The financials of hospital-acquired infections

What this means for your facility

Market research prepared by the Brookeside Group

PHILIPS

The statistics on hospital-acquired infections (HAIs) are astounding: while being treated at healthcare facilities, patients acquire an estimated 1.7 million infections, leading to 98,987 deaths per year every year.[1] These numbers have attracted attention and censure, leading to **legislation in twenty states mandating public reporting of infection rates.** The result is an environment in which hospitals are being increasingly judged, and their reputations affected, by their level of infection.

That's not all. Recent research is educating both healthcare professionals and an interested public on the staggering financial implications of HAIs. Consider the following (See Figure 1):

HAIs occur in 12.2 patients out of 1,000 admissions or 1.22% based on an extensive Pennsylvania Health Care Cost Containment Study written in November 2006.[5]

Figure 1

A single hospital-acquired infection causes:	For a 500-bed hospital with 150,000 admissions, this means annually:
• An average excess cost of $15,275[2]	• Excess costs totaling $27,953,250
• HAI cases are seen in 1.22% of admissions[5]	• 1830 total cases of HAI's
• 16.1 additional hospital days[3]	• 29,463 additional hospital days
• An unnecessary death in 10.6% of cases[4]	• 194 unnecessary deaths

* For more details on these calculations, please refer to the ROI calculator in Appendix A.

[1] Klevens, R. Monina and Jonathan R. Edwards. 'Estimating Health Care-Associated Infections and Deaths in U.S. Hospitals, 2002.' **CDC Public Health Reports.** March – April 2007. Volume 122. P 160-166.

[2] Roberts, Rebbeca R and R. Douglas Scott II. 'The Use of Economic Modeling to Determine the Hospital Costs Associated with Nosocomial Infections.' **Journal of Clinical Infectious Diseases.** 2003:36. P. 1424-1432.

[3] 'Hospital-acquired Infections in Pennsylvania.' **Pennsylvania Health Care Cost Containment Council.** November 2006. ***Number the result of Average Length of Stay in Days of HAI cases (20.6) minus the normal length of stay (4.5) for non HAI cases***

[4] 'Hospital-acquired Infections in Pennsylvania.' **Pennsylvania Health Care Cost Containment Council.** November 2006. ***Number the result of Average Mortality Rate of HAI cases (12.0) minus the normal mortality rate (2.4) for non HAI cases***

[5] "Hospital-acquired Infections in Pennsylvania Data Reporting Period: January 1, 2005 – December 31, 2005." **Pennsylvania Health Care Cost Containment Council** Nov 2006 11. 11/10/2007 <http://www.phc4.org/ reports/hai/05/>.

"I always think, if I have one infection, one hospital acquired infection, how many disposable leads could I have bought?" Betty Harris, ENS/CNS for Cardiac Surgery and Cardiopulmonary and Vascular Rehabilitation, University Health Systems of Eastern Carolina.

The excess cost of a HAI is the amount of treatment incurred due to the patient's acquired infection. It is true that hospitals do not currently pay all of the excess costs for a HAI. For example, in Pennsylvania insurance reimbursements amount to an average 26.7% of the excess costs, the hospitals incurring the loss for the rest. However, **in October 2008 Centers for Medicare and Medicaid (CMS) will stop paying for certain types of HAIs.**[6] In years to come the CMS list of non-payment HAIs will increase, as they are considering other items such as MRSA. It is generally expected that private insurers will follow suit and enact similar nonpayment regulations.

The future of reduced Medicare and Medicaid payments coupled with industry wide average profits of 5.2%[7] in 2004, means that hospitals will not only have increased need to control HAI costs – it will be vital to their survival.

A proven method of successfully reducing HAIs, while providing a positive return on investment, is through Philips' disposable lead-wire electrodes. Reusable ECG wires have been shown to be "an unappreciated reservoir" of multidrug-resistant nosocomial pathogens.[8] Furthermore, **the cost of disposable lead-wire electrodes will be covered by insurance**, since it is a disposable product used on one patient.

