Healthcare Quality Reporting Program

**HOSPITAL-ACQUIRED INFECTIONS AND PREVENTION ADVISORY SUBCOMMITTEE**

8:00-9:00am, 7/25/11
Department of Health, Room 401

| Goals/Objectives |
|---|
| ▪ To discuss HAI work to date and make policy recommendations for pending and upcoming reports |

**Members**

| | | | | | |
|---|---|---|---|---|---|
| T | Nicole Alexander, MD | T | Maureen Marsella, RN, BS | T | Janet Robinson, RN, Med, CIC |
| T | Rosa Baier, MPH | T | Linda McDonald, RN | T | Melinda Thomas |
| T | Utpala Bandy, MD | T | Leonard Mermel, DO, ScM | T | Georgette Uttley, MEd, BSN, RN |
| T | Margaret Cornell, MS, RN | T | Pat Mastors | G | Nancy Vallande, MSM, MT, CIC |
| G | Marlene Fishman, MPH, CIC | G | Robin Neale, MT (ASCP), SM,CIC | G | Cindy Vanner |
| G | Yongwen Jiang | T | Kathleen O'Connell, RN | T | Samara Viner-Brown, MS |
| T | Julie Jefferson, RN, MPH, CIC | G | Lee Ann Quinn, RN, BS, CIC | | |

| Time | Topic/Notes |
|---|---|

8:00am **Welcome & Administrative Updates**
*Leonard Mermel, DO, ScM*
*Samara Viner-Brown, MS*

- Len opened the meeting and reviewed today's objectives, which included reviewing the 5-day preview report for 2010-2011 employee flu vaccination.
- Previous meeting's action items:
  - **Share any recent NHSN benchmarks with Rachel or Rosa** (All) – Complete

    Rosa sent the 2009 National Healthcare Safety Network (NHSN) Report with today's agenda.
  - **Provide feedback on the MRSA CLABSI preview report** (Hospitals) – Complete

    The team incorporated hospital feedback into the final report.
  - **Update the MRSA CLABSI report based votes** (Rachel/Rosa) – Complete

    The program published the MRSA CLABSI report in May.
  - **Share *Partnership for Patients* videos** (Maureen) – Complete

    Maureen sent the link after the May Subcommittee meeting.
  - **Perform periodic reporting scans, as directed by the Subcommittee** (Rachel/Rosa) – Pending

    This is an ad hoc task, which will be performed and/or repeated as needed.

8:10am **Reporting Updates**
*Rachel Voss, MPH*
*Rosa Baier, MPH*

- CLABSI, MRSA CLABSI and C. Difficile data collection:
  - Ann sent the 4-week data submission reminder for all three reports, and plans to send the 2-week reminder today. Data are due 8/10.
  - For CLABSI, Rosa clarified that if a hospital is reporting CLABSI through the ICU Collaborative, they don't have to submit data via the SurveyMonkey link. For now, that link is solely for the PICU and NICUs. Margaret indicated that that Phase 3 of the ICU Collaborative ends on 8/31, but there is a 16-month transitional period for the database, ending on 12/31/2012. After that date, the Subcommittee can revisit data submission to determine whether to use the data submitted to Medicare for Hospital Compare.
- Employee influenza vaccination:
  - Rachel and Rosa distributed the 2010-2011 preview report to the Subcommittee, noting that this draft should not be disseminated until the preview period ends and the data are finalized. Ann will send the report to the preview period distribution list today for the 5-day preview today, with comments due at noon next Monday, 8/1.
  - The handouts included some summary statistics calculated by John Fulton, including vaccination rates by employee type and also reasons for declination. Interestingly, 21% of physicians, nurse practitioners and physician assistants indicated that they "think the vaccine makes them sick" – the highest proportion of any employee type.
  - Gina asked about trends in the results from last year to this year. Rosa indicated she would include descriptive statistics with the minutes:

    All healthcare workers:
    2009-2010 61.2% vaccinated
    2010-2011 68.3% vaccinated (+7.1%)

    Rosa will also attach a copy of the 2009-2010 report with the minutes, so that everyone can compare the data by employee type and hospital.
  - Len and Julie shared that flu vaccination is now mandatory at Lifespan hospitals; the full program will be phased in during this year and next flu season.

8:30am **Open Forum & Action Items**
*Rosa Baier, MPH*

- MDR-GNB (ESBL & CPE-producing Gram negative bacilli) issues:
  - Len shared what he learned about multi-drug resistant Gram-negative bacilli (MDR-GNB) at recent Geneva infection control conference. Basically, such pathogens are prevalent in some countries where they're found colonizing gastrointestinal tracts and found in environmental water samples, have already spread to several other countries, and may be difficult to detect by some current microbiologic methods (eg, so called NDM-1 first found in India). Because of this and reports of other MDR-GNB in the US, Len suggested that we begin thinking strategically about how to evaluate the current burden of MDR-GNB in RI and plan ahead (e.g., point-prevalence surveys of rectal swabs from patients in acute care and skilled nursing facilities).

- Stefan and Julie both commented that some MDR infections arise a decade or more before overseas before they appear in the U.S., with Stefan indicating this may be due, in part, to the ease of access antibiotics in some countries outside the U.S.
- Len's main suggestion was to determine the prevalence of such microbes in RI healthcare facilities. Maureen, Julie and Janet will coordinate next steps between the HAI Collaborative, ICP SNE group and epidemiologists at HEALTH.

- Nursing home HAI reporting and projects:
  - Stefan updated the Subcommittee on several nursing home-specific HAI efforts that are complementary or synergistic to the hospital efforts, including work with the East Side Laboratory to improve measurement and reporting and a project to measure antibiotic pressure, led by Aurora Pop-Vicas.
- HAI Collaborative:
  - Maureen provided an update on the HAI Collaborative, which meets tomorrow (7/26) at 2pm at Quality Partners.
  - The 2nd Learning Session is a half-day session scheduled for 9/27 in the auditorium at HEALTH and will focus on antibiotic stewardship. Dr. Rice, Chair of Medicine at Brown, will be the keynote speaker and will speak about the business case. Because space is limited to 100 attendees, pre-registration is required.
  - Margaret asked Subcommittee members to help ensure multi-disciplinary participation. Maureen sent the invite to the ICP SNE group, CEOs, CNOs, quality and others who attend her Hospital Workgroup Meetings. She will send the invite to Rosa to distribute with the minutes, so that everyone has a copy.
  - The group discussed the importance of making the business case, with Maureen and Margaret indicating that they planned to provide template materials for the hospitals to use. Gina and Julie also asked about recording the session to help spread the messaging to those unable to attend. Maureen and Margaret will explore logistics for making content available (particularly the business case).
  - Gina also indicated that HARI has provided hospitals with hospital-acquired condition (HAC) reports in advance of the CMS payment penalty. This data is available to the hospital CEOs and could help inform the business case. Gina will follow-up with individual Subcommittee members to share their hospital's data.
- **Action items**:
  - Send 2-week CLABSI, MRSA CLABSI & *C. Difficile* data submission reminder (Ann)
  - Include 2009-2010 flu vaccination summary statistics with the minutes (Rosa)
  - Attach a copy of the 2009-2010 flu vaccination report with the minutes (Rosa)
  - Coordinate next steps to evaluate Gram negative bacilli (Maureen/Julie/Janet)
  - Share the HAI Collaborative Learning Session invite (Maureen)
  - Explore ways to record the Learning Session (Maureen/Margaret)
  - Follow-up with Subcommittee members to share their hospital's data (Gina)
- Next meeting: 8/22/11

**PERCENTAGE OF HOSPITAL EMPLOYEES IMMUNIZED FOR INFLUENZA, 2010-2011**

| Function | Low (% rec'd) | High (% rec'd) | (N) | (%) | Hospital Employees |
|---|---|---|---|---|---|
| **CNAs** | 54% | 81% | 776 | 49% | RECEIVED seasonal influenza vaccine OFFERED BY THIS FACILITY |
| | | | 82 | 5% | RECEIVED seasonal influenza vaccine AT ANOTHER LOCATION |
| | | | 196 | 12% | DID NOT RECEIVE seasonal influenza vaccine |
| | | | 523 | 33% | UNKNOWN seasonal influenza vaccine status |
| | | | 1577 | 100% | Total engaged in direct patient contact 9/1/2010 - 4/30/2011 |
| **RN/LPNs** | 69% | 88% | 3867 | 63% | RECEIVED seasonal influenza vaccine OFFERED BY THIS FACILITY |
| | | | 359 | 6% | RECEIVED seasonal influenza vaccine AT ANOTHER LOCATION |
| | | | 579 | 9% | DID NOT RECEIVE seasonal influenza vaccine |
| | | | 1302 | 21% | UNKNOWN seasonal influenza vaccine status |
| | | | 6107 | 100% | Total engaged in direct patient contact 9/1/2010 - 4/30/2011 |
| **MDs &c** | 64% | 94% | 1795 | 62% | RECEIVED seasonal influenza vaccine OFFERED BY THIS FACILITY |
| | | | 67 | 2% | RECEIVED seasonal influenza vaccine AT ANOTHER LOCATION |
| | | | 115 | 4% | DID NOT RECEIVE seasonal influenza vaccine |
| | | | 924 | 32% | UNKNOWN seasonal influenza vaccine status |
| | | | 2901 | 100% | Total engaged in direct patient contact 9/1/2010 - 4/30/2011 |
| **Others** | 74% | 84% | 3104 | 67% | RECEIVED seasonal influenza vaccine OFFERED BY THIS FACILITY |
| | | | 331 | 7% | RECEIVED seasonal influenza vaccine AT ANOTHER LOCATION |
| | | | 653 | 14% | DID NOT RECEIVE seasonal influenza vaccine |
| | | | 526 | 11% | UNKNOWN seasonal influenza vaccine status |
| | | | 4614 | 100% | Total engaged in direct patient contact 9/1/2010 - 4/30/2011 |
| **All** | 68% | 87% | 9542 | 63% | RECEIVED seasonal influenza vaccine OFFERED BY THIS FACILITY |
| | | | 839 | 6% | RECEIVED seasonal influenza vaccine AT ANOTHER LOCATION |
| | | | 1543 | 10% | DID NOT RECEIVE seasonal influenza vaccine |
| | | | 3275 | 22% | UNKNOWN seasonal influenza vaccine status |
| | | | 15199 | 100% | Total engaged in direct patient contact 9/1/2010 - 4/30/2011 |

**REASONS HOSPITAL EMPLOYEES OFFERED FOR REFUSING INFLUENZA VACCINE, 2010-2011**

| | CNAs | RN/LPNs | MDs &c | Others | All |
|---|---|---|---|---|---|
| | (%) | (%) | (%) | (%) | **(%)** |
| Medical exemption | 3% | 6% | 7% | 4% | **5%** |
| Do not think they are at risk for flu or that patients are at risk of getting flu from them | 20% | 12% | 27% | 15% | **15%** |
| Do not want to put anything unnatural in their bodies | 11% | 14% | 2% | 16% | **14%** |
| Do not think the vaccine works | 8% | 10% | 14% | 8% | **9%** |
| Think the vaccine makes them sick | 18% | 12% | 21% | 17% | **15%** |
| All other reasons | 40% | 47% | 29% | 40% | **42%** |
| | 100% | 100% | 100% | 100% | **100%** |
| | (N) | (N) | (N) | (N) | **(N)** |
| Medical exemption | 6 | 35 | 8 | 33 | **82** |
| Do not think they are at risk for flu or that patients are at risk of getting flu from them | 42 | 73 | 33 | 107 | **255** |
| Do not want to put anything unnatural in their bodies | 23 | 89 | 3 | 121 | **236** |
| Do not think the vaccine works | 16 | 61 | 17 | 58 | **152** |
| Think the vaccine makes them sick | 38 | 73 | 26 | 122 | **259** |
| All other reasons | 82 | 288 | 35 | 296 | **701** |
| | 207 | 619 | 122 | 737 | **1685** |

**Public release date: 5-Jul-2011**
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Contact: Nancy Cawley Jean
njean@lifespan.org
Lifespan

# Not all tests are created equal: Identifying C. diff in hospital labs

***Study from Lifespan shows 50 percent more cases identified through molecular lab technology***

PROVIDENCE, R.I. – A study from the microbiology lab at the Lifespan hospitals has found that some lab tests are much more accurate in identifying *Clostridium difficile* Toxin (*C. diff*) infection (CDI), which causes diarrhea. The findings indicate that a molecular method detects up to 50 percent more cases of *C. diff* than other methods. While molecular technology is more expensive, it allows for more cases to be identified and assists in patient safety efforts within the hospital in terms of preventing hospital-acquired *C. diff* infections. The study is published online the July issue of the Journal of Molecular Diagnostics.

**IMAGE:** A study led by Kimberly Chapin, M.D., of the microbiology lab at the Lifespan hospitals has found that some lab tests are much more accurate in identifying Clostridium difficile Toxin...
Click here for more information.

*C. diff* is a bacterium that produces toxins that cause diarrhea. A 2009 article in the American Journal of Infection Control reported an estimated 13 in every 1,000 hospital inpatients had *C. diff* -- 20 times more than previous estimates. In Rhode Island, that number is estimated to be closer to 29 per 1,000 patients, and is among the highest in the country. In her paper, lead author Kimberle Chapin, M.D., director of the microbiology lab at Lifespan, reports that across the country, *C. diff* results in 9,000 hospital deaths each year, along with 3,000 post-discharge deaths and 16,500 deaths in nursing homes. To prevent the spread of *C. diff*, it is critical that it be identified and both appropriate treatment and proper infection control methods be implemented to prevent the spread to others.

In Chapin's study, she compared five different assays used in the laboratory for identifying *C. diff*. Her labs at Rhode Island Hospital/Hasbro Children's Hospital, The Miriam Hospital and Newport Hospital perform 15,000 *C. diff* assays each year. The study evaluated the results of molecular versus non-molecular tests. Chapin says, "The molecular methods we tested detected between 35 and 54 percent more patients who were positive for *C. diff* than the non-molecular methods."

Chapin says these findings bring up concerns in the number of unconfirmed cases of *C. diff* in hospitals that are not using molecular methods. "Through the use of molecular testing in our lab, combined with astute physicians and nurses requesting the tests, we were able to detect 50 percent more patients than we did prior to using molecular methods. Knowing the non-molecular tests did not find as many cases lead to patient safety concerns and the drive to implement the new method," she says.

The principle affiliation of Chapin is Lifespan, a health system in Rhode Island, and direct financial and infrastructure support for this project was received through the Lifespan Office of Research Administration. The researcher also has an academic appointment at The Warren Alpert Medical School of Brown University. Chapin's lab is fully supported by the Lifespan

health system.

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**About Lifespan**

Lifespan (www.lifespan.org) is a not-for-profit health care system based in Providence, R.I.. Formed in 1994, Lifespan includes three teaching hospitals of The Warren Alpert Medical School of Brown University: Rhode Island Hospital and its Hasbro Children's Hospital; The Miriam Hospital; and Bradley Hospital, the nation's first psychiatric hospital for children. Lifespan also includes Newport Hospital, a community-based hospital in Newport, RI. Lifespan hospitals are among the top recipients in the country of research funding from the National Institutes of Health. The hospitals received nearly $71 million in external research funding in fiscal 2009. All Lifespan-affiliated hospitals are charitable organizations that depend on support from the community to provide programs and services.

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ASIP 2011 JMD CME Program

*The Journal of Molecular Diagnostics, Vol. 13, No. 4, July 2011*
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*DOI: 10.1016/j.jmoldx.2011.03.004*

# Comparison of Five Assays for Detection of *Clostridium difficile* Toxin

Kimberle C. Chapin,*†‡ Roberta A. Dickenson,* Fongman Wu,* and Sarah B. Andrea*

*From the Departments of Pathology,* and Medicine,† Rhode Island Hospital, Providence; and Department of Medicine, Albert Brown Medical School,‡ Providence, Rhode Island*

**Performance characteristics of five assays for detection of *Clostridium difficile* toxin were compared using fresh stool samples from patients with *C. difficile* infection (CDI). Assays were performed simultaneously and according to the manufacturers' instructions. Patients were included in the study if they exhibited clinical symptoms consistent with CDI. Nonmolecular assays included glutamate dehydrogenase antigen tests, with positive findings followed by the Premier Toxin A and B Enzyme Immunoassay (GDH/EIA), and the C. Diff Quik Chek Complete test. Molecular assays (PCR) included the BD GeneOhm Cdiff Assay, the Xpert *C. difficile* test, and the ProGastro Cd assay. Specimens were considered true positive if results were positive in two or more assays. For each method, the Youden index was calculated and cost-effectiveness was analyzed. Of 81 patients evaluated, 26 (32.1%) were positive for CDI. Sensitivity of the BD GeneOhm Cdiff assay, the Xpert *C. difficile* test, the ProGastro Cd assay, C. Diff Quik Chek Complete test, and two-step GDH/EIA was 96.2%, 96.2%, 88.5%, 61.5%, and 42.3%, respectively. Specificity of the Xpert *C. difficile test* was 96.4%, and for the other four assays was 100%. Compared with nonmolecular methods, molecular methods detected 34.7% more positive specimens. Assessment of performance characteristics and cost-effectiveness demonstrated that the BD GeneOhm Cdiff assay yielded the best results. While costly, the Xpert *C. difficile* test required limited processing and yielded rapid results. Because of discordant results, specimen processing, and extraction equipment requirements, the ProGastro Cd assay was the least favored molecular assay. The GDH/EIA method lacked sufficient sensitivity to be recommended.** ***(J Mol Diagn 2011, 13:395–400; DOI: 10.1016/j.jmoldx.2011.03.004)***

*Clostridium difficile*, an anaerobic, spore-forming, gram-positive bacillus, has been associated with antibiotic-induced diarrhea since 1974 and with pseudomembranous colitis since 1978.[1,2] Toxigenic strains are responsible for *C. difficile* infection (CDI). Transmitted via the fecal-oral route, CDI has been historically associated primarily with antibiotic therapy, however, community-acquired CDI has been reported.[3,4] Symptoms include but are not limited to diarrhea, abdominal pain, and leukocytosis.[5–8] Age 65 years or older, immunosuppression, history of gastrointestinal disease, and recent antibiotic therapy have been associated with CDI.[3,5–8] Annually, there are 9000 deaths from hospital-acquired CDI, 3000 postdischarge deaths, and 16,500 deaths from CDI acquired in nursing homes (Overview of *Clostridium difficile* Infections; http://www.cdc.gov/HAI/organisms/cdiff/Cdiff_infect.html, last accessed April 2010). Methods currently in use for detection of *C. difficile* toxin include toxigenic culture, cytotoxicity assay, initial screening with glutamate dehydrogenase (GDH) antigen tests with positive screens followed by subsequent assays to detect toxins A and B, and most recently, molecular assays to detect the *tcdB* gene.[9–11]

The microbiology laboratory of the Lifespan network, which encompasses four hospitals in Rhode Island, performs 15,000 *C. difficile* assays per year. In this study, multiple assays were performed simultaneously using fresh stool specimens from patients who fulfilled the clinical criteria for CDI. Performance characteristics including the cost of each method were compared to determine the appropriate methods for use in each institution. The methods evaluated were the two-step algorithm currently used to detect *C. difficile* toxin [GDH testing followed by an enzyme immunoassay (EIA) for toxins A and B in GDH-positive specimens (GDH/EIA)] and four other assays including a combined GDH/toxin assay performed in a single cartridge and three molecular methods approved by the US Food and Drug Administration for detection of the *tcdB* gene. At Lifespan, the microbiology laboratory is mandated to provide *C. difficile* toxin results within 24 hours, seven days a week.

