygiene and proper disinfection of medical devices. Better reporting and monitoring systems will also lower HAI infection rates.

Our estimates indicate that it is difficult to reduce healthcare spending via HAI prevention efforts because the intervention cost per facility may exceed the savings from reducing infections. It is important to note that our estimates include only costs associated with hospitalization. It is possible that a higher savings estimate would be attained if one also considered the costs associated with long-term medical expenses or with lost productivity.

There are several limitations to our estimates. First, the cost estimates of HAI infections come from studies that were conducted in limited settings, involving either a specific region or a single hospital, and may not necessarily reflect the conditions in California. Second, the cost of the intervention is an estimate extrapolated from a previous study that surveyed facilities about their HAI prevention efforts. We make an assumption that larger facilities will have higher intervention costs, but do not account for the facility-specific interventions that may already be in place. Lastly, there are other types of HAI infections not considered in our estimates that may also be lowered by the suggested interventions.

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References

Anderson, D. J., Kirkland, K. B., Kaye, K. S., Thacker, P. A., 2nd, Kanafani, Z. A., Auten, G., et al. (2007). Underresourced hospital infection control and prevention programs: penny wise, pound foolish? *Infect Control Hosp Epidemiol, 28*(7), 767-773.

California Department of Public Health. (2009-2010). CDPH Technical Report: Healthcare-Associated Bloodstream Infections in California Hospitals. (January 2009-March 2010). http://www.cdph.ca.gov/programs/hai/Documents/HAIReportSB-1058BSI-FINAL.pdf. Accessed on November 8, 2012.

California Department of Public Health. (2011). Key Findings and Public Health Actions: Methicillin-Resistant Staphylococcus Aureusand Vancomycin-Resistant Enterococci Bloodstream Infections in California Hospitals (January-December 2011).

California Department of Public Health. (2012). Healthcare Associated Infections (HAI) Program. http://www.cdph.ca.gov/programs/hai/Pages/HealthcareAssociatedInfections.aspx. Accessed on October 10, 2012.

Centers for Disease Control and Prevention. (2012). California Activities to Prevent Healthcare-associated Infections http://www.cdc.gov/HAI/stateplans/state-hai-plans/ca.html. Accessed on October 10, 2012.

Goeschel, C. A., & Pronovost, P. J. (2008). *Harnessing the Potential of Health Care Collaboratives: Lessons from the Keystone ICU Project.* In Advances in Patient Safety: New Directions and Alternative Approaches (Vol. 2: Culture and Redesign). Rockville (MD): Agency for Healthcare Research and Quality.

Halpin, H. A., Milstein, A., Shortell, S. M., Vanneman, M., & Rosenberg, J. (2011). Mandatory public reporting of hospital-acquired infection rates: a report from California. *Health Aff (Millwood), 30*(4), 723-729.

Healthy People 2020. (2011). Healthcare-Associated Infections. http://www.hhdw.org/cms/uploads/Data%20Source_%20Other%20Reports/HP2020/Healthcare_AssociatedInfections_Healthy%20People.pdf. Accessed on November 8, 2012.

Jain, R., Kralovic, S. M., Evans, M. E., Ambrose, M., Simbartl, L. A., Obrosky, D. S., et al. (2011). Veterans Affairs initiative to prevent methicillin-resistant Staphylococcus aureus infections. *N Engl J Med, 364*(15), 1419-1430.

Jewett, C. (2012). *California Watch Review: Hospital-Acquired Infections Went Unreported, August 10, 2012*. http://abclocal.go.com/kgo/story?section=news/state&id=8769412. Accessed on October 15, 2012.

Marschall, J., Mermel, L. A., Classen, D., Arias, K. M., Podgorny, K., & Anderson, D. J. (2008). Strategies to prevent central line-associated bloodstream infections in acute care hospitals. *Infection Control and Hospital Epidemiology , 29*(S1), S22-S30.

Milstein, A. (2009). Ending extra payment for "never events"--stronger incentives for patients' safety. *N Engl J Med, 360*(23), 2388-2390.

Muto, C. A., Giannetta, E. T., Durbin, L. J., Simonton, B. M., & Farr, B. M. (2002). Cost-effectiveness of perirectal surveillance cultures for controlling vancomycin-resistant Enterococcus. *Infect Control Hosp Epidemiol, 23*(8), 429-435.

Office of Statewide Health Planning & Development. (2010-2011). *Healthcare Information Division: Annual Financial Data*. http://www.oshpd.ca.gov/hid/Products/Hospitals/AnnFinanData/CmplteDataSet/index.asp. Accessed on October 15, 2012.

Pronovost, P., Needham, D., Berenholtz, S., Sinopoli, D., Chu, H., Cosgrove, S., et al. (2006). An intervention to decrease catheter-related bloodstream infections in the ICU. *N Engl J Med, 355*(26), 2725-2732.

Pronovost, P. J., Marsteller, J. A., & Goeschel, C. A. (2011). Preventing bloodstream infections: a measurable national success story in quality improvement. *Health Aff (Millwood), 30*(4), 628-634.

Scott, R. (2009). The direct medical costs of healthcare-associated infections in the US hospitals and the benefits of prevention. Atlanta, GA: Division of Healthcare Quality Promotion, National Center for Preparedness, Detection, and Control of Infectious Diseases, Coordinating Center for Infectious Diseases, CDC.

Stone, P. W. (2009). Economic burden of healthcare-associated infections: an American perspective. *Expert Rev Pharmacoecon Outcomes Res, 9*(5), 417-422.

Warren, D. K., Quadir, W. W., Hollenbeak, C. S., Elward, A. M., Cox, M. J., & Fraser, V. J. (2006). Attributable cost of catheter-associated bloodstream infections among intensive care patients in a nonteaching hospital. *Crit Care Med, 34*(8), 2084-2089.