In a 500 bed hospital with 150,000 admissions per year, every $1 spent on disposable leads hospital-wide will return a $1.74 reduction in HAI costs, or an 74% ROI (Return on Investment). This assumes no insurance reimbursement for disposable leads. Furthermore, strategically implementing disposable leads in critical care units, like the ICU, which typically have higher infection rates, provides a 253% ROI. Please refer to Appendix A and B for this example ROI calculator.

To calculate ROI's for your facility, be sure to ask your local Philips Sales Representative for the ROI calculator in excel format.

[6] These include catheter-associated urinary tract infections, surgical site infections, ventilator associated pneumonia, and others.

[7] Appleby, Julie. "Hospitals' profit margin hits 6-year high in 2004." **USA TODAY.** January 5, 2006.

[8] Jancin, Bruce. "Antibiotic-Resistant Pathogens Found on 77% of ECG Lead Wires." **Cardiology News.** V2, N3, March 2004: P14.

"Often times leads are put on in the OR and the patient comes back to cardiac care with the same leads on. The blood from surgery gets down in the grooves, the little cracks, and there's no way to get all of the bacteria out – it harbors bacteria." Betty Harris.

Reusable lead cross contamination

Picture the chest of a surgical patient and imagine how many wires criss-cross with their ECG leads. The leads are laid over surgical wounds, IV wires, shaved areas (with a multitude of microscopic cuts), near catheters and intravenous tubes. Bacteria can easily enter the bloodstream and the body near these sites.

There is no exact percentage of HAIs that will be avoided by reusable leads, as every hospital is different. Different climates and patient demographics mean different diseases and rates are prevalent. However, there are two studies which provide reliable guidelines:

1. Dr. Paul Brookmeyer's study

Immediately before their planned reattachment to a patient, 77% of ECG leads were found to be contaminated with one or more antibiotic-resistant nosocomial pathogens, in a study by Dr. Brookmeyer of University of Wisconsin Hospital and Clinics, Madison. This includes 67% contaminated with MRSA (Methicillin-resistant staphylococcus Aureus) and 17% with VRE (Vancomycin-resistant Enterococcus).[9] At the 2004 annual Interscience Conference on Antimicrobial Agents and Chemotherapy, Dr. Brookmeyer stated:

"We believe our findings are representative of hospitals worldwide. Attachment of contaminated lead-wires to a new patient can result in colonization and ultimately in invasive infection by multiresistant nosocomial microorganisms…Moreover, the extent of bacterial contamination we found we suggest that lead-wires can also become contaminated by nosocomial viruses."[10]

2. Results of environmental cultures for VRE from patient rooms

After an outbreak of VRE in a burn unit in Texas, weekly environmental cultures were taken for 9 months. In total, 2,844 cultures were taken, and 338 were positive for VRE. The results are below[11] (See Figure 2):

Figure 2

Site	No. of cultures taken	No. of cultures positive	% of cultures taken that tested positive
Infusion pumps	73	19	26%
ECG leads	**68**	**18**	**26%**
Bed rails	175	33	19%
Shelves	48	9	19%
Overbed tables	179	32	18%
Bedside tables	187	31	17%
Pulse oximeters	176	24	14%
Stethoscopes	142	18	13%
Monitors	40	5	13%
Suction canisters	142	17	12%
Chairs	101	11	11%
Doors	202	22	11%
IV poles	190	19	10%
Oxygen flow meters	202	16	8%
Faucets	206	13	6%
Miscellaneous	90	13	14%
Total	**2,221**	**300**	**13.5%**

[9] Jancin, Bruce. "Antibiotic-Resistant Pathogens Found on 77% of ECG Lead Wires." **Cardiology News.** V2, N3, March 2004: P14.

[10] Jancin, Bruce. "Antibiotic-Resistant Pathogens Found on 77% of ECG Lead Wires." **Cardiology News.** March 2004. Vol 2. No 3.