Accepted for publication March 9, 2011.

Preliminary results were presented at the 110th General Meeting of the American Society for Microbiology, San Diego, CA, May 2009 (Poster C-1094). Becton Dickinson and Co. provided poster printing and handouts.

CME Disclosure: Reagent kits for the BD GeneOhm Cdiff assay were provided by Becton, Dickinson and Co., and for the Xpert *C. difficile* test by Prodesse, Inc.

Address reprint requests to Kimberle C. Chapin, M.D., Rhode Island Hospital, APC 11, Rm 1166, 593 Eddy St, Providence, RI 02903. E-mail: Kchapin@lifespan.org.

## Materials and Methods

### Patients and Specimen Selection

From July 28, 2009, to August 28, 2009, consecutive liquid or soft stool specimens were obtained from hospitalized patients and transported refrigerated to the Lifespan network laboratory for detection of *C. difficile* toxin. Patient medical records were reviewed retrospectively. Inclusion criteria for entry into the study were the presence of one or more CDI-associated symptoms including diarrhea, abdominal pain, previous CDI infection, recent antibiotic therapy, leukocytosis, fever, loss of appetite, gastrointestinal tract bleeding, and nausea or vomiting.[5–8] Patients who tested positive for CDI less than 1 month before specimen collection were excluded. The study design was approved by the Lifespan Institutional Review Board (#2142–10).

### Assays

#### Nonmolecular Assays

All nonmolecular assays required visual interpretation of the results, and contained a positive control line.

The C. Diff Quik Chek test (TechLab, Inc., Blacksburg, VA), a membrane-bound lateral-flow immunoassay, was used to screen stool specimens for the presence of *C. difficile* GDH-specific antigens. Samples positive using the C. Diff Quik Check test underwent reflex testing using the Premier Toxin A and B Enzyme Immunoassay (Meridian Bioscience, Inc., Cincinnati, OH) to confirm the presence of *C. difficile* toxins A and B. For the second nonmolecular method, *C. difficile* GDH antigen and A and B toxins were simultaneously detected using antibodies specific to those antigens in a single cartridge (C. Diff Quik Chek Complete test; TechLab, Inc.).

#### Molecular Methods

The BD GeneOhm Cdiff Assay (Becton, Dickinson and Co., Franklin Lakes, NJ) was the first of three molecular methods assessed. If present in the stool, the *tcdB* gene was amplified using manual lysis and detected via a molecular beacon on emission of a fluorescent signal. Fluorescent emissions were monitored, and data were compiled using the SmartCycler II System (Cepheid, Sunnyvale, CA).

Testing using the second molecular method, Xpert *C. difficile test* (Cepheid, Sunnyvale, CA), was conducted using a self-contained cartridge that, along with the GeneXpert DX System (Cepheid), automated and integrated sample purification, nucleic acid amplification, and detection of the target sequence using RT-PCR for detection of the *tcdB* gene.

The final molecular assay assessed was the ProGastro Cd Assay (Prodesse, Inc., Waukesha, WI). After a manual process of stool clarification and nucleic acid extraction and purification using the NucliSENS easyMAG System (bioMérieux SA, Marcy l'Etoile, France), samples were added to the *C. difficile* master mix, which contained oligonucleotide primers and probes for the *tcdB* gene. PCR amplification and detection were performed using the SmartCycler II System (Cepheid).

### Specimen Processing

On arrival in the laboratory, stool specimens were refrigerated until tested. All five assays were performed within 24 hours. Specimens were fresh and not frozen before processing. Assays were performed simultaneously from fresh specimens to yield optimum results and enable valid comparisons between assays. All assays were performed according to the respective manufacturer's instructions.

### Laboratory Personnel

The C. Diff Quik Chek Complete test and subsequent EIAs were performed for clinical diagnostic purposes by the microbiology laboratory. After GDH/EIA was performed, two certified and licensed clinical laboratory scientists who specialize in molecular diagnostics (R.A.D. and F.W.) performed the C. Diff Quik Chek Complete test and all molecular methods.

### Invalid Results

In addition to definitive positive and negative results, all analyzed molecular assays had a third test interpretation, that is, invalid results. Methods of resolution for invalid specimens varied between molecular assays; however, all were specified in each manufacturer's package insert. Specimens that initially yielded an invalid test result were reanalyzed, following the manufacturer's recommendation, and final interpretation of the specimen was determined. The rate of invalid results for each assay was determined.

### Discrepant Analysis

Specimens with discrepant molecular results were frozen at −70°C after initial testing and sent to a reference laboratory for further testing. Discrepant samples underwent toxigenic culture. Culture-positive specimens were subsequently analyzed using PCR for both the *tcdC* gene and GDH, and with a toxin A and B enzyme-linked immunosorbent assay (ELISA). The reference laboratory labeled specimens positive according to results of ELISA, and both PCR targets as positive. Samples that were culture-positive, PCR positive for GDH but negative using ELISA toxin A and B, and PCR *tcdC*-negative were labeled nontoxigenic. The reference laboratory was blinded to the original individual PCR specimen results.

### Data Interpretation

Specimens were considered true positive when at least two of the three molecular methods detected the presence of the *tcdB* gene.

### Statistical Analysis

Fisher's exact test was performed to calculate the statistical significance of associated risk factors and sensitivity

and specificity for each assay using commercially available software (PRISM, version 5.00 for Windows; GraphPad Software Inc., San Diego, CA). The null hypothesis was rejected at $P < 0.05$ (two-sided). Matched sample tables and the Youden index, a single characteristic that captures the performance of a test, was applied to each molecular method to determine comparability, as previously described.[12] The Youden index was calculated as follows: (sensitivity + specificity) − 1. Method with the calculated Youden index closest to 1 exhibited comparatively superior performance.

### Cost-Effectiveness Analysis

Cost-effective analysis was performed as previously described using the formula: CE ratio = (Cost of molecular assay − Cost of nonmolecular assay) ÷ (Effect of molecular assay − Effect of nonmolecular assay).[13,14] Costs exclusive to the laboratory were included in the analysis. BD GeneOhm Cdiff assay cost was based on an all-inclusive reagent rental program. The BD GeneOhm Cdiff assay kit (48 tests) includes master mix for an additional 16 tests. Thus, unless a high number of invalid results was experienced (>30%), there was no additional cost for retesting of invalid results. Total cost for the Xpert *C. difficile* test included purchase of the instrument, service program, initial cartridges, and invalid retest cartridges. Cost of the ProGastro Cd assay included kits and service packages for both the easyMAG and SmartCycler II systems. Technologist time was not factored into this cost analysis. Marginal effect, the difference between molecular and nonmolecular assay effects, was defined as the difference between the Youden index values of the methods compared.[13]

## Results

### Patient Data

Of 89 patients who submitted specimens, 81 patients with symptoms compatible with CDI were included in the study. Their mean (median; range) age was 64.4 (71; 4 to 97) years, and 26 (32%) tested positive for CDI. Signs and symptoms of CDI in the patients evaluated are given in Table 1. The most common symptoms were diarrhea (69.1%), abdominal pain (63.0%), and leukocytosis (39.5%). Physicians requested testing for *C. difficile* toxins appropriately in 81 of 82 patients (98.8% of test requests), as determined by the presence of signs and symptoms consistent with CDI. Assessment for CDI in patients with known risk or symptoms resulted in detection of CDI 32.1% of the time. While leukocytosis was the only statistically significant independent symptom ($P$ = 0.02; relative risk, 3.3; 95% confidence interval, 1.3 to 8.5), leukocytosis in conjunction with abdominal pain was statistically significant ($P$ = 0.047; odds ratio, 3.2; 95% confidence interval, 1.1 to 9.1). CDI occurred in patients younger than 65 years; however, individuals 65 years or older exhibited a higher incidence of CDI (17 versus 9 cases, respectively). However, there was no statistical difference between the two age groups.

**Table 1.** Signs and Symptoms in Population Analyzed

| Variable | Patients No. (%) | CDI-Positive No. (%) |
|---|---|---|
| Symptom | | |
| Diarrhea | 56 (69.1) | 16 (61.5) |
| Abdominal pain | 51 (63) | 17 (65.4) |
| Leukocytosis* | 32 (39.5) | 15 (57.7) |
| Nausea | 24 (29.6) | 10 (38.5) |
| Loss of appetite | 21 (25.9) | 4 (15.4) |
| Vomiting | 16 (19.8) | 8 (30.8) |
| GI bleeding | 12 (14.8) | 4 (15.4) |
| Fever | 11 (22.2) | 4 (15.4) |
| Previous CDI | 5 (6.2) | 3 (11.5) |
| Associated risk | | |
| Female sex | 34 (42.0) | 12 (46.2) |
| Age ≥65 years | 46 (56.8) | 17 (65.4) |
| History of colitis, IBS, or other GI disorder | 29 (35.8) | 10 (38.5) |
| Previous antibiotic therapy | 23 (28.4) | 7 (26.9) |
| Immunocompromise | 19 (23.5) | 5 (19.2) |
| Nursing home | 9 (11.1) | 4 (15.4) |

*Defined as >10 WBC per cubic millimeter. $P$ = 0.02; relative risk, 3.3; 95% confidence interval, 1.3 to 8.5. No other symptoms were significant.
CDI, *C. difficile* infection; GI, gastrointestinal tract; IBS, irritable bowel syndrome.

### Performance Data

Performance data for each assay after invalid results and discrepant analysis testing was performed are given in Table 2. Sensitivity of the BD GeneOhm Cdiff assay, Xpert *C. difficile* test, ProGastro Cd assay, C. Diff Quik Chek Complete test, and two-step GDH/EIA were 96.2%, 96.2%, 88.5%, 61.5%, and 42.3%, respectively. Specificity of the Xpert *C. difficile* test was 96.4%, and for all other methods was 100%.

### Invalid Results

Tests with results initially determined as invalid were repeated per the manufacturer's instructions. The rates of invalid results for the BD GeneOhm Cdiff assay, Xpert C difficile test, and ProGastro Cd assay were 4.0%, 1.1%, and 0%, respectively. Repeat testing of all specimens with initially invalid results yielded a definitive negative result.

### Discrepant Results

Of the 81 stool specimens tested, six were considered discordant between molecular methods. Two of two specimens positive using the BD GeneOhm Cdiff assay and Xpert *C. difficile* test but negative using the ProGastro Cd assay were resolved as true positive. One of three specimens positive using only the Xpert *C. difficile* test was resolved as true positive. One of one specimen positive using only the ProGastro Cd assay was resolved as true positive.

### Cost-Effectiveness Analysis

Results of cost-effectiveness analysis for each assay evaluated are given in Table 3.

**Table 2.** Comparison of Methods for Detection of CDI in Patients with Symptoms

| Diagnostic method | No. true positive | No. false positive | No. false negative | No. true negative | Invalid results*, % | Sensitivity† | | Specificity | | Predictive value, % | | Youden index, % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | % | 95% CI | % | 95% CI | Positive | Negative | |
| GeneOhm Cdiff assay | 25 | 0 | 1 | 55 | 4.0 | 96.2 | 88.0–96.2 | 100 | 96.1 to 100 | 100 | 98.2 | 96.2 |
| Xpert *C. difficile* test | 25 | 2 | 1 | 53 | 1.1 | 96.2 | 86.0–99.2 | 96.4 | 91.6 to 97.8 | 92.6 | 98.1 | 92.5 |
| ProGastro Cd assay | 23 | 0 | 3 | 55 | 0 | 88.5 | 79.3–88.5 | 100 | 95.6 to 100 | 100 | 94.8 | 88.5 |
| Quik Chek Complete‡ | 16 | 0 | 10 | 55 | NA | 61.5 | 51.4–61.5 | 100 | 95.2 to 100 | 100 | 84.6 | 61.5 |
| GDH/EIA§ | 11 | 0 | 15 | 55 | NA | 42.3 | 32.4–42.3 | 100 | 95.3 to 100 | 100 | 78.6 | 57.7 |

Eighty-one specimens were analyzed using all methods.
*Xpert demonstrated an additional 5.5% "error rate." At repeat testing, 100% of invalid specimens and errors for both GeneOhm and Xpert were resolved and provided definitive results, which are included in the total.
†$P < 0.03$ for all molecular methods versus nonmolecular methods; Quik Chek Complete versus GDH/EIA was not significant.
‡GDH component was 96.2% sensitive and 81.8% specific.
§GDH component was 96.2% sensitive and 76.4% specific.
CDI, *C. difficile* infection; GI, gastrointestinal tract; IBS, irritable bowel syndrome.

## Discussion

This is the first study to evaluate simultaneously three Food and Drug Administration–approved molecular methods, the Xpert *C. difficile* test, the BD GeneOhm Cdiff assay, and the ProGastro Cd assay. Compared with nonmolecular methods, these assays detected 35% to 54% more specimens positive for *C. difficile*. The better performance of molecular versus nonmolecular methods was significant at $P < 0.03$ for all methods evaluated. This is consistent with previous studies that suggested that single independent molecular methods are 8.5% to 51.3% more sensitive than nonmolecular methods.[9,10,15–18] However, the data presented herein are in contrast to those of other investigators, who have demonstrated high sensitivity with GDH screening (90% to 100%).[19–21] The differences in GDH sensitivity in these studies relative to molecular assay performance could be due to geographic and genetically varied strains, timeliness of testing, sample condition, and inclusion of patients who recently tested positive. The present study eliminated potential bias related to testing timeliness, duplicate specimens, and patients who previously tested positive.

When comparing all assays using their calculated Youden index values, the BD GeneOhm Cdiff assay was the most efficient (96.2%), followed by the Xpert *C. difficile* test (92.5%), the ProGastro Cd assay (88.5%), the C. Diff Quik Chek Complete test (61.5%), and the GDH/EIA two-step algorithm (57.7%). Whereas molecular assays were similarly efficient, a significant difference in cost-effectiveness was observed due to great variance in associated laboratory costs.

Although the sample size was not sufficient to support statistical analysis for noninferiority, the results produced using the molecular methods were comparable. In our laboratory, the BD GeneOhm Cdiff assay demonstrated superior performance and cost-effectiveness when compared with both the Xpert *C. difficile* test and the ProGastro Cd assay. Invalid results occurred more often on initial testing with the BD GeneOhm Cdiff assay (4.0%); however, repeat testing of invalid results could be performed during the same shift from the frozen specimen lysate with no additional cost because each kit contained master mix overage of 33%. Repeat testing provided results 100% of the time, and all results were available within the required 24-hour turnaround time. Compared with the Xpert *C. difficile* test, the BD GeneOhm Cdiff assay required additional hands-on extraction and setup; however, it was also considerably less expensive. In addition, cost-effectiveness analysis revealed that despite the increased cost of the molecular assay, greater savings were attained with the BD GeneOhm Cdiff assay compared with the C. Diff Quik Chek Complete test and the two-step GDH/EIA method because of greatly enhanced performance. Testing the batch once a day worked well at our high-volume site because of less hands-on time; however, this benefit may not be realized in a laboratory with a smaller volume.

Turnaround time for the Xpert *C. difficile* test was quick, approximately 50 minutes, and the processing procedure was limited. However, the laboratory cost for reagents was twice that for the other molecular assays. In addition, the

**Table 3.** Yearly Cost-Effectiveness of Methods

| Diagnostic method | Total cost, $ | Effect, %* | CE ratio versus GDH/EIA |
|---|---|---|---|
| BD GeneOhm Cdiff assay | 367,650.00† | 96.2 | $5894.81 |
| Xpert *C. difficile* test | 649,662.50‡ | 92.5 | $14,625.36 |
| ProGastro Cd assay | 456,004.20§ | 88.5 | $10,237.15 |
| C.Diff Quik Chek Complete test | 175,950.00 | 61.5 | $9276.32 |
| GDH/EIA | 140,700.00 | 57.7 | NA |

Assuming 15,000 assays are performed in 1 year.
*For this analysis, effect was defined as the Youden index.
†All-inclusive reagent rental program. No additional charge for invalid retesting. Includes cost of SmartCycler II System.
‡Includes purchase of instrument, service program, initial cartridges, and invalid retest cartridges.
§Includes purchase of easyMag, SmartCycler II System, service packages, and kits.
CE, cost-effectiveness; EIA, toxins A and B enzyme immunoassay; GDH, glutamate dehydrogenase; NA, not applicable.

hands-on time at our large-volume site would have required a dedicated technologist to perform testing throughout the day, with the 16-bay instrument available. The rate of invalid results was1.1%, and the error rate was 5.5%, secondary to syringe pressure and probe check errors. Careful attention to modules with repeated errors is necessary to differentiate between specimen issues or module malfunction. Of all specimens, 6.6% were determined to be invalid or erroneous. Repeated testing was successful 100% of the time; however, the cost of the test doubled because a new cartridge was necessary for each test.

The ProGastro Cd assay was the least favored of the three molecular assays for the following reasons. According to the Food and Drug Administration–approved product package insert, stool specimens must be kept on ice during processing, and an easyMAG extraction instrument (bioMérieux SA) must be used for specimen processing. While many laboratories have this equipment, the coordination of workflow with other molecular assays that require use of this extraction instrument could be a factor in high-volume sites. In addition, this assay produced the greatest number of discordant results.

Compared with the molecular assays evaluated, both the antigenic C. Diff Quik Chek Complete test and the two-step GDH/EIA assay performed poorly. However, testing using nonmolecular assays may be the only option in certain settings, and has performed adequately as a two-step algorithm with GDH antigen as the preliminary test followed by either PCR or the C. Diff Quik Chek Complete test.[15,18,19,21] Because the C. Diff Quik Chek Complete test detected nearly 20% more specimens correctly in this evaluation, as well as having both the GDH and toxin assay performed simultaneously, this assay is preferred over the two-step GDH/EIA method. Because of the potential severity of CDI and the implications for infection control, institutions that provide nonmolecular test results should alert physicians to performance characteristics of nonmolecular assays and the continued need to consider treatment in patients in whom there is high suspicion of CDI positivity despite negative test results.

While only laboratory costs were considered in this analysis, a turnaround time of results more than once a day may have a positive effect on nursing and housekeeping issues related to patient care, initial placement, transfer, and discharge, and a more rapid test would be appropriate in some settings such as institutions with shared rooms or a limited number of available beds.[22–25] However, more rapid laboratory turnaround time does not always indicate rapid physician response. Delays in reviewing test results are common,[26] and delayed response is consistent with findings at our institution when traditional methods were replaced with more rapid procedures.[27] To realize the full benefit of rapid molecular techniques, variables other than laboratory turnaround time and physician response are critical to cost-effective implementation.

Based on our large test volume and mandated daily toxin reporting, the BD GeneOhm Cdiff assay was selected for use in operations performed on Monday through Friday, when manual processing and testing can be done within an 8-hour shift. The Xpert *C. difficile* test was chosen for late Friday afternoon and weekend processing to enable maximum workflow efficiency with limited personnel on weekend shifts while still being able to address the daily toxin result turnaround time requirement. The molecular methods selected for use in the Lifespan laboratory yielded a statistically higher number of positive CDI results. In addition, and important for purposes of instituting the new molecular test, the BD GeneOhm Cdiff assay was more cost-effective than the previously used GDH/EIA method.