[11] Falk, Pamela S., Janice Winnike, Carla Woodmansee, and M. Desai. "Outbreak of Vancomycin-Resistant Enterococci in a Burn Unit." **Infection Control and Hospital Epidemiology.** V21,N9 (2000): 575-582.

The VRE infection rate of 26% of ECG leads is in the range of Dr. Paul Brookmeyer's VRE infection rate of 17%. These cultures were solely for VRE, and one can assume that the infection rate would be higher if testing for all antibiotic-resistant diseases.

The 18 positive VRE ECG lead cultures referenced above represent 6% of the total 300 positive cultures. **Therefore, it is safe to assume that disposable ECG leads could reduce infections by as much as 6% (as it would eradicate the VRE transmission from lead-wires).** The reduction rate may be more, as 6% only encompasses VRE contaminations. To be conservative, the ROI calculator in Appendix A & B assumes a 6% reduction.

VRE Outbreak in Texas Burn Unit Linked to ECG Lead

In thirteen months between June 1996 and July 1997 twenty-one cases of VRE were identified in a burn intensive care unit (BICU) of an 800-bed university medical center in Galveston, Texas. After apparent eradication of VRE from the BICU, weekly surveillance and environmental cultures were instituted. For the five weeks between October 14 and November 18, 1996 all cultures were negative for VRE. However, "on November 18, during a routine weekly culture survey, an electrocardiogram (ECG) lead on a patient, from which cultures had not previously been taken, had a positive culture for VRE…The time from discharge of the last patient with a culture positive for VRE in the room until recovery of VRE from culture of the ECG lead was 38 days."[12] **The VRE bacteria had survived on the lead for 38 days and very well may have survived longer if it was not found.**

[12] Falk, Pamela S. and Janice Winnike. 'Outbreak of Vancomycin-Resistant Enterococci in a Burn Unit.' Journal of Infection Control and Hospital Epidemiology. September 2000. Vol. 21 No. 9. P575-582.

Philips' solution

The Philips' disposable lead-wire electrodes are an extremely effective method of reducing HAI cross-contamination between patients. The lead-wires come in 3- and 5-lead ECG monitoring capability. The solid-gel electrode technology has a 72 hour life expectancy and a 36 month shelf life (if pouch is unopened).

Versatile –

- Can be used for expanded applications within the hospital because of the radiolucent & metallic lead-wires
- The lead-wire is 39 inches (1 meter), allowing for a one size fits all adult patients
- Repositionable at least one time

Efficient –

- The electrodes are pre-attached to reduce clinician time
- The design allows for easy replacement of defunct lead-wires, not the whole lead set

Easy –

- Simple lead placement identification with AAMI & IEC color-coded wires
- No adapters necessary; plug leads directly into a Philips trunk cable
- Removable connector clip to prevent tangling of lead-wires

Utilizing Philips' disposable lead-wire electrodes and a 6% HAI reduction, an example of a 500-bed hospital with 150,000 yearly admissions would have the following results (See Figure 3):

For more details on this example, please refer to the ROI calculator in Appendix A & B.

Partial solution

Because of the potentially high cost of converting an entire facility to disposable lead-wire electrodes, many facilities are introducing disposable leads on a department by department basis, slowly integrating the technology into their facility. Strategically, there are critically important places to introduce disposable leads first, such as the ICU. Research has shown that "up to 45% of hospital-acquired infections occur in ICU patients, although these patients occupy only 8% of hospital beds."[13] This is a 6.86% infection rate instead of 1.22%. The ICU, and similar critical departments, are areas where a facility can reap high impact with a low investment cost.