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# National Healthcare Safety Network (NHSN) Report, Data Summary for 2009, Device-associated Module

Dudeck MA, Horan TC, Peterson KD, Bridson KA, Morrell GC, Pollock DA, Edwards JR

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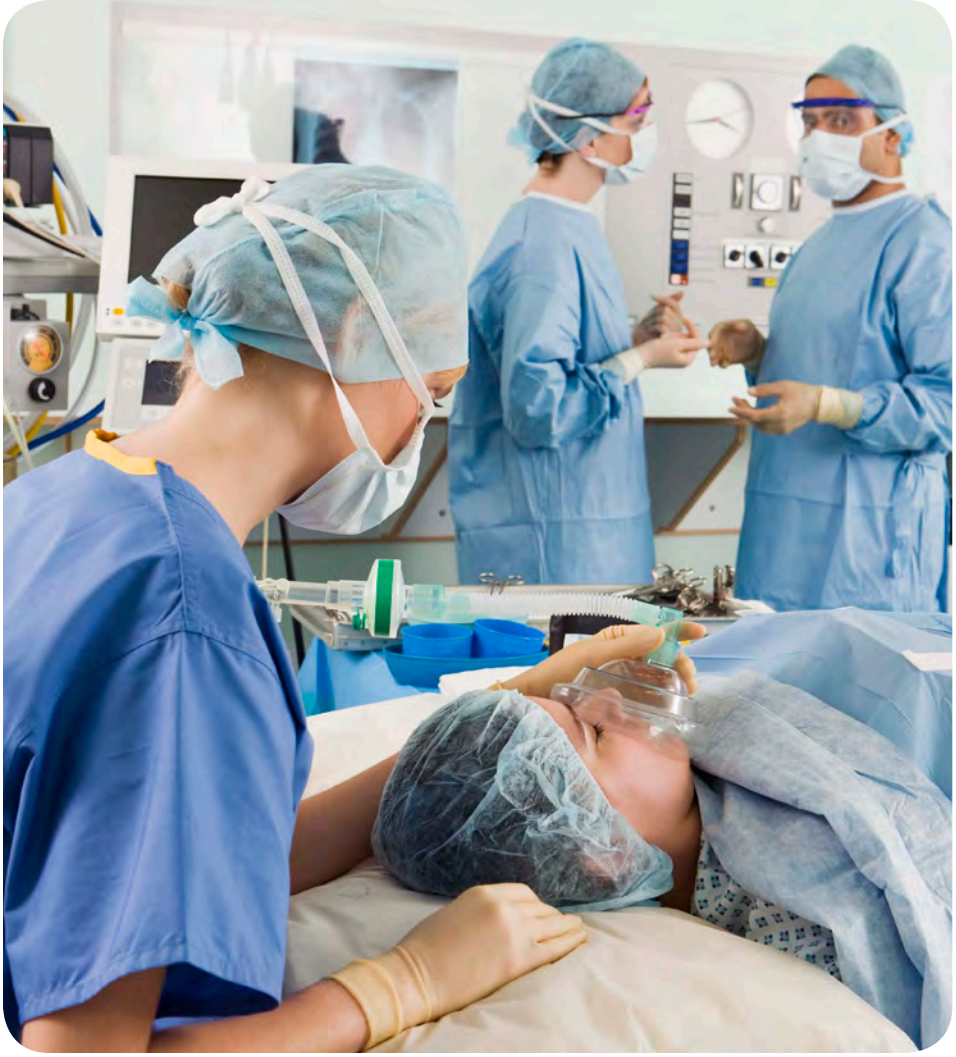
National Center for Emerging and Zoonotic Infectious Diseases
Division of Healthcare Quality Promotion

# Background

This report is a summary of Device-associated Module data collected by hospitals participating in the National Healthcare Safety Network (NHSN) for events occurring from January through December 2009 and reported to the Centers for Disease Control and Prevention (CDC) by October 18, 2010. This report updates previously published Device-associated Module data from NHSN and provides contemporary comparative rates.[1] Procedure-associated module data will be reported separately: surgical site infection (SSI) data will be reported as standardized infection ratios utilizing new logistic regression models; post-procedure pneumonia rates for 2009 are available on the NHSN public website. This report complements other NHSN reports, including national and state-specific standardized infection ratios (SIRs) for select healthcare-associated infections (HAIs).[2,3,4]

NHSN was established in 2005 to integrate and supersede three legacy surveillance systems at CDC: the National Nosocomial Infections Surveillance system, the Dialysis Surveillance Network (DSN), and the National Surveillance System for Healthcare Workers (NaSH). NHSN data collection, reporting, and analysis are organized into three components: Patient Safety, Healthcare Personnel Safety, and Biovigilance, and use standardized methods and definitions in accordance with specific module protocols.[5,6,7] The modules may be used singly or simultaneously, but once selected, they must be used for a minimum of one calendar month. All infections are categorized using standard CDC definitions that include laboratory and clinical criteria.[7] The Device-associated (DA) Module may be used by facilities other than hospitals, including long-term care facilities and outpatient dialysis centers. A report of data from this module for outpatient dialysis centers was published separately.[8] For this report, only data from the Patient Safety component will be presented. NHSN facilities report their healthcare-associated infection (HAI) surveillance data voluntarily or in response to state mandatory reporting requirements. CDC aggregates these data into a single national database for the stated purposes in place in 2009, which were to:



- Collect data from a sample of healthcare facilities in the United States to permit valid estimation of the magnitude of adverse events among patients and healthcare personnel.
- Collect data from a sample of healthcare facilities in the United States to permit valid estimation of the adherence to practices known to be associated with prevention of these adverse events.
- Analyze and report collected data to permit recognition of trends.
- Provide facilities with risk-adjusted metrics that can be used for inter-facility comparisons and local quality improvement activities.
- Assist facilities in developing surveillance and analysis methods that permit timely recognition of patient and healthcare worker safety problems and prompt intervention with appropriate measures.
- Conduct collaborative research studies with NHSN member facilities (e.g., describe the epidemiology of emerging healthcare-associated infection [HAI] and pathogens, assess the importance of potential risk factors, further characterize HAI pathogens and their mechanisms of resistance, and evaluate alternative surveillance and prevention strategies).

Identity of all NHSN facilities is kept confidential by CDC in accordance with sections 304, 306, and 308(d) of the Public Health Service Act (42 USC 242b, 242K, and 242m(d)).

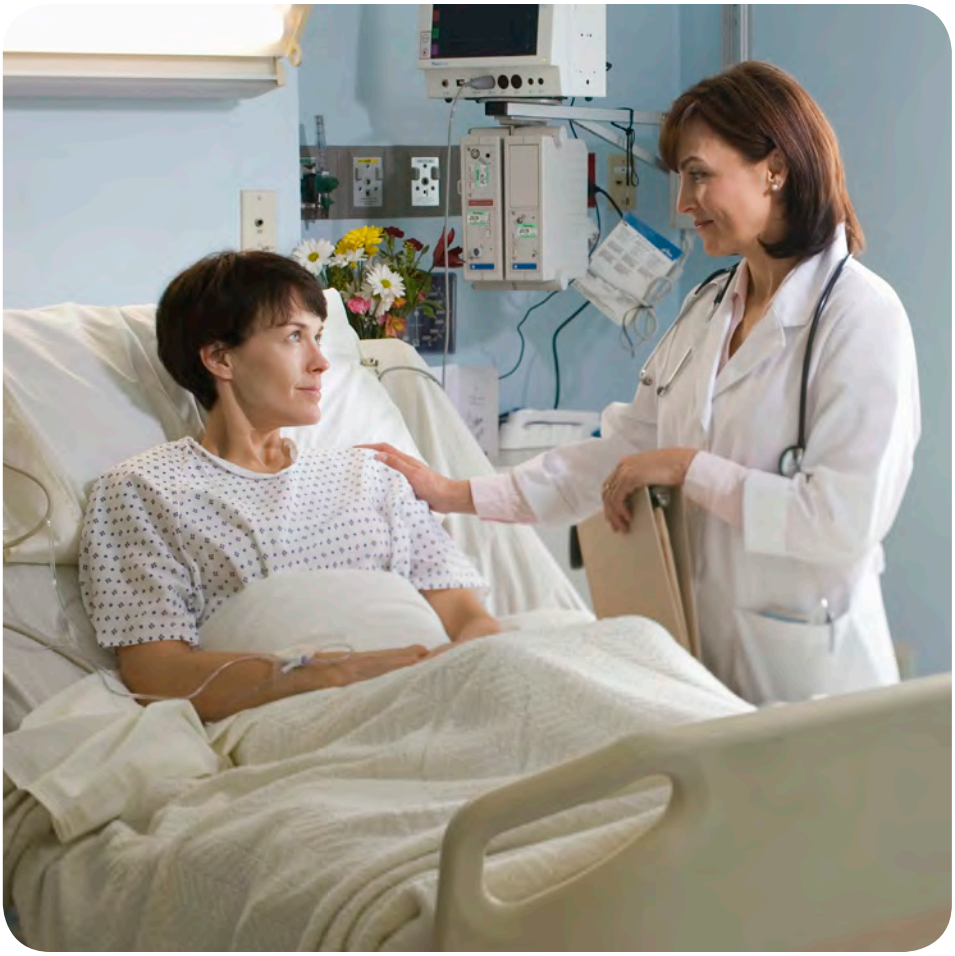
# Methods

## *Data Collection Methods*

Healthcare facility personnel responsible for infection prevention and patient safety may choose, with consideration of state mandates and prevention initiatives, to collect data on central line-associated primary bloodstream infections (BSIs), ventilator-associated pneumonias, or urinary catheter-associated urinary tract infections (UTIs) that occur in patients staying in a patient care location such as a critical care or intensive care unit (ICU), specialty care area (SCA), or ward. In NHSN, these locations are further characterized according to patient population: adults, children, or infants (in tables, pediatric and nursery locations are so noted). In neonatal intensive care unit (NICU) locations (level III or level II/III), IPs collect data on central line-associated and umbilical catheter-associated primary bloodstream infections or ventilator-associated pneumonia for each of five birth-weight categories (≤750 g, 751–1000 g, 1001–1500 g, 1501–2500 g, and >2500 g); data on catheter-associated urinary tract infections are not collected in any neonatal location. Corresponding location-specific denominator data consisting of patient-days and specific device-days are also collected by IPs or other trained personnel.

Four new locations — acute stroke ward, orthopedic trauma ward, pediatric rehabilitation ward, and pulmonary ward — had sufficient data to be included in this report.

Locations were further stratified by bedsize or teaching status if pooled mean rates and percentile distributions significantly differed between two groups. The data for adult combined medical/surgical ICUs were split into two groups by type of hospital: "major teaching" and "all others." Facilities self-identified teaching status through an annual facility survey. Major teaching status was defined as a hospital that is an important part of the medical school teaching program in which the majority of medical students rotate through multiple clinical services. The "all others" group of adult combined medical/surgical ICUs were further split into two groups by unit bed size: "<= 15 beds" and "> 15 beds." The data for adult medical ICUs were split into two groups by type of hospital as defined above. We assessed the potential impact of teaching status on DA infection rates and distributions for additional critical care and inpatient ward locations and found no consistent significant differences between "major teaching" status and "all other".



In non-NICU locations, the device-days consisted of the total number of central line-days, urinary catheter-days, or ventilator-days. In NICU locations, the device-days consisted of the total number of central line-days and umbilical catheter-days, or ventilator days for each birth weight category. Device utilization (DU) of a location is one measure of invasive practices in that location and constitutes an extrinsic risk factor for healthcare-associated infection.[9] DU may also serve as a marker for severity of illness of patients, that is, patients' intrinsic susceptibility to infection.

## *Data Reporting Methods*

The pooled mean infection rates and DU ratios required data from at least 5 different reporting units of a given location type. For the percentile distributions, data from at least 20 different locations were required, excluding rates or DU ratios for locations that did not report at least 50 device-days or patient-days. Because of this, the number of locations contributing data may vary among the tables.

## *Results*

Among the 2449 facilities eligible to report to NHSN at the end of 2009, 1942 had filed monthly reporting plans signaling their intent to follow one or more of the Patient Safety Component modules for at least one month and 1749 hospitals had reported at least denominator data for some patient cohorts under surveillance during 2009. These 1749 hospitals are located in 49 states and the District of Columbia and are predominantly general acute care hospitals (Table 1); approximately

two-thirds were smaller hospitals of 200 beds or less (63.6), and only 16% were categorized as major teaching facilities (Table 2). Additionally, 77% of the hospitals included in this report are located in states with a mandate for reporting DA module data to NHSN. Where data volume was sufficient for this report, we tabulated device-associated infection rates and DU ratios for January through December 2009 (Tables 3–12). Data on select attributes of the device-associated infections are provided in Tables 13–20.

Tables 3–6 update and augment previously published device-associated rates and DU ratios by type of non-NICU locations.[1] The UTI definition was revised in January 2009. This revision included an update to the symptomatic urinary tract infection (SUTI) criterion, the removal of asymptomatic bacteriuria (ASB), and the addition of asymptomatic bacteremic urinary tract infection (ABUTI).[7,10]

Tables 7–12 update and augment the previously published, device-associated rates and DU ratios by birth-weight category for NICU locations.[1] The clinical sepsis (CSEP) criterion was discontinued in January 2010.[7,11] Therefore, the central line-associated bloodstream infection (CLABSI) rate tables exclude all BSIs that were reported using this criterion in 2009. This allows unpublished hospital-specific CLABSI rates collected using the changed BSI definition to be compared directly to the aggregate data included in this report.

Tables 13–20 provide data on select attributes of the device-associated infections for each location. For example, Tables 13, 14, 17 and 18 show the frequency and percent distribution of the specific sites of BSI and the criterion used for identifying these infections. Note that for these tables, criteria 2 and 3 have been combined.

## *Discussion*

The data in this report were restricted to a single year for several reasons. First, there were more facilities contributing data than in previous years and because of this, there were sufficient data reported in 2009 to support the analysis of a single year of data (e.g., considerable data contributing to the pooled means, most location types with >20 locations reporting), thus obviating the need to combine data with previous years. Second, data included in the last published report have recently been used as baseline data (i.e., referent population) for calculating standardized infection ratios (SIR) and measuring progress toward infection prevention goals in the U. S. Department of Health and Human Services' HAI Action Plan.[1,12] Third, analyzing one year of data removes the need to assess the influence mandatory HAI reporting may have on the aggregate data across years.

The characteristics of hospitals reporting to NHSN remain consistent with the last published report, including a sustained contribution of smaller hospitals.[1] The diversity of healthcare facilities reporting to NHSN may change in future reports as a result of two factors: 1) increased use of NHSN as the operational system to fulfill mandatory HAI reporting requirements in additional states, and 2) the Center for Medicare and Medicaid Services (CMS) Hospital Inpatient Quality Reporting Program, which requires hospitals participating in this program to use NHSN as the tool to report CLABSI data from all adult, pediatric, and neonatal ICUs, beginning January 1, 2011.

Comparisons of these data to previous NHSN Annual Reports reveal several differences. Reporting of DA infections from inpatient wards continues to increase, which is apparent in the 16-fold increase in the number of medical wards reporting CLABSI rates, compared to the first NHSN Annual Report.[13] In this type of inpatient ward, the pooled mean CLABSI rate was reduced from 2.1 to 1.1 CLABSIs per 1000 central line-days, which could be related to the influx of data from smaller hospitals that generally have lower risks of HAI. Another factor that may have contributed to this reduction is an increase in the implementation and effectiveness of HAI prevention strategies.[14] Further growth in NHSN's coverage, specifically in the number and types of inpatient wards and specialty care areas reporting data, will improve NHSN usefulness in characterizing rates of device-associated infections among patients in those care areas.

In this report, NICU CLABSI rates for each of the two lowest birth weight categories are higher than CLABSI rates in each of the other ICU types, with the exception of the adult burn ICU location. It is unclear if these differences in rates are due to differences in CLABSI prevention practices among these diverse patient groups, or if it suggests a need for

prevention strategies specific to this high-risk NICU population.

Tables 13–20 were included to aid the reader in interpreting the DA infection rates data. One important use of these data is to better understand the distribution of DA infections by type of reporting criterion. For example, nearly 80% of the CLABSIs from adult and pediatric ICU and inpatient wards were identified using the least subjective criterion (1); however, for NICUs, fewer than two-thirds used this criterion. Similarly, the specific site of ventilator-associated pneumonia (VAP) most frequently reported, regardless of location, was the clinical criterion (PNU1). However, in adult and pediatric critical care locations, approximately 41% of VAPs reported used more rigorous criteria that include laboratory findings (PNU2 and PNU3) whereas in NICU locations, only 27% of VAPs were reported using these same criteria.

Another important difference from the previous NHSN Annual Report is that the catheter-associated UTI (CAUTI) rates reflect the revised definition for UTI, implemented in January 2009.[7,10] This revision included an update to the SUTI criterion, the removal of ASB and the addition of ABUTI. The change in the SUTI criterion removed the use of symptoms that are related to the use of a urinary catheter alone, thereby increasing specificity in the identification of CAUTIs. The specific site of CAUTI was largely reported as SUTI. Due to the significant change in the UTI definition, the CAUTI rates in this report should not be used for the comparison of CAUTIs identified under the previous definition.

As more and diverse types of facilities participate in NHSN, either voluntarily or by mandate, the need for careful scrutiny of the data increases. We will continue to assess how the changing composition of facilities, the changing proportion of data contributed by various types of facilities, and the effects of validation efforts by mandatory reporting states impact the rates and their distributions so that the best possible risk-adjusted comparative data may be provided in future reports.

If you would like to compare your hospital's rates and ratios with those in this report, you must first collect information from your hospital in accordance with the methods described for NHSN.[5,6,7] You should also refer to Appendices A and B for further instructions. Appendix A discusses the calculation of infection rates and DU ratios for the DA Module. Appendix B gives a step-by-step method for interpretation of percentiles of infection rates or DU ratios. Although a high rate or ratio (>90th percentile) does not necessarily define a problem, it does suggest an area for further investigation. Similarly, a low rate or ratio (<10th percentile) may be the result of inadequate infection detection.

Facilities should use the data in this report and their own data to guide local prevention strategies and other quality improvement efforts aimed at reducing the occurrence of infections as much as possible.

The authors are indebted to the NHSN participants for their ongoing efforts to monitor infections and improve patient safety. We also gratefully acknowledge our colleagues in the Division of Healthcare Quality Promotion who tirelessly support this unique public health network.

The findings and conclusions of the report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

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## Table 1. NHSN hospitals contributing data used in this report

| Hospital type | N (%) |
|---|---|
| Children's | 41 ( 2.3) |
| General, including acute, trauma, and teaching | 1550 ( 88.6) |
| Long Term Acute Care | 49 ( 2.8) |
| Military | 19 ( 1.1) |
| Oncology | 11 ( 0.6) |
| Orthopedic | 8 ( 0.5) |
| Psychiatric | 8 ( 0.5) |
| Rehabilitation | 19 ( 1.1) |
| Surgical | 6 ( 0.3) |
| Veterans Affairs | 29 ( 1.7) |
| Women's | 4 ( 0.2) |
| Women's and Children's | 5 ( 0.3) |
| **Total** | **1749 (100)** |

## Table 2. NHSN hospitals contributing data used in this report by hospital type and bedsize

| Hospital type | Bed size category | | | | Total |
|---|---|---|---|---|---|
| | <= 200 | 201-500 | 501-1000 | > 1000 | |
| | N (%) | N (%) | N (%) | N (%) | |
| Major teaching | 81 ( 4.5) | 117 ( 6.7) | 83 ( 4.7) | 3 ( 0.1) | **284 (16.0)** |
| Graduate teaching | 85 ( 4.9) | 69 ( 3.9) | 22 ( 1.3) | 1 ( 0.1) | **177 (10.2)** |
| Limited teaching | 113 ( 6.5) | 74 ( 4.2) | 10 ( 0.6) | 0 ( 0.0) | **197 (11.3)** |
| Nonteaching | 834 (47.7) | 237 (13.6) | 19 ( 1.1) | 1 ( 0.1) | **1091 (62.5)** |
| **Total** | **1113(63.6)** | **497 (28.4)** | **134 ( 7.7)** | **5 ( 0.3)** | **1749 (100)** |

**Major:** Hospital is an important part of the teaching program of a medical school and the majority of medical students rotate through multiple clinical services.