Figure 3

	Hospital-wide		ICU only (8% of beds)	
	Reusable leads	Disposable leads	Reusable leads	Disposable leads
HAI infection rate	1.22%	1.15%*	6.86%	6.45%*
Annual cost of infections	$27,953,250	$26,723,866	$12,574,380	$12,021,359
Savings with disposable leads	$1,229,384		$553,021	
Investment	$705,425		$156,460	
ROI	74%		253%	

*94% of reusable lead HAI infection rate using a 6% HAI reduction with disposable leads

[13] Richards, Michael. "Epidemiology, Prevalence, and Sites of Infections in Intensive Care Units." **Seminars in Respiratory and Critical Care Medicine. 24(1):3-22, 2003.**

How to use the ROI calculator

For the hospital-wide calculator, attached in Appendix A, the steps to estimate the savings for a particular facility are:

1. Calculate the return

A) Since HAIs occur in 12.2 patients out of 1,000 admissions, the first step is to multiply your admissions (including inpatient and outpatient) by 1.22%. This is your total infections or cases in a given year.

B) Your total cases are then multiplied by the average excess cost of a HAI, or $15,275, to calculate the total excess costs.

C) The next factor is insurance reimbursements. According to 2004 Pennsylvania data, 180 hospitals billed insurance companies for $2.3 billion associated with HAIs, but only collected $614 million of that, or 26.70%. Therefore, the total attributable costs calculated will be reimbursed at a rate of 26.70%.[14] The hospital would have to cover the remainder of the costs incurred, or 73.30%. You should subtract 26.70% of your excess costs, to find the portion of costs that the hospital will incur.

D) Lastly, the loss to the hospital has to be multiplied by the percentage reduction in HAIs due to disposable lead-wires. Take the amount lost number from above and multiply by 6.00% to determine the return, or savings, you would obtain from disposable leads.

2. Calculate the investment

The investment is the cost of Philip's disposable lead-wire electrodes minus the new savings on reusable leads and electrodes (which will not be purchased). While the calculator only accounts for disposable lead cost, please note that disposable leads can be billed to insurance.

A) The disposable lead sets needed is based on the number of admissions to the hospital – including inpatient and outpatient. According to interviews, 70% of these patients will need monitoring.[15] The average selling price of a Philips' 5-lead disposable set is $7.88 (the metallic set is $7.36 and the radiolucent set is $8.40).

The number of admissions should be multiplied by the number of leads sets need per patient stay. Using an average patient stay, hospital-wide, of 2 days and a 3-day disposable lead life, each patient would need one lead set. This number is then multiplied by the 70% of patients that need monitoring, and then is finally multiplied by $7.88 to determine the total cost of disposable lead sets.

B) The savings you will experience is by not purchasing reusable leads and electrodes.

After speaking to a number of clinicians, the general thought was that reusable leads last 2 years. If 70% of beds have monitoring capabilities, this is 35% that get replaced every other year. The reusable lead cost savings is based off the number of beds which is multiplied by 35% to determine the reusable lead sets that would have been purchased yearly.

Once you determine the reusable lead sets purchased per year, multiply this by $73, the average Philip's selling price. This is your total reusable lead cost.

[14] Connolly, Ceci. "Infections Take Heavy Toll in Patients, Profits: Hospitals Urged to Boost Prevention." **Washington Post.** A03. March 29, 2006.

[15] Betty Harris, MSN, RN, ENS/CNS for Cardiac Surgery and Cardiopulmonary and Vascular Rehab, University Health Systems of Eastern Carolina

C) Next, calculate the cost of disposable electrodes used in reusable leads, which would not be purchased for disposable leads (these come pre-wired with electrodes). Using an average of 4 leads per set, multiply 4 by the number of patients requiring electrodes (which is equal to the number of disposable lead sets from earlier).

Next, multiply this by 2, the number of electrode replacements per average patient stay (assuming a 2-day average stay and electrode replacements every 24 hours). This will equal your total number of yearly electrodes.

Finally multiply by $0.13 per electrode to determine the total electrode cost.

D) To calculate the investment, subtract the total reusable lead cost and total electrode cost from the total disposable cost.

3. Calculate the ROI

A) Finally, the ROI is calculated by first subtracting your investment from your return.

B) Next, divide this number by your investment cost.

C) Third, multiply this number by 100 and this is your ROI percentage.