**Graduate:** Hospital is used by the medical school for graduate training programs only; i.e., residency and/or fellowships.

**Limited:** Hospital is used in the medical school's teaching program only to a limited extent.

**Table 3. Pooled means and key percentiles of the distribution of laboratory-confirmed central line-associated BSI rates and central line utilization ratios, by type of location, DA module, 2009**

| Central line-associated BSI rate* | | | | | Percentile | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Type of Location | No. of locations+ | No. of CLABSI | Central line-days | Pooled mean | 10% | 25% | 50% (median) | 75% | 90% |
| **Critical Care Units** | | | | | | | | | |
| Burn | 33 | 193 | 36,355 | **5.3** | 0.2 | 1.8 | 3.8 | 5.9 | 12.4 |
| Medical Major teaching | 135 (134) | 740 | 335,840 | **2.2** | 0.2 | 0.8 | 1.7 | 3.1 | 4.7 |
| Medical All other | 191 (183) | 461 | 293,177 | **1.6** | 0.0 | 0.0 | 1.1 | 2.4 | 4.1 |
| Medical Cardiac | 252 (246) | 556 | 330,123 | **1.7** | 0.0 | 0.0 | 1.1 | 2.5 | 4.2 |
| Medical/Surgical Major teaching | 192 | 760 | 446,751 | **1.7** | 0.0 | 0.3 | 1.3 | 2.4 | 3.8 |
| Medical/Surgical All other <= 15 beds | 837 (771) | 982 | 693,747 | **1.4** | 0.0 | 0.0 | 0.0 | 1.8 | 3.8 |
| Medical/Surgical All other > 15 beds | 324 (323) | 1,111 | 871,750 | **1.3** | 0.0 | 0.3 | 0.9 | 1.8 | 3.0 |
| Neurologic | 23 | 67 | 36,414 | **1.8** | 0.0 | 1.1 | 1.7 | 2.5 | 4.7 |
| Neurosurgical | 79 (78) | 194 | 129,732 | **1.5** | 0.0 | 0.3 | 1.2 | 2.5 | 3.6 |
| Pediatric Cardiothoracic | 21 | 161 | 65,419 | **2.5** | 0.4 | 0.9 | 2.7 | 3.6 | 4.0 |
| Pediatric Medical | 15 (13) | 36 | 13,823 | **2.6** | | | | | |
| Pediatric Medical/Surgical | 142 (135) | 504 | 228,206 | **2.2** | 0.0 | 0.0 | 1.7 | 3.0 | 4.5 |
| Respiratory | 9 | 27 | 12,627 | **2.1** | | | | | |
| Surgical | 223 (222) | 817 | 466,224 | **1.8** | 0.0 | 0.5 | 1.2 | 2.5 | 4.2 |
| Surgical Cardiothoracic | 219 | 540 | 460,406 | **1.2** | 0.0 | 0.0 | 0.8 | 1.7 | 2.5 |
| Trauma | 74 | 439 | 168,784 | **2.6** | 0.0 | 0.7 | 2.0 | 3.7 | 6.7 |
| **Inpatient Wards** | | | | | | | | | |
| Acute Stroke | 5 | 1 | 2,039 | **0.5** | | | | | |
| Adult Step Down Unit (post-critical care) | 214 (204) | 293 | 194,080 | **1.5** | 0.0 | 0.0 | 0.8 | 2.4 | 3.7 |
| Behavioral Health/Psych | 56 (12) | 0 | 2,432 | **0.0** | | | | | |
| Genitourinary | 7 | 12 | 12,379 | **1.0** | | | | | |
| Gerontology | 6 | 4 | 5,029 | **0.8** | | | | | |
| Gynecology | 21 (9) | 6 | 5,263 | **1.1** | | | | | |

## Table 3, continued

| Central line-associated BSI rate* | | | | | Percentile | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Type of Location | No. of locations+ | No. of CLABSI | Central line-days | Pooled mean | 10% | 25% | 50% (median) | 75% | 90% |
| Labor and Delivery | 17 (3) | 0 | 400 | **0.0** | | | | | |
| Labor, Delivery, Recovery, Postpartum Suite | 32 (4) | 0 | 866 | **0.0** | | | | | |
| Medical | 289 (274) | 362 | 317,612 | **1.1** | 0.0 | 0.0 | 0.6 | 1.7 | 3.1 |
| Medical/Surgical | 807 (751) | 700 | 674,005 | **1.0** | 0.0 | 0.0 | 0.0 | 1.5 | 2.8 |
| Neurology | 17 (16) | 19 | 15,041 | **1.3** | | | | | |
| Neurosurgical | 21 (20) | 19 | 14,310 | **1.3** | 0.0 | 0.0 | 0.0 | 3.3 | 5.1 |
| Orthopedic | 84 (71) | 33 | 40,666 | **0.8** | 0.0 | 0.0 | 0.0 | 0.8 | 2.7 |
| Orthopedic Trauma | 6 | 13 | 4,409 | **2.9** | | | | | |
| Pediatric Medical | 18 (16) | 20 | 15,568 | **1.3** | | | | | |
| Pediatric Med/Surg | 94 (59) | 54 | 42,966 | **1.3** | 0.0 | 0.0 | 0.0 | 1.1 | 3.3 |
| Pediatric Rehabilitation | 6 (5) | 7 | 1,306 | **5.4** | | | | | |
| Postpartum | 54 (5) | 0 | 1,192 | **0.0** | | | | | |
| Pulmonary | 10 | 17 | 14,560 | **1.2** | | | | | |
| Rehabilitation | 161 (141) | 40 | 64,469 | **0.6** | 0.0 | 0.0 | 0.0 | 0.0 | 1.8 |
| Step down Neonatal ICU (Level II) | 11 (3) | 1 | 450 | **2.2** | | | | | |
| Surgical | 142 (136) | 173 | 150,799 | **1.1** | 0.0 | 0.0 | 0.0 | 1.6 | 3.4 |
| Vascular Surgery | 13 (12) | 17 | 13,190 | **1.3** | | | | | |
| Well Baby Nursery (Level I) | 7 (1) | 0 | 901 | **0.0** | | | | | |

| Central line-associated BSI rate* | | | | | Percentile | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Type of Location | No. of locations+ | No. of CLABSI | Central line-days | Pooled mean | 10% | 25% | 50% (median) | 75% | 90% |
| **Inpatient Long-Term Care Units** | | | | | | | | | |
| Long-Term Care | 10 (8) | 10 | 5,783 | **1.7** | | | | | |

## Table 3, continued

| Central line utilization ratio** | | | | | Percentile | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Type of location | No. of locations+ | Central line-days | Patient-days | Pooled mean | 10% | 25% | 50% (median) | 75% | 90% |
| **Critical Care Units** | | | | | | | | | |
| Burn | 33 | 36,355 | 73,441 | **0.50** | 0.25 | 0.33 | 0.46 | 0.64 | 0.83 |
| Medical Major teaching | 135 | 335,840 | 540,411 | **0.62** | 0.42 | 0.51 | 0.61 | 0.71 | 0.79 |
| Medical All other | 191 (189) | 293,177 | 682,737 | **0.43** | 0.13 | 0.22 | 0.44 | 0.61 | 0.73 |
| Medical Cardiac | 252 (250) | 330,123 | 822,571 | **0.40** | 0.17 | 0.29 | 0.39 | 0.53 | 0.63 |
| Medical/Surgical Major teaching | 192 | 446,751 | 774,040 | **0.58** | 0.30 | 0.46 | 0.59 | 0.67 | 0.76 |
| Medical/Surgical All other <= 15 beds | 837 (824) | 693,747 | 1,790,060 | **0.39** | 0.10 | 0.20 | 0.34 | 0.50 | 0.65 |
| Medical/Surgical All other > 15 beds | 324 | 871,750 | 1,823,287 | **0.48** | 0.27 | 0.41 | 0.53 | 0.62 | 0.71 |
| Neurologic | 23 | 36,414 | 76,731 | **0.47** | 0.18 | 0.28 | 0.43 | 0.61 | 0.67 |
| Neurosurgical | 79 | 129,732 | 283,525 | **0.46** | 0.23 | 0.33 | 0.48 | 0.57 | 0.64 |
| Pediatric Cardiothoracic | 21 | 65,419 | 92,941 | **0.70** | 0.31 | 0.61 | 0.75 | 0.85 | 0.91 |
| Pediatric Medical | 15 | 13,823 | 34,435 | **0.40** | | | | | |
| Pediatric Medical/Surgical | 142 (141) | 228,206 | 457,621 | **0.50** | 0.14 | 0.29 | 0.41 | 0.57 | 0.66 |
| Respiratory | 9 | 12,627 | 21,605 | **0.58** | | | | | |
| Surgical | 223 | 466,224 | 776,724 | **0.60** | 0.36 | 0.49 | 0.61 | 0.71 | 0.79 |
| Surgical Cardiothoracic | 219 | 460,406 | 649,249 | **0.71** | 0.43 | 0.57 | 0.73 | 0.83 | 0.95 |
| Trauma | 74 | 168,784 | 287,095 | **0.59** | 0.44 | 0.50 | 0.60 | 0.67 | 0.77 |
| **Inpatient Wards** | | | | | | | | | |
| Acute Stroke | 5 | 2,039 | 15,732 | **0.13** | | | | | |
| Adult Step Down Unit (post-critical care) | 214 (213) | 194,080 | 1,059,519 | **0.18** | 0.06 | 0.09 | 0.16 | 0.30 | 0.45 |
| Behavioral Health/Psych | 56 | 2,432 | 83,531 | **0.03** | 0.01 | 0.01 | 0.02 | 0.03 | 0.05 |
| Genitourinary | 7 | 12,379 | 51,719 | **0.24** | | | | | |
| Gerontology | 6 | 5,029 | 38,705 | **0.13** | | | | | |
| Gynecology | 21 | 5,263 | 60,953 | **0.09** | 0.00 | 0.01 | 0.02 | 0.16 | 0.18 |

## Table 3, continued

| Central line utilization ratio** | | | | | Percentile | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Type of location | No. of locations+ | Central line-days | Patient-days | Pooled mean | 10% | 25% | 50% (median) | 75% | 90% |
| Labor and Delivery | 17 | 400 | 14,316 | **0.03** | | | | | |
| Labor, Delivery, Recovery, Postpartum Suite | 32 | 866 | 44,595 | **0.02** | 0.00 | 0.01 | 0.02 | 0.03 | 0.05 |
| Medical | 289 | 317,612 | 1,730,163 | **0.18** | 0.05 | 0.09 | 0.14 | 0.20 | 0.31 |
| Medical/Surgical | 807 (804) | 674,005 | 4,739,514 | **0.14** | 0.04 | 0.07 | 0.11 | 0.18 | 0.27 |
| Neurology | 17 | 15,041 | 94,017 | **0.16** | | | | | |
| Neurosurgical | 21 | 14,310 | 99,260 | **0.14** | 0.04 | 0.07 | 0.12 | 0.16 | 0.25 |
| Orthopedic | 84 | 40,666 | 424,227 | **0.10** | 0.02 | 0.05 | 0.07 | 0.11 | 0.16 |
| Orthopedic Trauma | 6 | 4,409 | 40,226 | **0.11** | | | | | |
| Medical Pediatric | 18 | 15,568 | 75,442 | **0.21** | | | | | |
| Pediatric Med/Surg | 94 | 42,966 | 229,584 | **0.19** | 0.02 | 0.04 | 0.08 | 0.17 | 0.36 |
| Pediatric Rehabilitation | 6 | 1,306 | 15,334 | **0.09** | | | | | |
| Postpartum | 54 (53) | 1,192 | 100,598 | **0.01** | 0.00 | 0.01 | 0.01 | 0.02 | 0.04 |
| Pulmonary | 10 | 14,560 | 57,194 | **0.25** | | | | | |
| Rehabilitation | 161 | 64,469 | 750,608 | **0.09** | 0.03 | 0.05 | 0.08 | 0.11 | 0.16 |
| Step down Neonatal ICU (Level II) | 11 (9) | 450 | 6,286 | **0.07** | | | | | |
| Surgical | 142 | 150,799 | 865,118 | **0.17** | 0.06 | 0.10 | 0.15 | 0.21 | 0.28 |
| Vascular Surgery | 13 | 13,190 | 69,098 | **0.19** | | | | | |
| Well Baby Nursery (Level I) | 7 (6) | 901 | 9,401 | **0.10** | | | | | |
| **Inpatient Long-Term Care Units** | | | | | | | | | |
| Long-Term Care | 10 | 5,783 | 43,219 | **0.13** | | | | | |

* $\frac{\text{Number of CLABSI}}{\text{Number of central line-days}} \times 1000$

** $\frac{\text{Number of central line-days}}{\text{Number of patient-days}}$

*BSI*, bloodstream infection; *CLABSI*, central line-associated BSI.

+ Number of locations meeting minimum requirements for percentile distributions if less than total number of locations. If this number <20, percentile distributions are not calculated.

**Table 4. Pooled means and key percentiles of the distribution of laboratory-confirmed permanent and temporary central line-associated BSI rates and central line utilization ratios, by type of location, DA module, 2009**

| Permanent Central line-associated BSI rate * | | | | | Percentile | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Type of Location | No. of locations+ | No. of PCLABS | Permanent Central line-days | Pooled mean | 10% | 25% | 50% (median) | 75% | 90% |
| **Specialty Care Area** | | | | | | | | | |
| Bone Marrow Transplant | 25 (24) | 190 | 53,944 | **3.5** | 0.0 | 0.0 | 2.8 | 4.3 | 6.9 |
| Hematology/Oncology | 59 | 189 | 99,646 | **1.9** | 0.0 | 0.0 | 0.7 | 2.2 | 4.6 |
| Pediatric Hematology/ Oncology | 10 | 96 | 32,282 | **3.0** | | | | | |
| Long-Term Acute Care (LTAC) | 60 (55) | 34 | 37,365 | **0.9** | 0.0 | 0.0 | 0.0 | 1.0 | 2.7 |
| Solid Organ Transplant | 6 | 7 | 2,631 | **2.7** | | | | | |

| Temporary Central line-associated BSI rate ** | | | | | Percentile | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Type of Location | No. of locations+ | No. of TCLABS | Temporary Central line-days | Pooled mean | 10% | 25% | 50% (median) | 75% | 90% |
| **Specialty Care Area** | | | | | | | | | |
| Bone Marrow Transplant | 25 (24) | 167 | 40,426 | **4.1** | 0.0 | 0.0 | 3.9 | 6.2 | 7.5 |
| Hematology/Oncology | 51 (49) | 173 | 53,786 | **3.2** | 0.0 | 0.0 | 1.1 | 4.9 | 6.8 |
| Pediatric Hematology/ Oncology | 9 (8) | 31 | 6,454 | **4.8** | | | | | |
| Long-Term Acute Care (LTAC) | 84 (81) | 430 | 257,966 | **1.7** | 0.0 | 0.5 | 1.3 | 2.5 | 4.1 |
| Solid Organ Transplant | 9 (8) | 47 | 19,252 | **2.4** | | | | | |

## Table 4, continued

| Permanent Central line utilization ratio # | | | | | Percentile | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Type of location | No. of locations+ | Permanent Central line-days | Patient-days | Pooled mean | 10% | 25% | 50% (median) | 75% | 90% |
| **Specialty Care Area** | | | | | | | | | |
| Bone Marrow Transplant | 25 | 53,944 | 103,814 | **0.52** | 0.22 | 0.32 | 0.56 | 0.75 | 0.87 |
| Hematology/Oncology | 59 | 99,646 | 284,402 | **0.35** | 0.15 | 0.21 | 0.33 | 0.49 | 0.72 |
| Pediatric Hematology/ Oncology | 10 | 32,282 | 46,449 | **0.69** | | | | | |
| Long-Term Acute Care (LTAC) | 60 | 37,365 | 291,642 | **0.13** | 0.04 | 0.05 | 0.08 | 0.13 | 0.51 |
| Solid Organ Transplant | 6 | 2,631 | 28,231 | **0.09** | | | | | |

| Temporary Central line utilization ratio ## | | | | | Percentile | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Type of location | No. of locations+ | Temporary Central line-days | Patient-days | Pooled mean | 10% | 25% | 50% (median) | 75% | 90% |
| **Specialty Care Area** | | | | | | | | | |
| Bone Marrow Transplant | 25 | 40,426 | 100,318 | **0.40** | 0.05 | 0.18 | 0.47 | 0.68 | 0.77 |
| Hematology/Oncology | 51 (50) | 53,786 | 272,554 | **0.20** | 0.05 | 0.11 | 0.18 | 0.29 | 0.37 |
| Pediatric Hematology/ Oncology | 9 | 6,454 | 41,466 | **0.16** | | | | | |
| Long-Term Acute Care (LTAC) | 84 | 257,966 | 481,748 | **0.54** | 0.10 | 0.29 | 0.57 | 0.74 | 0.85 |
| Solid Organ Transplant | 9 (8) | 19,252 | 40,296 | **0.48** | | | | | |

* $\frac{\text{Number of PCLAB}}{\text{Number of permanent central line-days}} \times 1000$

\# $\frac{\text{Number of permanent central line-days}}{\text{Number of patient-days}}$

** $\frac{\text{Number of TCLAB}}{\text{Number of temporary central line-days}} \times 1000$

\#\# $\frac{\text{Number of temporary central line-days}}{\text{Number of patient-days}}$

*BSI,* bloodstream infection; *PCLAB,* permanent central line-associated BSI; *TCLAB,* temporary central line-associated BSI.

\+ Number of locations meeting minimum requirements for percentile distributions if less than total number of locations. If this number < 20, percentile distributions are not calculated.

**Table 5. Pooled means and key percentiles of the distribution of urinary catheter-associated UTI rates and urinary catheter utilization ratios, by type of location, DA module, 2009**

| Urinary catheter-associated UTI rate * | | | | | Percentile | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Type of location | No. of locations + | No. of CAUTI | Urinary catheter-days | Pooled mean | 10% | 25% | 50% (median) | 75% | 90% |
| **Critical care units** | | | | | | | | | |
| Burn | 18 | 92 | 20,921 | **4.4** | | | | | |
| Medical Major teaching | 54 | 342 | 148,501 | **2.3** | 0.2 | 0.9 | 1.7 | 3.1 | 4.9 |
| Medical All other | 70 (69) | 351 | 173,724 | **2.0** | 0.0 | 0.3 | 1.4 | 2.4 | 4.5 |
| Medical Cardiac | 112 (109) | 348 | 177,455 | **2.0** | 0.0 | 0.7 | 1.6 | 3.0 | 4.0 |
| Medical/Surgical Major teaching | 95 | 593 | 260,079 | **2.3** | 0.0 | 0.7 | 1.9 | 3.0 | 5.4 |
| Medical/Surgical All other <= 15 beds | 270 (259) | 449 | 348,334 | **1.3** | 0.0 | 0.0 | 0.0 | 1.8 | 3.1 |
| Medical/Surgical All other > 15 beds | 116 (115) | 510 | 410,556 | **1.2** | 0.0 | 0.4 | 1.1 | 1.8 | 3.0 |
| Neurologic | 14 | 124 | 32,777 | **3.8** | | | | | |
| Neurosurgical | 33 | 357 | 81,783 | **4.4** | 0.1 | 1.6 | 3.6 | 6.8 | 10.5 |
| Pediatric Cardiothoracic | 9 | 25 | 9,187 | **2.7** | | | | | |
| Pediatric Medical | 5 (4) | 1 | 1,244 | **0.8** | | | | | |
| Pediatric Medical/Surgical | 55 (52) | 139 | 49,935 | **2.8** | 0.0 | 0.0 | 1.4 | 3.5 | 5.5 |
| Respiratory | 5 | 18 | 7,136 | **2.5** | | | | | |
| Surgical | 92 | 611 | 235,104 | **2.6** | 0.0 | 0.5 | 2.0 | 3.4 | 5.5 |
| Surgical Cardiothoracic | 92 | 307 | 184,567 | **1.7** | 0.0 | 0.5 | 1.2 | 2.4 | 3.6 |
| Trauma | 42 | 437 | 126,916 | **3.4** | 0.6 | 1.7 | 2.8 | 4.5 | 6.7 |
| **Specialty Care Areas** | | | | | | | | | |
| Bone Marrow Transplant | 10 (9) | 8 | 4,093 | **2.0** | | | | | |
| Hematology/ Oncology | 41 (40) | 93 | 39,459 | **2.4** | 0.0 | 1.0 | 2.6 | 4.8 | 6.0 |
| Pediatric Hematology/ Oncology | 5 (3) | 2 | 555 | **3.6** | | | | | |
| Long-Term Acute Care (LTAC) | 62 | 449 | 169,450 | **2.6** | 0.1 | 0.9 | 2.1 | 3.9 | 6.2 |

## Table 5, continued

| Urinary catheter-associated UTI rate * | | | | | Percentile | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Type of location | No. of locations + | No. of CAUTI | Urinary catheter-days | Pooled mean | 10% | 25% | 50% (median) | 75% | 90% |
| **Inpatient Wards** | | | | | | | | | |
| Adult Step Down Unit (post-critical care) | 153 (148) | 389 | 206,562 | **1.9** | 0.0 | 0.0 | 1.2 | 2.6 | 4.3 |
| Behavioral Health/Psych | 71 (27) | 6 | 4,526 | **1.3** | 0.0 | 0.0 | 0.0 | 0.0 | 5.0 |
| Genitourinary | 6 | 12 | 9,992 | **1.2** | | | | | |
| Gynecology | 16 (15) | 12 | 11,765 | **1.0** | | | | | |
| Labor and Delivery | 21 (15) | 5 | 7,449 | **0.7** | | | | | |
| Labor, Delivery, Recovery, Postpartum Suite | 56 (50) | 7 | 20,079 | **0.3** | 0.0 | 0.0 | 0.0 | 0.0 | 1.7 |
| Medical | 213 (208) | 430 | 230,952 | **1.9** | 0.0 | 0.0 | 1.4 | 2.4 | 4.3 |
| Medical/Surgical | 623 (602) | 1,141 | 711,849 | **1.6** | 0.0 | 0.0 | 1.0 | 2.5 | 4.2 |
| Neurology | 11 | 39 | 12,583 | **3.1** | | | | | |
| Neurosurgical | 17 | 52 | 21,828 | **2.4** | | | | | |
| Orthopedic | 66 (64) | 154 | 95,010 | **1.6** | 0.0 | 0.0 | 0.6 | 2.7 | 3.5 |
| Orthopedic Trauma | 5 | 14 | 7,070 | **2.0** | | | | | |
| Pediatric Med/Surg | 63 (34) | 11 | 8,293 | **1.3** | 0.0 | 0.0 | 0.0 | 0.0 | 6.2 |
| Pediatric Medical | 14 (6) | 2 | 1,249 | **1.6** | | | | | |
| Pediatric Rehabilitation | 5 (3) | 1 | 371 | **2.7** | | | | | |
| Postpartum | 77 (75) | 31 | 37,566 | **0.8** | 0.0 | 0.0 | 0.0 | 0.8 | 2.9 |
| Pulmonary | 5 | 17 | 9,917 | **1.7** | | | | | |
| Rehabilitation | 147 (132) | 258 | 68,055 | **3.8** | 0.0 | 0.0 | 2.4 | 4.8 | 9.2 |
| Surgical | 109 | 285 | 155,042 | **1.8** | 0.0 | 0.0 | 1.4 | 2.7 | 4.7 |
| Vascular Surgery | 6 (5) | 20 | 6,160 | **3.2** | | | | | |

## Table 5, continued

| Urinary catheter-associated UTI rate * | | | | | Percentile | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Type of location | No. of locations + | No. of CAUTI | Urinary catheter-days | Pooled mean | 10% | 25% | 50% (median) | 75% | 90% |
| **Inpatient Long-Term Care Units** | | | | | | | | | |
| Long-Term Care Unit | 10 | 17 | 6,962 | **2.4** | | | | | |

| Urinary catheter utilization ratio ** | | | | | Percentile | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Type of location | No. of locations + | Urinary catheter-days | Patient days | Pooled mean | 10% | 25% | 50% (median) | 75% | 90% |
| **Critical care units** | | | | | | | | | |
| Burn | 18 | 20,921 | 37,161 | **0.56** | | | | | |
| Medical Major teaching | 54 | 148,501 | 200,735 | **0.74** | 0.55 | 0.65 | 0.75 | 0.82 | 0.88 |
| Medical All other | 70 | 173,724 | 260,799 | **0.67** | 0.37 | 0.58 | 0.72 | 0.80 | 0.86 |
| Medical Cardiac | 112 (111) | 177,455 | 345,315 | **0.51** | 0.26 | 0.40 | 0.55 | 0.66 | 0.77 |
| Medical/Surgical Major teaching | 95 | 260,079 | 357,500 | **0.73** | 0.51 | 0.68 | 0.76 | 0.81 | 0.85 |
| Medical/Surgical All other <= 15 beds | 270 (266) | 348,334 | 518,740 | **0.67** | 0.38 | 0.50 | 0.65 | 0.78 | 0.86 |
| Medical/Surgical All other > 15 beds | 116 | 410,556 | 570,420 | **0.72** | 0.54 | 0.68 | 0.77 | 0.83 | 0.88 |
| Neurologic | 14 | 32,777 | 43,184 | **0.76** | | | | | |
| Neurosurgical | 33 | 81,783 | 106,478 | **0.77** | 0.60 | 0.70 | 0.78 | 0.83 | 0.90 |
| Pediatric Cardiothoracic | 9 | 9,187 | 36,555 | **0.25** | | | | | |
| Pediatric Medical | 5 | 1,244 | 8,339 | **0.15** | | | | | |
| Pediatric Medical/Surgical | 55 | 49,935 | 176,374 | **0.28** | 0.10 | 0.17 | 0.24 | 0.31 | 0.39 |
| Respiratory | 5 | 7,136 | 11,569 | **0.62** | | | | | |
| Surgical | 92 | 235,104 | 298,630 | **0.79** | 0.59 | 0.75 | 0.81 | 0.86 | 0.91 |
| Surgical Cardiothoracic | 92 | 184,567 | 254,438 | **0.73** | 0.43 | 0.63 | 0.76 | 0.86 | 0.94 |
| Trauma | 42 | 126,916 | 153,275 | **0.83** | 0.71 | 0.78 | 0.85 | 0.92 | 0.95 |

## Table 5, continued

| Urinary catheter utilization ratio ** | | | | | Percentile | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Type of location | No. of locations + | Urinary catheter-days | Patient days | Pooled mean | 10% | 25% | 50% (median) | 75% | 90% |
| **Specialty Care Areas** | | | | | | | | | |
| Bone Marrow Transplant | 10 | 4,093 | 41,627 | **0.10** | | | | | |
| Hematology/ Oncology | 41 | 39,459 | 201,514 | **0.20** | 0.10 | 0.12 | 0.17 | 0.27 | 0.37 |
| Pediatric Hematology/ Oncology | 5 | 555 | 22,647 | **0.02** | | | | | |
| Long-Term Acute Care (LTAC) | 62 | 169,450 | 331,978 | **0.51** | 0.22 | 0.38 | 0.55 | 0.66 | 0.75 |
| **Inpatient Wards** | | | | | | | | | |
| Adult Step Down Unit (post-critical care) | 153 (152) | 206,562 | 848,898 | **0.24** | 0.11 | 0.14 | 0.23 | 0.35 | 0.50 |
| Behavioral Health/Psych | 71 | 4,526 | 169,133 | **0.03** | 0.00 | 0.01 | 0.02 | 0.03 | 0.04 |
| Genitourinary | 6 | 9,992 | 46,554 | **0.21** | | | | | |
| Gynecology | 16 | 11,765 | 60,016 | **0.20** | | | | | |
| Labor and Delivery | 21 | 7,449 | 38,769 | **0.19** | 0.01 | 0.06 | 0.14 | 0.22 | 0.34 |
| Labor, Delivery, Recovery, Postpartum Suite | 56 | 20,079 | 125,423 | **0.16** | 0.09 | 0.10 | 0.15 | 0.24 | 0.31 |
| Medical | 213 | 230,952 | 1,341,028 | **0.17** | 0.08 | 0.12 | 0.16 | 0.23 | 0.30 |
| Medical/Surgical | 623 (618) | 711,849 | 3,731,332 | **0.19** | 0.10 | 0.13 | 0.18 | 0.23 | 0.30 |
| Neurology | 11 | 12,583 | 60,531 | **0.21** | | | | | |
| Neurosurgical | 17 | 21,828 | 86,450 | **0.25** | | | | | |
| Orthopedic | 66 (65) | 95,010 | 345,378 | **0.28** | 0.13 | 0.20 | 0.27 | 0.35 | 0.43 |
| Orthopedic Trauma | 5 | 7,070 | 37,585 | **0.19** | | | | | |
| Pediatric Med/Surg | 63 | 8,293 | 139,610 | **0.06** | 0.01 | 0.02 | 0.04 | 0.08 | 0.15 |
| Pediatric Medical | 14 | 1,249 | 42,533 | **0.03** | | | | | |
| Pediatric Orthopedic | 4 (3) | 3,249 | 10,376 | **0.31** | | | | | |
| Pediatric Rehabilitation | 5 | 371 | 8,182 | **0.05** | | | | | |
| Postpartum | 77 | 37,566 | 275,824 | **0.14** | 0.05 | 0.09 | 0.14 | 0.18 | 0.24 |
| Pulmonary | 5 | 9,917 | 37,806 | **0.26** | | | | | |
| Rehabilitation | 147 | 68,055 | 742,120 | **0.09** | 0.03 | 0.05 | 0.08 | 0.10 | 0.15 |
| Surgical | 109 | 155,042 | 670,460 | **0.23** | 0.14 | 0.17 | 0.22 | 0.28 | 0.36 |

## Table 5, continued

| Urinary catheter utilization ratio ** | | | | | Percentile | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Type of location | No. of locations + | Urinary catheter-days | Patient days | Pooled mean | 10% | 25% | 50% (median) | 75% | 90% |
| Vascular Surgery | 6 | 6,160 | 40,283 | **0.15** | | | | | |
| **Inpatient Long-Term Care Units** | | | | | | | | | |
| Long-Term Care Unit | 10 | 6,962 | 48,208 | **0.14** | | | | | |

* $\frac{\text{Number of CAUTI}}{\text{Number of urinary catheter-days}} \times 1000$

** $\frac{\text{Number of urinary catheter-days}}{\text{Number of patient-days}}$

*UTI,* urinary tract infection; *CAUTI,* urinary catheter-associated UTI.

+ Number of locations meeting minimum requirements for percentile distributions if less than total number of locations. If this number <20, percentile distributions are not calculated.

**Table 6. Pooled means and key percentiles of the distribution of ventilator-associated PNEU rates and ventilator utilization ratios, by type of location, DA module, 2009**

| Ventilator-associated PNEU rate * | | | | | Percentile | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Type of location | No. of locations + | No. of VAP | Ventilator -days | Pooled mean | 10% | 25% | 50% (median) | 75% | 90% |
| **Critical care units** | | | | | | | | | |
| Burn | 21 | 109 | 14,703 | **7.4** | 0.0 | 0.0 | 2.7 | 10.9 | 14.2 |
| Medical Major teaching | 75 (74) | 263 | 140,784 | **1.9** | 0.0 | 0.0 | 1.1 | 2.9 | 5.6 |
| Medical All other | 97 (92) | 178 | 131,185 | **1.4** | 0.0 | 0.0 | 0.2 | 2.2 | 4.6 |
| Medical Cardiac | 125 (116) | 149 | 100,768 | **1.5** | 0.0 | 0.0 | 0.0 | 2.4 | 4.8 |
| Medical/Surgical Major teaching | 116 (115) | 398 | 194,776 | **2.0** | 0.0 | 0.0 | 1.2 | 3.1 | 5.6 |
| Medical/Surgical All other <= 15 beds | 359 (305) | 284 | 209,206 | **1.4** | 0.0 | 0.0 | 0.0 | 1.6 | 5.1 |
| Medical/Surgical All other > 15 beds | 154 (152) | 348 | 295,884 | **1.2** | 0.0 | 0.0 | 0.7 | 1.9 | 3.5 |
| Neurologic | 14 (13) | 61 | 15,731 | **3.9** | | | | | |
| Neurosurgical | 44 (42) | 169 | 45,019 | **3.8** | 0.0 | 0.0 | 2.3 | 4.3 | 8.5 |
| Pediatric Cardiothoracic | 12 | 15 | 22,943 | **0.7** | | | | | |
| Pediatric Medical | 9 (7) | 6 | 6,411 | **0.9** | | | | | |
| Pediatric Medical/Surgical | 72 (70) | 113 | 102,822 | **1.1** | 0.0 | 0.0 | 0.4 | 1.5 | 4.1 |
| Respiratory | 6 | 7 | 6,548 | **1.1** | | | | | |
| Surgical | 124 (122) | 645 | 171,680 | **3.8** | 0.0 | 0.5 | 2.1 | 5.1 | 9.0 |
| Surgical Cardiothoracic | 110 (107) | 247 | 115,628 | **2.1** | 0.0 | 0.0 | 1.3 | 3.0 | 6.3 |
| Trauma | 47 | 580 | 88,644 | **6.5** | 0.0 | 1.2 | 4.3 | 10.0 | 15.7 |
| **Specialty Care Areas** | | | | | | | | | |
| Long-Term Acute Care (LTAC) | 45 | 42 | 66,665 | **0.6** | 0.0 | 0.0 | 0.0 | 0.8 | 2.3 |

## Table 6, continued

| Ventilator-associated PNEU rate * | | | | | Percentile | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Type of location | No. of locations + | No. of VAP | Ventilator -days | Pooled mean | 10% | 25% | 50% (median) | 75% | 90% |
| **Inpatient Wards** | | | | | | | | | |
| Adult Step Down Unit (post-critical care) | 37 (33) | 27 | 18,307 | **1.5** | 0.0 | 0.0 | 0.0 | 2.1 | 4.2 |
| Medical | 10 (6) | 1 | 4,558 | **0.2** | | | | | |
| Medical/Surgical | 25 (13) | 1 | 10,490 | **0.1** | | | | | |
| Pediatric Med/Surg | 5 (4) | 0 | 1,948 | **0.0** | | | | | |
| Pediatric Medical | 6 (3) | 0 | 1,090 | **0.0** | | | | | |
| Pulmonary | 5 | 5 | 4,189 | **1.2** | | | | | |

| Ventilator utilization ratio ** | | | | | Percentile | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Type of location | No. of locations + | Ventilator-days | Patient-days | Pooled mean | 10% | 25% | 50% (median) | 75% | 90% |
| **Critical care units** | | | | | | | | | |
| Burn | 21 | 14,703 | 45,574 | **0.32** | 0.16 | 0.18 | 0.30 | 0.42 | 0.59 |
| Medical Major teaching | 75 | 140,784 | 292,844 | **0.48** | 0.27 | 0.37 | 0.49 | 0.56 | 0.69 |
| Medical All other | 97 (96) | 131,185 | 354,489 | **0.37** | 0.08 | 0.22 | 0.38 | 0.49 | 0.60 |
| Medical Cardiac | 125 (124) | 100,768 | 389,898 | **0.26** | 0.07 | 0.15 | 0.25 | 0.36 | 0.46 |
| Medical/Surgical Major teaching | 116 | 194,776 | 454,227 | **0.43** | 0.21 | 0.30 | 0.40 | 0.53 | 0.62 |
| Medical/Surgical All other <= 15 beds | 359 (352) | 209,206 | 701,388 | **0.30** | 0.06 | 0.12 | 0.23 | 0.37 | 0.48 |
| Medical/Surgical All other > 15 beds | 154 | 295,884 | 901,241 | **0.33** | 0.22 | 0.29 | 0.38 | 0.46 | 0.54 |
| Neurologic | 14 | 15,731 | 40,234 | **0.39** | | | | | |
| Neurosurgical | 44 | 45,019 | 140,989 | **0.32** | 0.09 | 0.23 | 0.32 | 0.40 | 0.49 |
| Pediatric Cardiothoracic | 12 | 22,943 | 53,000 | **0.43** | | | | | |

## Table 6, continued

| Ventilator utilization ratio ** | | | | | Percentile | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Type of location | No. of locations + | Ventilator -days | Patient-days | Pooled mean | 10% | 25% | 50% (median) | 75% | 90% |
| Pediatric Medical/Surgical | 72 | 102,822 | 247,274 | **0.42** | 0.13 | 0.26 | 0.35 | 0.47 | 0.54 |
| Pediatric Medical | 9 | 6,411 | 19,067 | **0.34** | | | | | |
| Respiratory | 6 | 6,548 | 14,941 | **0.44** | | | | | |
| Surgical | 124 | 171,680 | 428,439 | **0.40** | 0.24 | 0.30 | 0.38 | 0.46 | 0.59 |
| Surgical Cardiothoracic | 110 | 115,628 | 319,264 | **0.36** | 0.18 | 0.26 | 0.33 | 0.44 | 0.56 |
| Trauma | 47 | 88,644 | 175,248 | **0.51** | 0.36 | 0.45 | 0.52 | 0.60 | 0.69 |
| **Specialty Care Areas** | | | | | | | | | |
| Long-Term Acute Care (LTAC) | 45 | 66,665 | 249,282 | **0.27** | 0.07 | 0.12 | 0.22 | 0.32 | 0.53 |
| **Inpatient Wards** | | | | | | | | | |
| Adult Step Down Unit (post-critical care) | 37 | 18,307 | 160,446 | **0.11** | 0.02 | 0.05 | 0.10 | 0.17 | 0.23 |
| Medical | 10 | 4,558 | 45,569 | **0.10** | | | | | |
| Medical/Surgical | 25 (24) | 10,490 | 99,602 | **0.11** | 0.00 | 0.01 | 0.02 | 0.20 | 0.36 |
| Pediatric Med/Surg | 5 | 1,948 | 30,887 | **0.06** | | | | | |
| Medical Pediatric | 6 | 1,090 | 17,432 | **0.06** | | | | | |
| Pulmonary | 5 | 4,189 | 33,972 | **0.12** | | | | | |

* $\frac{\text{Number of VAP}}{\text{Number of ventilator-days}} \times 1000$

** $\frac{\text{Number of ventilator-days}}{\text{Number of patient-days}}$

*PNEU,* pneumonia infection; *VAP,* ventilator-associated PNEU.

+ Number of locations meeting minimum requirements for percentile distributions if less than total number of locations. If this number < 20, percentile distributions are not calculated.