For the ICU calculator, attached in Appendix B, the steps to estimate the savings for implementing disposable leads in the ICU are:

1. Calculate the return

Follow the instructions for calculating the return from section 1 of page 7. The only difference is the infection rate – which is significantly higher in the ICU. 45% of HAIs occur in the ICU, which is only 8% of the beds. This is a 6.86% infection rate, instead of 1.22%.

If you are unsure of your exact number of ICU admissions, assume 8% of your yearly admissions.

2. Calculate the investment

Follow the instructions for calculating the return from section 2 of page 7. There are two differences:

- Instead of 70% of patients needing monitoring, assume 100% will need lead-wires
- Instead of a 2-day average patient stay, assume a 5-day average stay in the ICU

3. Calculate the ROI

Follow the instructions for calculating the ROI from section 3 of page 8.

Please be sure to ask your local Philips Sales Representative for a copy of the ROI calculator in excel format.

Appendix A

Hospital-wide infection rates

Customer inputs required

Return	
Cost of HAI	
Enter admission per year →	150,000
x Infection rate	1.22%
Total cases	1,830
x Average cost	$15,275
Total excess cost	$27,953,250
– Insurance reimbursement	
Total excess cost (from above)	$27,953,250
– % Reimbursed by insurance	26.70%
Amount lost by hospital	$20,489,732
Amount saved with disposable leads	
Amount lost by hospital (above)	$20,489,732
x % HAI's attributable to reusable ECG leads	6.00%
Total savings	$1,229,384
Return	**$1,229,384**

Average patient stay hospital-wide (in # of days) 2 days

Investment	
Disposable lead cost	
Enter admissions per year →	150,000
# of leads sets needed for avg patient stay (replace every 3 days)	1
x 100% patients needing monitoring	70%
Disposable lead sets needed	105,000
x Average price per lead set	$7.88
(A) Total disposable cost	$827,400
– Reusable lead cost	
Enter # of monitored beds →	500
Reusable lead life in years	2
ECG lead sets purchased each year	175
x Average price per reusable lead set	$73
(B) Total reusable lead cost	$12,775
– Disposable electrode cost	
Average type of lead sets used (3- or 5-lead)	4
x Patients requiring electrodes	105,000
x # of electrode replacements per patient stay (1 every 24 hours)	2
Total # of electrodes	840,000
x Cost of each electrode	$0.13
(C) Total electrode cost	$109,200
Investment (=A-B-C)	**$705,425**

ROI	
Return	
– Investment	
÷ Investment	
x 100%	
ROI→	**74%**

Partial solution (%of hospital areas for disposable leads) 100%

Appendix B

ICU infection rates

Customer inputs required

Return	
Cost of HAI	
Enter admission per year →	12,000
x Infection rate	6.86%
Total cases	823.20
x Average cost	$15,275
Total excess cost	$12,574,380
– Insurance reimbursement	
Total excess cost (from above)	$12,574,380
– % Reimbursed by insurance	26.70%
Amount lost by hospital	$9,217,021
Amount saved with disposable leads	
Amount lost by hospital (from above)	$9,217,021
x HAI's reduction	6.00%
Total savings	$553,021
Return	**$553,021**

Average patient stay in ICU (in # of days) 5

Investment	
Disposable lead cost	
Enter admissions per year →	12,000
# of leads sets needed for avg patient stay (replace every 3 days)	2
x 100% patients needing monitoring	100%
Disposable lead sets needed	24,000
x Average price per lead set	$7.88
(A) Total disposable cost	$189,120
– Reusable lead cost	
Enter # of monitored beds →	40
Reusable lead life in years	2
ECG lead sets purchased each year	20
x Average price per reusable lead set	$73
(B) Total reusable lead cost	$1,460
– Disposable electrode cost	
Average type of lead sets used (3- or 5-lead)	4
x Patients requiring electrodes	12,000
x # of electrode replacements per patient stay (1 every 24 hours)	5
Total # of electrodes	240,000
x Cost of each electrode	$0.13
(C) Total electrode cost	$31,200
Investment (=A-B-C)	**$156,460**

ROI	
Return	
– Investment	
÷ Investment	
x 100%	
ROI →	**253%**

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