**Table 7. Pooled means and key percentiles of the distribution of central line-associated BSI rates and central line utilization ratios for level III NICUs, DA module, 2009**

| Central line-associated BSI rate * | | | | | Percentile | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Birth-weight category | No. of locations + | No. of CLABSI | Central line-days | Pooled mean | 10% | 25% | 50% (median) | 75% | 90% |
| <=750 grams | 172 (150) | 291 | 86,469 | **3.4** | 0.0 | 0.0 | 2.7 | 5.0 | 8.6 |
| 751-1000 grams | 179 (159) | 187 | 68,320 | **2.7** | 0.0 | 0.0 | 1.4 | 4.9 | 8.8 |
| 1001-1500 grams | 183 (156) | 133 | 69,926 | **1.9** | 0.0 | 0.0 | 0.0 | 2.8 | 5.8 |
| 1501-2500 grams | 172 (134) | 84 | 55,896 | **1.5** | 0.0 | 0.0 | 0.0 | 1.9 | 4.7 |
| > 2500 grams | 167 (106) | 73 | 55,659 | **1.3** | 0.0 | 0.0 | 0.0 | 1.2 | 3.5 |

| Central line utilization ratio ** | | | | | Percentile | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Birth-weight category | No. of locations + | Central line-days | Patient-days | Pooled Mean | 10% | 25% | 50% (median) | 75% | 90% |
| <=750 grams | 172 (164) | 86,469 | 233,812 | **0.37** | 0.20 | 0.27 | 0.35 | 0.47 | 0.57 |
| 751-1000 grams | 179 (177) | 68,320 | 219,356 | **0.31** | 0.17 | 0.22 | 0.30 | 0.40 | 0.51 |
| 1001-1500 grams | 183 (180) | 69,926 | 300,033 | **0.23** | 0.08 | 0.14 | 0.22 | 0.32 | 0.45 |
| 1501-2500 grams | 172 (170) | 55,896 | 352,778 | **0.16** | 0.04 | 0.06 | 0.11 | 0.20 | 0.39 |
| > 2500 grams | 167 | 55,659 | 285,437 | **0.19** | 0.03 | 0.06 | 0.13 | 0.21 | 0.32 |

* $\frac{\text{Number of CLABSI}}{\text{Number of central line-days}} \times 1000$

** $\frac{\text{Number of central line-days}}{\text{Number of patient-days}}$

*BSI*, bloodstream infection, includes laboratory-confirmed BSI; *CLABSI*, central line-associated BSI.

\+ Number of locations meeting minimum requirements for percentile distributions if less than total number of locations. If this number < 20, percentile distributions are not calculated.

**Table 8. Pooled means and key percentiles of the distribution of umbilical catheter-associated BSI rates and umbilical catheter utilization ratios for level III NICUs, DA module, 2009**

| Umbilical catheter-associated BSI rate * | | | | | Percentile | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Birth-weight category | No. of locations + | No. of UCAB | Umbilical catheter-days | Pooled mean | 10% | 25% | 50% (median) | 75% | 90% |
| <=750 grams | 173 (125) | 94 | 22,442 | **4.2** | 0.0 | 0.0 | 0.0 | 6.4 | 12.7 |
| 751-1000 grams | 176 (124) | 52 | 19,508 | **2.7** | 0.0 | 0.0 | 0.0 | 0.8 | 10.1 |
| 1001-1500 grams | 180 (123) | 22 | 24,000 | **0.9** | 0.0 | 0.0 | 0.0 | 0.0 | 2.4 |
| 1501-2500 grams | 178 (106) | 11 | 22,126 | **0.5** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| > 2500 grams | 178 (125) | 15 | 31,030 | **0.5** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

| Umbilical catheter utilization ratio ** | | | | | Percentile | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Birth-weight category | No. of locations + | Umbilical catheter-days | Patient-days | Pooled mean | 10% | 25% | 50% (median) | 75% | 90% |
| <=750 grams | 173 (160) | 22,442 | 202,445 | **0.11** | 0.06 | 0.08 | 0.13 | 0.21 | 0.34 |
| 751-1000 grams | 176 (173) | 19,508 | 195,709 | **0.10** | 0.04 | 0.08 | 0.11 | 0.17 | 0.26 |
| 1001-1500 grams | 180 (176) | 24,000 | 268,328 | **0.09** | 0.03 | 0.05 | 0.09 | 0.14 | 0.20 |
| 1501-2500 grams | 178 (176) | 22,126 | 342,955 | **0.06** | 0.02 | 0.03 | 0.05 | 0.09 | 0.14 |
| > 2500 grams | 178 (177) | 31,030 | 306,772 | **0.10** | 0.04 | 0.05 | 0.08 | 0.15 | 0.20 |

* $\frac{\text{Number of UCAB}}{\text{Number of umbilical catheter-days}} \times 1000$

** $\frac{\text{Number of umbilical catheter-days}}{\text{Number of patient-days}}$

*BSI*, bloodstream infection, includes laboratory-confirmed BSI; *UCAB*, umbilical catheter-associated BSI.

\+ Number of locations meeting minimum requirements for percentile distributions if less than total number of locations. If this number < 20, percentile distributions are not calculated.

**Table 9. Pooled means and key percentiles of the distribution of central line-associated BSI rates and central line utilization ratios for level II/III NICUs, DA module, 2009**

| Central line-associated BSI rate * | | | | | Percentile | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Birth-weight category | No. of locations + | No. of CLABSI | Central line-days | Pooled mean | 10% | 25% | 50% (median) | 75% | 90% |
| <=750 grams | 111 (78) | 98 | 29,567 | **3.3** | 0.0 | 0.0 | 1.8 | 5.8 | 10.5 |
| 751-1000 grams | 125 (99) | 84 | 29,601 | **2.8** | 0.0 | 0.0 | 0.0 | 4.0 | 6.8 |
| 1001-1500 grams | 148 (103) | 59 | 34,853 | **1.7** | 0.0 | 0.0 | 0.0 | 2.1 | 6.8 |
| 1501-2500 grams | 142 (78) | 41 | 29,935 | **1.4** | 0.0 | 0.0 | 0.0 | 1.8 | 5.2 |
| > 2500 grams | 136 (58) | 28 | 20,334 | **1.4** | 0.0 | 0.0 | 0.0 | 0.0 | 2.9 |

| Central line utilization ratio ** | | | | | Percentile | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Birth-weight category | No. of locations + | Central line-days | Patient-days | Pooled mean | 10% | 25% | 50% (median) | 75% | 90% |
| <=750 grams | 111 (93) | 29,567 | 90,059 | **0.33** | 0.21 | 0.28 | 0.37 | 0.46 | 0.58 |
| 751-1000 grams | 125 (115) | 29,601 | 101,386 | **0.29** | 0.12 | 0.22 | 0.30 | 0.41 | 0.53 |
| 1001-1500 grams | 148 (136) | 34,853 | 151,963 | **0.23** | 0.09 | 0.14 | 0.21 | 0.30 | 0.42 |
| 1501-2500 grams | 142 (135) | 29,935 | 198,907 | **0.15** | 0.03 | 0.05 | 0.11 | 0.17 | 0.33 |
| > 2500 grams | 136 (121) | 20,334 | 128,207 | **0.16** | 0.04 | 0.06 | 0.09 | 0.16 | 0.29 |

* $\frac{\text{Number of CLABSI}}{\text{Number of central line-days}} \times 1000$

** $\frac{\text{Number of central line-days}}{\text{Number of patient-days}}$

*BSI*, bloodstream infection, includes laboratory-confirmed BSI; *CLABSI*, central line-associated BSI.

\+ Number of locations meeting minimum requirements for percentile distributions if less than total number of locations. If this number < 20, percentile distributions are not calculated.

## Table 10. Pooled means and key percentiles of the distribution of umbilical catheter-associated BSI rates and umbilical catheter utilization ratios for level II/III NICUs, DA module, 2009

| Umbilical catheter-associated BSI rate * | | | | | Percentile | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Birth-weight category | No. of locations + | No. of UCAB | Umbilical catheter-days | Pooled mean | 10% | 25% | 50% (median) | 75% | 90% |
| <=750 grams | 110 (52) | 39 | 8,800 | **4.4** | 0.0 | 0.0 | 0.0 | 8.7 | 14.6 |
| 751-1000 grams | 127 (63) | 23 | 8,809 | **2.6** | 0.0 | 0.0 | 0.0 | 0.0 | 8.7 |
| 1001-1500 grams | 140 (76) | 17 | 11,530 | **1.5** | 0.0 | 0.0 | 0.0 | 0.0 | 3.9 |
| 1501-2500 grams | 151 (72) | 12 | 11,829 | **1.0** | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 |
| > 2500 grams | 150 (75) | 13 | 15,538 | **0.8** | 0.0 | 0.0 | 0.0 | 0.0 | 2.1 |

| Umbilical catheter utilization ratio ** | | | | | Percentile | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Birth-weight category | No. of locations + | Umbilical catheter-days | Patient-days | Pooled mean | 10% | 25% | 50% (median) | 75% | 90% |
| <=750 grams | 110 (83) | 8,800 | 63,689 | **0.14** | 0.06 | 0.10 | 0.18 | 0.23 | 0.37 |
| 751-1000 grams | 127 (105) | 8,809 | 79,681 | **0.11** | 0.05 | 0.08 | 0.12 | 0.20 | 0.27 |
| 1001-1500 grams | 140 (127) | 11,530 | 124,252 | **0.09** | 0.04 | 0.07 | 0.10 | 0.15 | 0.22 |
| 1501-2500 grams | 151 (143) | 11,829 | 198,570 | **0.06** | 0.02 | 0.03 | 0.06 | 0.10 | 0.14 |
| > 2500 grams | 150 (142) | 15,538 | 162,944 | **0.10** | 0.03 | 0.05 | 0.08 | 0.13 | 0.20 |

$$* \quad \frac{\text{Number of UCAB}}{\text{Number of umbilical catheter-days}} \times 1000$$

$$** \quad \frac{\text{Number of umbilical catheter-days}}{\text{Number of patient-days}}$$

*BSI*, bloodstream infection, includes laboratory-confirmed BSI; *UCAB*, umbilical catheter-associated BSI.

+ Number of locations meeting minimum requirements for percentile distributions if less than total number of locations. If this number < 20, percentile distributions are not calculated.

## Table 11. Pooled means and key percentiles of the distribution of ventilator-associated PNEU rates and ventilator utilization ratios for level III NICUs, DA module, 2009

| Ventilator-associated PNEU rate * | | | | | Percentile | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Birth-weight category | No. of locations + | No. of VAP | Ventilator-days | Pooled mean | 10% | 25% | 50% (median) | 75% | 90% |
| <=750 grams | 85 (79) | 93 | 51,592 | **1.8** | 0.0 | 0.0 | 0.2 | 2.8 | 6.7 |
| 751-1000 grams | 86 (72) | 34 | 26,635 | **1.3** | 0.0 | 0.0 | 0.0 | 1.8 | 7.8 |
| 1001-1500 grams | 90 (62) | 17 | 15,969 | **1.1** | 0.0 | 0.0 | 0.0 | 0.0 | 3.4 |
| 1501-2500 grams | 88 (45) | 7 | 13,569 | **0.5** | 0.0 | 0.0 | 0.0 | 0.0 | 1.8 |
| > 2500 grams | 87 (53) | 7 | 22,930 | **0.3** | 0.0 | 0.0 | 0.0 | 0.0 | 0.7 |

| Ventilator utilization ratio ** | | | | | Percentile | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Birth-weight category | No. of locations + | Ventilator-days | Patient-days | Pooled mean | 10% | 25% | 50% (median) | 75% | 90% |
| <=750 grams | 85 (83) | 51,592 | 118,886 | **0.43** | 0.25 | 0.36 | 0.47 | 0.56 | 0.65 |
| 751-1000 grams | 86 (84) | 26,635 | 100,973 | **0.26** | 0.10 | 0.17 | 0.24 | 0.36 | 0.48 |
| 1001-1500 grams | 90 (87) | 15,969 | 134,822 | **0.12** | 0.03 | 0.05 | 0.08 | 0.15 | 0.29 |
| 1501-2500 grams | 88 (85) | 13,569 | 173,799 | **0.08** | 0.02 | 0.03 | 0.04 | 0.11 | 0.20 |
| > 2500 grams | 87 (86) | 22,930 | 158,888 | **0.14** | 0.03 | 0.04 | 0.08 | 0.18 | 0.24 |

* $\frac{\text{Number of VAP}}{\text{Number of ventilator-days}} \times 1000$

** $\frac{\text{Number of ventilator-days}}{\text{Number of patient-days}}$

*PNEU,* pneumonia infection; *VAP,* ventilator-associated PNEU.

\+ Number of locations meeting minimum requirements for percentile distributions if less than total number of locations. If this number < 20, percentile distributions are not calculated.

## Table 12. Pooled means and key percentiles of the distribution of ventilator-associated PNEU rates and ventilator utilization ratios for level II/III NICUs, DA module, 2009

| Ventilator-associated PNEU rate * | | | | | Percentile | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Birth-weight category | No. of locations + | No. of VAP | Ventilator-days | Pooled mean | 10% | 25% | 50% (median) | 75% | 90% |
| <=750 grams | 55 (42) | 21 | 15,284 | **1.4** | 0.0 | 0.0 | 0.0 | 1.3 | 6.0 |
| 751-1000 grams | 61 (41) | 17 | 11,056 | **1.5** | 0.0 | 0.0 | 0.0 | 0.7 | 5.5 |
| 1001-1500 grams | 70 (33) | 9 | 7,436 | **1.2** | 0.0 | 0.0 | 0.0 | 0.0 | 4.0 |
| 1501-2500 grams | 67 (28) | 5 | 6,171 | **0.8** | 0.0 | 0.0 | 0.0 | 0.0 | 1.3 |
| > 2500 grams | 71 (28) | 4 | 7,602 | **0.5** | 0.0 | 0.0 | 0.0 | 0.0 | 4.5 |

| Ventilator utilization ratio ** | | | | | Percentile | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Birth-weight category | No. of locations + | Ventilator-days | Patient-days | Pooled mean | 10% | 25% | 50% (median) | 75% | 90% |
| <=750 grams | 55 (45) | 15,284 | 42,064 | **0.36** | 0.17 | 0.28 | 0.39 | 0.54 | 0.72 |
| 751-1000 grams | 61 (51) | 11,056 | 46,730 | **0.24** | 0.09 | 0.15 | 0.21 | 0.31 | 0.45 |
| 1001-1500 grams | 70 (62) | 7,436 | 63,940 | **0.12** | 0.03 | 0.05 | 0.07 | 0.13 | 0.26 |
| 1501-2500 grams | 67 (63) | 6,171 | 93,907 | **0.07** | 0.01 | 0.02 | 0.04 | 0.08 | 0.23 |
| > 2500 grams | 71 (66) | 7,602 | 82,631 | **0.09** | 0.02 | 0.04 | 0.06 | 0.10 | 0.24 |

* $\frac{\text{Number of VAP}}{\text{Number of ventilator-days}} \times 1000$

** $\frac{\text{Number of ventilator-days}}{\text{Number of patient-days}}$

*PNEU,* pneumonia infection; *VAP,* ventilator-associated PNEU.

+ Number of locations meeting minimum requirements for percentile distributions if less than total number of locations. If this number < 20, percentile distributions are not calculated.

## Table 13. Distribution of criteria for central line-associated laboratory confirmed BSI by location, 2009

| Type of Location | LCBI | | | | Total |
|---|---|---|---|---|---|
| | Criterion 1 | | Criterion 2/3 | | |
| **Critical Care Units** | | | | | |
| Burn | 183 | 94.8% | 10 | 5.2% | **193** |
| Medical<br>Major teaching | 606 | 81.9% | 134 | 18.1% | **740** |
| Medical<br>All other | 353 | 76.6% | 108 | 23.4% | **461** |
| Medical Cardiac | 432 | 77.7% | 124 | 22.3% | **556** |
| Medical/Surgical<br>Major teaching | 596 | 78.4% | 164 | 21.6% | **760** |
| Medical/Surgical<br>All other<br><= 15 beds | 749 | 76.3% | 233 | 23.7% | **982** |
| Medical/Surgical<br>All other<br>> 15 beds | 795 | 71.6% | 316 | 28.4% | **1,111** |
| Neurologic | 52 | 77.6% | 15 | 22.4% | **67** |
| Neurosurgical | 149 | 76.8% | 45 | 23.2% | **194** |
| Pediatric Cardiothoracic | 132 | 82.0% | 29 | 18.0% | **161** |
| Pediatric Medical | 31 | 86.1% | 5 | 13.9% | **36** |
| Pediatric Medical/Surgical | 408 | 81.0% | 96 | 19.0% | **504** |
| Respiratory | 24 | 88.9% | 3 | 11.1% | **27** |
| Surgical | 631 | 77.2% | 186 | 22.8% | **817** |
| Surgical Cardiothoracic | 424 | 78.5% | 116 | 21.5% | **540** |
| Trauma | 376 | 85.6% | 63 | 14.4% | **439** |
| **Inpatient Wards** | | | | | |
| Acute Stroke | | | 1 | 100.0% | **1** |
| Adult Step Down Unit<br>(post-critical care) | 244 | 83.3% | 49 | 16.7% | **293** |
| Genitourinary | 9 | 75.0% | 3 | 25.0% | **12** |
| Gerontology | 3 | 75.0% | 1 | 25.0% | **4** |
| Gynecology | 5 | 83.3% | 1 | 16.7% | **6** |
| Medical | 289 | 79.8% | 73 | 20.2% | **362** |
| Medical/Surgical | 548 | 78.3% | 152 | 21.7% | **700** |
| Neurology | 12 | 63.2% | 7 | 36.8% | **19** |
| Neurosurgical | 15 | 78.9% | 4 | 21.1% | **19** |
| Orthopedic | 24 | 72.7% | 9 | 27.3% | **33** |
| Orthopedic Trauma | 11 | 84.6% | 2 | 15.4% | **13** |
| Pediatric Medical | 18 | 90.0% | 2 | 10.0% | **20** |

## Table 13, continued

| Type of Location | LCBI | | | | Total |
|---|---|---|---|---|---|
| | Criterion 1 | | Criterion 2/3 | | |
| Pediatric Med/Surg | 38 | 70.4% | 16 | 29.6% | **54** |
| Pediatric Rehabilitation | 6 | 85.7% | 1 | 14.3% | **7** |
| Pulmonary | 17 | 100.0% | | | **17** |
| Rehabilitation | 37 | 92.5% | 3 | 7.5% | **40** |
| Step down Neonatal ICU (Level II) | 1 | 100.0% | | | **1** |
| Surgical | 128 | 74.0% | 45 | 26.0% | **173** |
| Vascular Surgery | 12 | 70.6% | 5 | 29.4% | **17** |
| **Inpatient Long-Term Care Units** | | | | | |
| Long-Term Care | 9 | 90.0% | 1 | 10.0% | **10** |
| **Total** | **7,367** | **78.5%** | **2,022** | **21.5%** | **9,389** |

See reference 11 for criteria.

*BSI*, bloodstream infection; *LCBI*, laboratory-confirmed BSI.

## Table 14. Distribution of criteria for permanent and temporary central line-associated laboratory confirmed BSI by location, 2009

| Type of location | LCBI | | | | Total |
|---|---|---|---|---|---|
| | Criterion 1 | | Criterion 2/3 | | |
| **Permanent Central Line** | | | | | |
| Bone Marrow Transplant | 135 | 71.1% | 55 | 28.9% | **190** |
| Hematology/Oncology | 141 | 74.6% | 48 | 25.4% | **189** |
| Long-Term Acute Care (LTAC) | 27 | 79.4% | 7 | 20.6% | **34** |
| Pediatric Hematology/ Oncology | 70 | 72.9% | 26 | 27.1% | **96** |
| Solid Organ Transplant | 6 | 85.7% | 1 | 14.3% | **7** |
| **Total** | 379 | 73.4% | 137 | 26.6% | **516** |
| **Temporary Central Line** | | | | | |
| Bone Marrow Transplant | 117 | 70.1% | 50 | 29.9% | **167** |
| Hematology/Oncology | 136 | 78.6% | 37 | 21.4% | **173** |
| Long-Term Acute Care (LTAC) | 351 | 81.6% | 79 | 18.4% | **430** |
| Pediatric Hematology/Oncol-ogy | 26 | 83.9% | 5 | 16.1% | **31** |
| Solid Organ Transplant | 39 | 83.0% | 8 | 17.0% | **47** |
| **Total** | **669** | **78.9%** | **179** | **21.1%** | **848** |

See reference 11 for criteria.

*BSI*, bloodstream infection; *LCBI*, laboratory-confirmed BSI.

## Table 15. Distribution of specific sites of urinary catheter-associated UTI by location, 2009

| Type of location | SUTI | | ABUTI | | Total |
|---|---|---|---|---|---|
| **Critical care units** | | | | | |
| Burn | 89 | 96.7% | 3 | 3.3% | **92** |
| Medical<br>Major teaching | 335 | 98.0% | 7 | 2.0% | **342** |
| Medical<br>All other | 346 | 98.6% | 5 | 1.4% | **351** |
| Medical Cardiac | 343 | 98.6% | 5 | 1.4% | **348** |
| Medical/Surgical<br>Major teaching | 577 | 97.5% | 15 | 2.5% | **592** |
| Medical/Surgical<br>All other<br><= 15 beds | 443 | 98.7% | 6 | 1.3% | **449** |
| Medical/Surgical<br>All other<br>> 15 beds | 505 | 99.0% | 5 | 1.0% | **510** |
| Neurologic | 122 | 98.4% | 2 | 1.6% | **124** |
| Neurosurgical | 356 | 99.7% | 1 | 0.3% | **357** |
| Pediatric Cardiothoracic | 24 | 96.0% | 1 | 4.0% | **25** |
| Pediatric Medical | 1 | 100.0% | | | **1** |
| Pediatric Medical/Surgical | 135 | 97.1% | 4 | 2.9% | **139** |
| Respiratory | 17 | 94.4% | 1 | 5.6% | **18** |
| Surgical | 605 | 99.0% | 6 | 1.0% | **611** |
| Surgical Cardiothoracic | 304 | 99.0% | 3 | 1.0% | **307** |
| Trauma | 432 | 98.9% | 5 | 1.1% | **437** |
| **Specialty Care Areas** | | | | | |
| Bone Marrow Transplant | 8 | 100.0% | | | **8** |
| Hematology/Oncology | 91 | 97.8% | 2 | 2.2% | **93** |
| Pediatric Hematology/ Oncology | 2 | 100.0% | | | **2** |
| Long-Term Acute Care (LTAC) | 438 | 97.6% | 11 | 2.4% | **449** |
| **Inpatient Wards** | | | | | |
| Adult Step Down Unit (post-critical care) | 381 | 97.9% | 8 | 2.1% | **389** |
| Behavioral Health/Psych | 6 | 100.0% | | | **6** |
| Genitourinary | 12 | 100.0% | | | **12** |
| Gynecology | 12 | 100.0% | | | **12** |
| Labor and Delivery | 5 | 100.0% | | | **5** |
| Labor, Delivery, Recovery, Postpartum Suite | 7 | 100.0% | | | **7** |

## Table 15, continued

| Type of location | SUTI | | ABUTI | | Total |
|---|---|---|---|---|---|
| Medical | 422 | 98.1% | 8 | 1.9% | **430** |
| Medical/Surgical | 1,121 | 98.2% | 20 | 1.8% | **1,141** |
| Neurology | 39 | 100.0% | | | **39** |
| Neurosurgical | 52 | 100.0% | | | **52** |
| Orthopedic | 154 | 100.0% | | | **154** |
| Orthopedic Trauma | 14 | 100.0% | | | **14** |
| Pediatric Med/Surg | 11 | 100.0% | | | **11** |
| Pediatric Medical | 2 | 100.0% | | | **2** |
| Pediatric Rehabilitation | 1 | 100.0% | | | **1** |
| Postpartum | 31 | 100.0% | | | **31** |
| Pulmonary | 16 | 94.1% | 1 | 5.9% | **17** |
| Rehabilitation | 257 | 99.6% | 1 | 0.4% | **258** |
| Surgical | 282 | 98.9% | 3 | 1.1% | **285** |
| Vascular Surgery | 20 | 100.0% | | | **20** |
| **Inpatient Long-Term Care Units** | | | | | |
| Long-Term Care Unit | 17 | 100.0% | | | **17** |
| **Total** | **8,035** | **98.5%** | **123** | **1.5%** | **8,158** |

See reference 10 for criteria.

## Table 16. Distribution of specific sites of ventilator-associated pneumonia by location, 2009

| Type of location | PNU1 | | PNU2 | | PNU3 | | Total |
|---|---|---|---|---|---|---|---|
| **Critical care units** | | | | | | | |
| Burn | 42 | 38.5% | 63 | 57.8% | 4 | 3.7% | **109** |
| Medical<br>Major teaching | 173 | 65.8% | 89 | 33.8% | 1 | 0.4% | **263** |
| Medical<br>All other | 118 | 66.3% | 57 | 32.0% | 3 | 1.7% | **178** |
| Medical Cardiac | 90 | 60.4% | 59 | 39.6% | | | **149** |
| Medical/Surgical<br>Major teaching | 228 | 57.3% | 166 | 41.7% | 4 | 1.0% | **398** |
| Medical/Surgical<br>All other<br><= 15 beds | 203 | 71.5% | 76 | 26.8% | 5 | 1.8% | **284** |
| Medical/Surgical<br>All other<br>> 15 beds | 227 | 65.2% | 118 | 33.9% | 3 | 0.9% | **348** |
| Neurologic | 32 | 52.5% | 29 | 47.5% | | | **61** |
| Neurosurgical | 98 | 58.0% | 71 | 42.0% | | | **169** |
| Pediatric Cardiothoracic | 6 | 40.0% | 8 | 53.3% | 1 | 6.7% | **15** |
| Pediatric Medical | 5 | 83.3% | 1 | 16.7% | | | **6** |
| Pediatric Medical/Surgical | 81 | 71.7% | 32 | 28.3% | | | **113** |
| Respiratory | 3 | 42.9% | 3 | 42.9% | 1 | 14.3% | **7** |
| Surgical | 360 | 55.8% | 276 | 42.8% | 9 | 1.4% | **645** |
| Surgical Cardiothoracic | 155 | 62.8% | 80 | 32.4% | 12 | 4.9% | **247** |
| Trauma | 279 | 48.1% | 299 | 51.6% | 2 | 0.3% | **580** |
| **Specialty Care Areas** | | | | | | | |
| Long-Term Acute Care (LTAC) | 31 | 73.8% | 10 | 23.8% | 1 | 2.4% | **42** |
| **Inpatient Wards** | | | | | | | |
| Adult Step Down Unit (post-critical care) | 24 | 88.9% | 3 | 11.1% | | | **27** |
| Medical | 1 | 100.0% | | | | | **1** |
| Medical/Surgical | | | 1 | 100.0% | | | **1** |
| Pulmonary | 3 | 60.0% | 2 | 40.0% | | | **5** |
| **Total** | **2,159** | **59.2%** | **1,443** | **39.6%** | **46** | **1.3%** | **3,648** |

See reference 7 for criteria.

## Table 17. Distribution of specific sites and criteria for device-associated BSI among Level III NICUs by birthweight, 2009

| Central line-associated BSI | | | | | |
|---|---|---|---|---|---|
| Birth-weight category | LCBI | | | | Total |
| | Criterion 1 | | Criterion 2/3 | | |
| <= 750 grams | 190 | 65.3% | 101 | 34.7% | **291** |
| 751-1000 grams | 121 | 64.7% | 66 | 35.3% | **187** |
| 1001-1500 grams | 96 | 72.2% | 37 | 27.8% | **133** |
| 1501-2500 grams | 57 | 67.9% | 27 | 32.1% | **84** |
| > 2500 grams | 46 | 63.0% | 27 | 37.0% | **73** |
| **Total** | **510** | **66.4%** | **258** | **33.6%** | **768** |

| Umbilical catheter-associated BSI | | | | | |
|---|---|---|---|---|---|
| Birth-weight category | LCBI | | | | Total |
| | Criterion 1 | | Criterion 2/3 | | |
| <= 750 grams | 56 | 59.6% | 38 | 40.4% | **94** |
| 751-1000 grams | 33 | 63.5% | 19 | 36.5% | **52** |
| 1001-1500 grams | 11 | 50.0% | 11 | 50.0% | **22** |
| 1501-2500 grams | 8 | 72.7% | 3 | 27.3% | **11** |
| > 2500 grams | 11 | 73.3% | 4 | 26.7% | **15** |
| **Total** | **119** | **61.4%** | **75** | **38.7%** | **194** |

See reference 11 for criteria.

*BSI*, bloodstream infection; *LCBI*, laboratory confirmed bloodstream infection.

## Table 18. Distribution of specific sites and criteria for device-associated BSI among Level II/III NICUs by birthweight, 2009

| Central line-associated BSI | | | | | |
|---|---|---|---|---|---|
| Birth-weight category | LCBI | | | | Total |
| | Criterion 1 | | Criterion 2/3 | | |
| <= 750 grams | 60 | 61.2% | 38 | 38.8% | **98** |
| 751-1000 grams | 55 | 65.5% | 29 | 34.5% | **84** |
| 1001-1500 grams | 37 | 62.7% | 22 | 37.3% | **59** |
| 1501-2500 grams | 26 | 63.4% | 15 | 36.6% | **41** |
| > 2500 grams | 22 | 78.6% | 6 | 21.4% | **28** |
| **Total** | **200** | **64.5%** | **110** | **35.5%** | **310** |

| Umbilical catheter-associated BSI | | | | | |
|---|---|---|---|---|---|
| Birth-weight category | LCBI | | | | Total |
| | Criterion 1 | | Criterion 2/3 | | |
| <= 750 grams | 21 | 53.8% | 18 | 46.2% | **39** |
| 751-1000 grams | 11 | 47.8% | 12 | 52.2% | **23** |
| 1001-1500 grams | 10 | 58.8% | 7 | 41.2% | **17** |
| 1501-2500 grams | 7 | 58.3% | 5 | 41.7% | **12** |
| > 2500 grams | 6 | 46.2% | 7 | 53.8% | **13** |
| **Total** | **55** | **52.9%** | **49** | **47.1%** | **104** |

See reference 11 for criteria.

*BSI*, bloodstream infection; *LCBI*, laboratory confirmed bloodstream infection.

## Table 19. Distribution of specific sites of ventilator-associated pneumonia among Level III NICUs by birthweight, 2009

| Birth-weight category | PNU1 | | PNU2 | | PNU3 | | Total |
|---|---|---|---|---|---|---|---|
| <= 750 grams | 73 | 78.5% | 19 | 20.4% | 1 | 1.1% | **93** |
| 751-1000 grams | 26 | 76.5% | 8 | 23.5% | 0 | 0.0% | **34** |
| 1001-1500 grams | 11 | 64.7% | 6 | 35.3% | 0 | 0.0% | **17** |
| 1501-2500 grams | 5 | 71.4% | 2 | 28.6% | 0 | 0.0% | **7** |
| > 2500 grams | 6 | 85.7% | 1 | 14.3% | 0 | 0.0% | **7** |
| **Total** | **121** | **76.6%** | **36** | **22.8%** | **1** | **0.6%** | **158** |

See reference 7 for criteria.

## Table 20. Distribution of specific sites of ventilator-associated pneumonia among Level II/III NICUs by birthweight, 2009

| Birth-weight category | PNU1 | | PNU2 | | PNU3 | | Total |
|---|---|---|---|---|---|---|---|
| <= 750 grams | 14 | 66.7% | 3 | 14.3% | 4 | 19.0% | **21** |
| 751-1000 grams | 10 | 58.8% | 4 | 23.5% | 3 | 17.6% | **17** |
| 1001-1500 grams | 6 | 66.7% | 3 | 33.3% | 0 | 0.0% | **9** |
| 1501-2500 grams | 3 | 60.0% | 2 | 40.0% | 0 | 0.0% | **5** |
| > 2500 grams | 3 | 75.0% | 1 | 25.0% | 0 | 0.0% | **4** |
| **Total** | **36** | **64.3%** | **13** | **23.2%** | **7** | **12.5%** | **56** |

See reference 7 for criteria.

# Appendix A.
# How to calculate a device-associated infection rate and device utilization ratio with Device-associated Module data

## *Calculation of Device-associated Infection Rate*

**Step 1:** Decide upon the time period for your analysis. It may be a month, a quarter, 6 months, a year, or some other period.

**Step 2:** Select the patient population for analysis, e.g., the type of location or a birthweight category in a NICU.

**Step 3:** Select the infections to be included in the numerator. They must be site-specific and must have occurred in the selected patient population. Their date of onset must be during the selected time period.

**Step 4:** Determine the number of device-days which is used as the denominator of the rate. Device-days are the total number of days of exposure to the device (central line, umbilical catheter, ventilator, or urinary catheter) by all of the patients in the selected population during the selected time period.

Example: Five patients on the first day of the month had one or more central lines in place; five on day 2; two on day 3; five on day 4; three on day 5; four on day 6; and four on day 7. Adding the number of patients with central lines on days 1 through 7, we would have 5+5+2+5+3+4+4=28 central line-days for the first week. If we continued for the entire month, the number of central line-days for the month is simply the sum of the daily counts.

**Step 5:** Calculate the device-associated infection rate (per 1000 device-days) using the following formula:

**Device-associated Infection Rate =**

$$\frac{\text{Number of device-associated infections for an infection site}}{\text{Number of device-days}} \times 1000$$

**Example: Central line-associated BSI rate per 1000 central line-days =**

$$\frac{\text{Number of central line-associated BSI}}{\text{Number of central line-days}} \times 1000$$

## *Calculation of Device Utilization (DU) Ratio*

**Steps 1,2,4:** Same as device-associated infection rates plus determine the number of patient-days which is used as the denominator of the DU ratio. Patient-days are the total number of days that patients are in the location during the selected time period.

Example: Ten patients were in the unit on the first day of the month; 12 on day 2; 11 on day 3; 13 on day 4; 10 on day 5; 6 on day 6; and 10 on day 7; and so on. If we counted the patients in the unit from days 1 through 7, we would add 10 + 12 + 11 + 13 + 10 + 6 + 10 for a total of 72 patient-days for the first week of the month. If we continued for the entire month, the number of patient-days for the month is simply the sum of the daily counts.

**Step 5:** Calculate the DU ratio with the following formula:

**DU Ratio =**

$$\frac{\text{Number of device-days}}{\text{Number of patient-days}}$$

With the number of device-days and patient-days from the examples above, DU = 28/72 = 0.39 or 39% of patient-days were also central line-days for the first week of the month.

**Step 6:** Examine the size of the denominator for your hospital's rate or ratio. Rates or ratios may not be good estimates of the "true" rate or ratio for your hospital if the denominator is small, i.e., <50 device-days or patient-days.

**Step 7:** Compare your hospital's location-specific rates or ratios with those found in the tables of this report. Refer to Appendix B for interpretation of the percentiles of the rates/ratios.

# Appendix B.
# Interpretation of percentiles of infection rates or device utilization ratios

**Step 1:** Evaluate the rate (ratio) you have calculated for your hospital and confirm that the variables in the rate (both numerator and denominator) are identical to the rates (ratios) in the table.

**Step 2:** Examine the percentiles in each of the tables and look for the 50th percentile (or median). At the 50th percentile, 50% of the hospitals have lower rates (ratios) than the median and 50% have higher rates (ratios).

**Step 3:** Determine if your hospital's rate (ratio) is above or below this median.

### *Determining whether your hospital's rate or ratio is a HIGH outlier*

**Step 4:** If it is above the median, determine whether the rate (ratio) is above the 75th percentile. At the 75th percentile, 75% of the hospitals had lower rates (ratios) and 25% of the hospital had higher rates (ratios).

**Step 5:** If the rate (ratio) is above the 75th percentile, determine whether it is above the 90th percentile. If it is, then the rate (ratio) is an outlier which may indicate a problem.

### *Determining whether your hospital's rate or ratio is a LOW outlier*

**Step 6:** If it is below the median, determine whether the rate (ratio) is below the 25th percentile. At the 25th percentile, 25% of the hospitals had lower rates (ratios) and 75% of the hospitals had higher rates (ratios).

**Step 7:** If the rate (ratio) is below the 25th percentile, determine whether it is below the 10th percentile. If the rate is, then it is a low outlier which may be due to underreporting of infections. If the ratio is below the 10th percentile, it is a low outlier and may be due to infrequent and/or short duration of device use.

**Note:** Device-associated infection rates and device utilization ratios should be examined together so that preventive measures may be appropriately targeted. For example, you find that the ventilator-associated pneumonia rate for a certain type of ICU is consistently above the 90th percentile and the ventilator utilization ratio is routinely between the 75th and 90th percentile. Since the ventilator is a significant risk factor for pneumonia, you may want to limit the duration of ventilation whenever possible (i.e., decrease unnecessary use) while at the same time optimize infection prevention strategies in patients for which ventilator use is required.

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# NHSN Updates

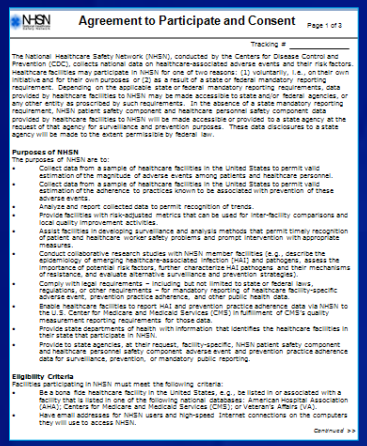
Daniel Pollock
Surveillance Branch Chief
Division of Healthcare Quality Promotion
National Center for Emerging and Zoonotic Infectious Diseases
Centers for Disease Control and Prevention

July 7, 2011
Monthly Call
American Hospital Association &
State Hospital Associations

# Use of the NHSN Patient Safety Component is Mandated in 25 States and the District of Columbia

| | |
|---|---|
| Central line-associated bloodstream infections (CLABSIs) | AL, AR, CA, CO, CT, DC, DE, HI, IL, MA, MD, NH, NJ, NV, NY, OK, OR, PA, SC, TN, TX, VA, VT, WA, WV |
| Surgical site infections (SSIs) | AL, CA, CO, DE, HI, IL, MA, MD, NH, NJ, NV, NY, OR, PA, SC, TN, TX, VT, WA |
| Multidrug-resistant organisms and *Clostridium difficile* infections | CA, DC, ME, NJ, NV, NY, PA, TN and other states considering its use |
| Ventilator-associated pneumonias (VAPs) | OK, PA, WA |
| Catheter-associated urinary tract infections (CAUTIs) | AL, NJ, PA |
| Central line insertion practices (CLIP) | CA, NH |
| Dialysis events | CO |

# NHSN Agreement to Participate and Consent Form



N-SN

Agreement to Participate and Consent

Page 1 of 3

Tracking # _____

The National Healthcare Safety Network (NHSN), conducted by the Centers for Disease Control and Prevention (CDC), collects national data on healthcare-associated adverse events and their risk factors. Healthcare facilities may participate in NHSN for one of two reasons: (1) voluntarily, i.e., on their own initiative and for their own purposes or (2) as a result of a state or federal mandatory reporting requirement. Depending on the applicable state or federal mandatory reporting requirements, data provided by healthcare facilities to NHSN may be made accessible to state and/or federal agencies, or any other entity as prescribed by such requirements. In the absence of a state mandatory reporting requirement, NHSN patient safety component and healthcare personnel safety component data provided by healthcare facilities to NHSN will be made accessible or provided to a state agency at the request of that agency for surveillance and prevention purposes. These data disclosures to a state agency will be made to the extent permissible by federal law.

**Purposes of NHSN**

The purposes of NHSN are to:

- Collect data from a sample of healthcare facilities in the United States to permit valid estimation of the magnitude of adverse events among patients and healthcare personnel.
- Collect data from a sample of healthcare facilities in the United States to permit valid estimation of the adherence to practices known to be associated with prevention of these adverse events.
- Analyze and report collected data to permit recognition of trends.
- Provide facilities with risk-adjusted metrics that can be used for inter-facility comparisons and local quality improvement activities.
- Assist facilities in developing surveillance and analysis methods that permit timely recognition of patient and healthcare worker safety problems and prompt intervention with appropriate measures.
- Conduct collaborative research studies with NHSN member facilities (e.g., describe the epidemiology of emerging healthcare-associated infection [HAI] and pathogens, assess the importance of potential risk factors, further characterize HAI pathogens and their mechanisms of resistance, and evaluate alternative surveillance and prevention strategies).
- Comply with legal requirements – including but not limited to state or federal laws, regulations, or other requirements – for mandatory reporting of healthcare facility-specific adverse event, prevention practice adherence, and other public health data.
- Enable healthcare facilities to report HAI and prevention practice adherence data via NHSN to the U.S. Center for Medicare and Medicaid Services (CMS) in fulfillment of CMS's quality measurement reporting requirements for those data.
- Provide state departments of health with information that identifies the healthcare facilities in their state that participate in NHSN.
- Provide to state agencies, at their request, facility-specific NHSN patient safety component and healthcare personnel safety component adverse event and prevention practice adherence data for surveillance, prevention, or mandatory public reporting.

**Eligibility Criteria**

Facilities participating in NHSN must meet the following criteria:

- Be a bona fide healthcare facility in the United States, e.g., be listed in or associated with a facility that is listed in one of the following national databases: American Hospital Association (AHA); Centers for Medicare and Medicaid Services (CMS); or Veterans Affairs (VA).
- Have email addresses for NHSN users and high-speed Internet connections on the computers they will use to access NHSN.

Continued >>

- **New stated purposes for NHSN include –** Extending data access to state health departments, even in the absence of a HAI reporting mandate
- **Assurance of confidentiality** - The voluntarily provided information obtained in this surveillance system . . . **will be used only for the purposes stated**, and will not otherwise be disclosed or released without the consent of the individual, or the institution . . ." (emphasis added)

# State-CDC Data Use Agreement Template: Covered Data

- Covers individual- and institution-identifiable data from the NHSN Patient Safety Component and Healthcare Personnel Safety Component that are voluntarily submitted to NHSN and for which there is **no** state mandate for reporting such individual- or institution-identifiable data ("Covered Data")
- State agrees to use Covered Data for surveillance and/or prevention purposes only (e.g., evaluating the impact of a targeted program to reduce central-line associated bloodstream infections)
- State specifically agrees not to use the Covered Data obtained under this data use agreement for any regulatory or punitive actions against healthcare institutions or for public reporting of institution-identifiable data

# State-CDC Data Use Agreement Template: Data Protections

- State acknowledges that Federal statutes may be implicated if the State does not protect the Covered Data from release pursuant to the Data Use Agreement
- State specifies legal, administrative, and technical safeguards it will use to protect the Covered Data
- State agrees that to the extent permitted by State law it will not release Covered Data requested under a State's open records law to media, for litigation purposes, or if data release could cause competitive harm
- State agrees to inform CDC in advance of any changes to State laws that will reduce legal safeguards that protect against data releases

# State-CDC Data Use Agreement Template: Provision and Management of Data

- State acknowledges that its access to Covered Data will be for adverse healthcare events and/or processes of care that occur after signing this agreement, specifically three full months after the signing date. Covered Data for prior events or processes of care will not be accessible
- State acknowledges that CDC/NHSN will provide a time-limited opportunity for institutions to opt out of reporting Covered Data to NHSN
- State acknowledges that CDC/NHSN will notify newly enrolling institutions of the provisions of this agreement

# State-CDC Data Use Agreement Template: Term and Termination of the Agreement

- Agreement shall be effective for a period of 5 years and may be terminated before the 5-year period by either party
- Upon CDC/NHSN's knowledge of a pattern or practice that constitutes material breach of this agreement by the state, CDC/NHSN may immediately and unilaterally terminate this agreement
- CDC requires that in the absence of a conflict with State law, the State must delete or otherwise destroy individual-identifiable Covered Data stored in its files within one year of the conclusion of the Data Use Agreement or a successor Agreement
- State signatory is state health officer or state epidemiologist; CDC/NHSN signatory is Director, Division of Healthcare Quality Promotion

# Program Operations and Technical Plans for Enabling New Access to NHSN Data

- State requests access to NHSN Patient Safety Component and Healthcare Personnel Safety Component data
- State and CDC use the Data Use Agreement Template as the starting point for discussions and decision-making about whether to complete and sign an agreement
- CDC provides access to the Covered Data specified in the agreement by preparing a data set or data sets for the state that cover an agreed-upon reporting interval or by enabling state access through an enhancement to the Group function of the NHSN reporting application

# Surgical Site Infection Reporting from NHSN to CMS: On the Horizon for 2012

- The American College of Surgeons (ACS) and CDC submitted separate surgical site infection (SSI) measure proposals to the National Quality Forum (NQF)
- At CMS's request, CDC worked with ACS to develop a single SSI measure proposal that is currently under review at NQF
- The scope of the single SSI measure proposal is 2 of the 10 NHSN operative procedure categories that CDC originally submitted to NQF: colon surgeries and abdominal hysterectomies
- The proposed SSI measure is a prototype and is to be followed by a more comprehensive measure or set of measures that add operative procedures and expand SSI risk adjustment
- NHSN reporting requirements for the prototype SSI measure involve no changes to the NHSN Patient Safety Protocol for SSIs

# Proposal for a Prototype SSI Measure: Main Elements of ACS-CDC Agreement

1. Colon surgeries and abdominal hysterectomies, specified using ICD-9-CM procedure codes for NHSN operative procedure categories, with CPT mappings to those categories
2. Separate SIRs for the two operative procedure categories
3. For some hospitals, SIRs will be calculated using a sample:
   - The first colon surgery per 8-day cycle for hospitals >42 colon surgeries annually
   - First 5 abdominal hysterectomies per 8-day cycle for hospitals >200 abdominal hysterectomies annually
4. Follow up for $\leq$ 30 days
5. Admission, readmission, and post-discharge surveillance
6. Includes inpatients who are $\geq$18 years old with deep incisional and organ/space SSIs
7. Risk adjustment: age and ASA score

Health Care Quality Performance (HCQP) Program

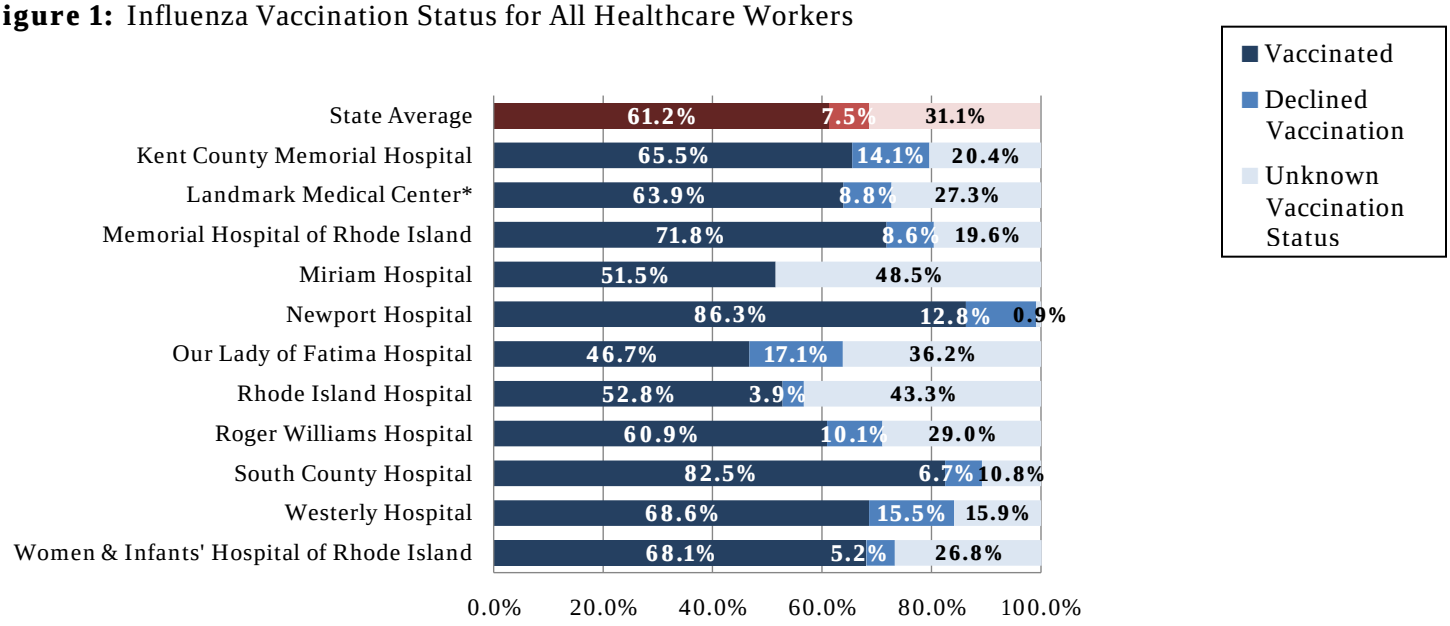
# HOSPITAL EMPLOYEE INFLUENZA VACCINATION STATUS

Data Report
October 2009-March 2010

Information about hospital employee influenza vaccination is reported annually on the Department of Health's (HEALTH's) Web site as part of the quality reporting program. Vaccinating healthcare workers can prevent the spread of influenza, or flu, to hospital patients. You can learn more about the rates—including their data source and how they are calculated—by reading the Technical Page. With questions about a hospital's score, please contact the hospital directly. This information is updated each year in the Spring.

**NOTE**: In hospitals, some of the doctors who care for patients are hospital employees and some are not hospital employees, but have "privileges" to see their patients when they are hospitalized. The information below includes only doctors and other healthcare workers who are hospital employees.

**Figure 1:** Influenza Vaccination Status for All Healthcare Workers

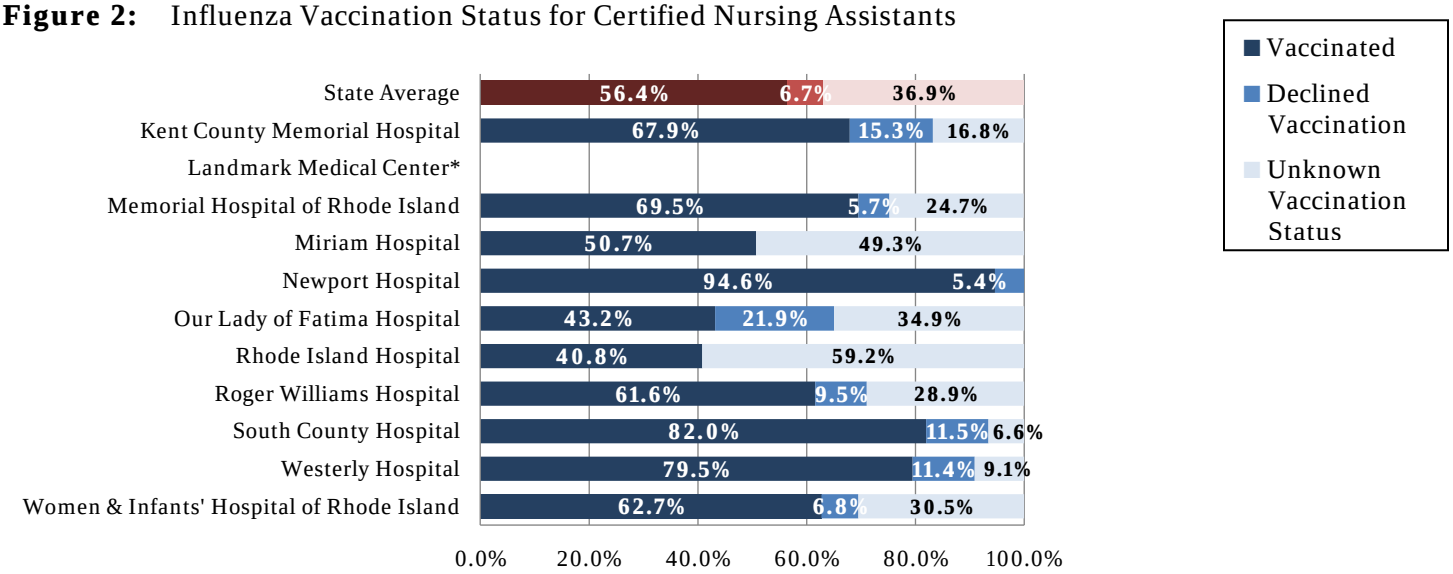



*** Hospital did not submit data**

**Hospital Score**
(% of All Healthcare Workers)

*For % vaccinated, higher scores are better*

**Figure 2:** Influenza Vaccination Status for Certified Nursing Assistants

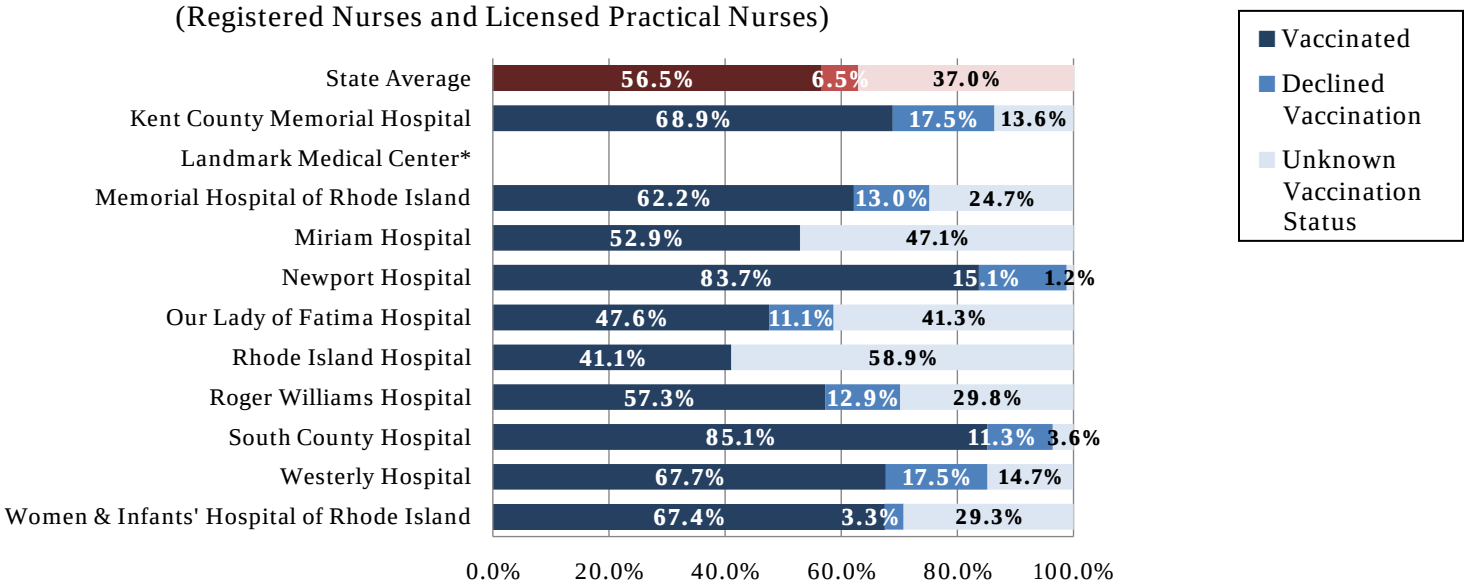



*** Hospital did not submit data**

**Hospital Score**
(% of Certified Nursing Assistants)

*For % vaccinated, higher scores are better*

**Figure 3:** Influenza Vaccination Status for Nurses
(Registered Nurses and Licensed Practical Nurses)

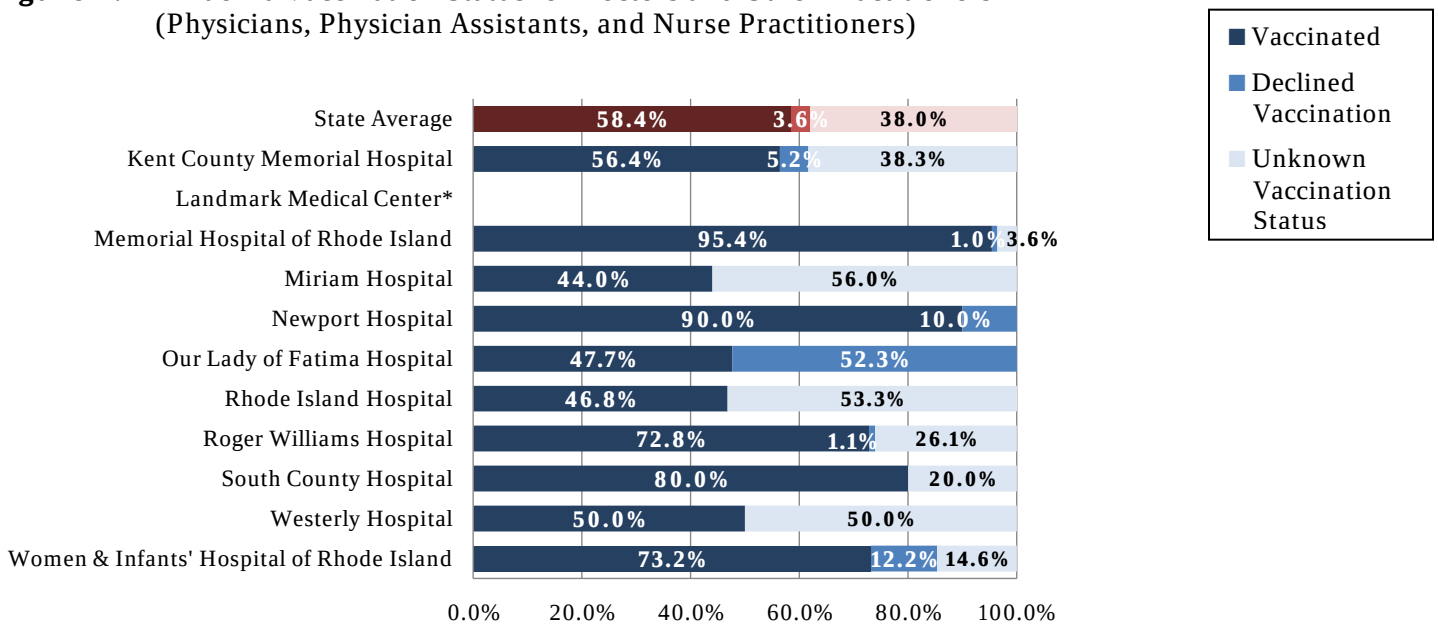



*** Hospital did not submit data**

**Hospital Score**
(% of Nurses)

*For % vaccinated, higher scores are better*

**Figure 4:** Influenza Vaccination Status for Doctors and Other Practitioners (Physicians, Physician Assistants, and Nurse Practitioners)




*** Hospital did not submit data**

**Hospital Score**
(% of Doctors/Practitioners)

*For % vaccinated, higher scores are better*