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# A Multidisciplinary Approach to Incorporate Bedside Nurses into Antimicrobial Stewardship and Infection Prevention

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**Background:** Antimicrobial stewardship programs exist to promote appropriate antimicrobial use. The Joint Commission has reported that although many US hospitals have implemented basic components of antimicrobial stewardship programs, there now exists a need for innovative, multidisciplinary approaches, including involving frontline clinicians such as bedside nurses.

**Methods:** A retrospective evaluation of bedside nurse–driven antimicrobial stewardship and infection prevention rounds was conducted on a 31-bed telemetry unit of a community regional medical center. Rounds were managed by a nurse coordinator and attended by an infectious diseases pharmacist, an infection preventionist, and a nurse practitioner. Primary outcome measures were antimicrobial and acid suppressant medication and invasive catheter use.

**Results:** In the 12-month intervention period the nurse-driven rounds team reviewed of a total of 472 antimicrobial medication, 480 acid suppressant medication, 321 urinary catheter, and 61 central venous catheter therapies over 867 total patient encounters. Compared with the 12-month preintervention period, significant reductions in unit antimicrobial use (791.2 vs. 697.1 days of therapy per 1,000 patient-days; $p = 0.03$), acid suppressant medication use (708.1 vs. 372.4 days of therapy per 1,000 patient-days; $p = 0.0001$), and urinary catheter use (0.3 vs. 0.2 catheter-days per patient-day; $p = 0.002$) were observed.

**Conclusion:** This study demonstrates successful engagement of bedside nurses in antimicrobial stewardship and infection prevention activities and a measurable impact on meaningful outcomes. More studies of strategies to integrate bedside nurses in antimicrobial stewardship are needed.

Antimicrobial resistance (AMR) is one of the greatest threats to global public health. Modeling suggests that from the current 700,000 deaths per year, deaths attributed to drug-resistant infections by 2050 will exceed 10 million annually, costing the global economy up to $100 trillion between 2015 and 2050.[1] Antimicrobial stewardship programs (ASPs) have been shown to improve patient outcomes and appropriate antibiotic use, while stabilizing or reducing AMR.[2] To address increasing rates of AMR, The Joint Commission issued a new Medication Management (MM) standard on antimicrobial stewardship (AMS): MM.09.01.01. This standard, effective January 1, 2017, consists of eight elements of performance and was designed around the core elements of ASPs recommended by the Centers for Disease Control and Prevention (CDC).[3,4]

Nine months after enactment of MM.09.01.01, only 34 of 779 (4.4%) hospitals surveyed were cited for deficiencies in their ASPs. Although this suggests that basic ASP components have been widely adopted, it is now imperative that institutions take the next steps in the continued progression of AMS, maximizing their effectiveness using existing resources.[4] A recent survey of leading ASPs suggests that a multidisciplinary approach, with AMS activities incorporated into the routine duties of direct patient care staff, offers advantages over the traditional model in which AMS is performed only by infectious diseases (ID) physicians and pharmacists.[5] Others have also advocated for this inclusive team effort approach in AMS.[4,6,7]

A multidisciplinary, interprofessional approach in ASPs has been espoused by the CDC.[3] Physicians and pharmacists, as well as infection preventionists (IPs), microbiologists, and administrators, have been traditionally recognized as core members of ASPs.[8] More recently, bedside nurses have been endorsed by a variety of organizations. including the CDC, the American Nurses Association, and the National Quality Forum, as contributors with potential to enhance antimicrobial stewardship efforts due to their integral role in the antimicrobial use process.[3,9,10] However, literature

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demonstrating successful integration of bedside nurses in ASPs is limited.[9,11,12]

To address the gap in literature on the impact of bedside nurses on AMS outcomes, Joint Commission executive vice president David W. Baker recently announced a call for studies of innovative AMS approaches in hospitals, including "Nurse engagement and nursing protocols to improve antimicrobial stewardship."[4 (p. 63)] This report describes the clinical outcomes of a bedside nurse–driven AMS intervention in a community regional medical center.

## METHODS

### Setting and Study Design

Pomona Valley Hospital Medical Center is a 417-bed community regional medical center. We performed a retrospective evaluation of bedside nurse–driven AMS rounds on a 31-bed medical step-down telemetry unit. July 2015 to June 2016 represented the preintervention time period, and July 2016 to June 2017 represented the intervention time period. This study was approved by the hospital Institutional Review Board.

### Intervention Design and Implementation

A multidisciplinary taskforce of ID pharmacists, nurses, nurse managers, ID physicians, and IPs was convened by the ASP committee to pilot a bedside nurse–driven intervention for AMS and infection prevention in January 2016. The design and implementation phase occurred from January 2016 to July 2016.

The task force began by aligning the goals of the pilot with hospital institutional priorities of AMS and infection prevention, namely promoting appropriate antimicrobial use and reducing hospital-associated infections, including health care facility–onset *Clostridium difficile* infections (HO-CDIs), catheter-associated urinary tract infections (CAUTIs), and central line–associated bloodstream infections (CLABSIs). The task force identified four meaningful measures related to these priorities that could be practically influenced by bedside nursing staff with appropriate clinical support: (1) antimicrobial medication use, (2) acid suppressant medication use, (3) urinary catheter use, and (4) central venous catheter (CVC) use.

Next, the task force determined what form the nurse-driven intervention would take to address these measures. Bedside nurse–driven, interdisciplinary rounds was chosen as the optimal method of intervention due to prior success with this type of activity for other hospital initiatives. A single telemetry unit was chosen to pilot the intervention due to preexisting working relationships between unit nursing staff and members of the ASP committee. The nurse-driven rounds were to be distinct and separate from already existing daily audit-and-feedback rounds performed by the ID physician and pharmacist that were an established practice of the existing hospital ASP.

A nurse coordinator was appointed from the unit nursing staff to champion and coordinate the nurse-driven rounds prior to implementation. The nurse coordinator's tasks were the initial education and ongoing coaching of nursing staff, daily coordination of rounds, and regular tracking and reporting of process and outcome measures. The nurse coordinator was trained in AMS principles and patient assessment by the ASP ID physician and ID pharmacist. Training included education on appropriate antibiotic use for various infectious syndromes, shadowing of audit-and-feedback rounds with the ID physician and pharmacist, and analysis of relevant AMS publications.

To assist the nurse coordinator in patient identification and outcomes tracking, two electronic tools were developed by the task force and hospital information services department. The first was a report that could be run in real time to identify patients with active orders for antimicrobial or acid suppressant medications or active urinary catheters or CVCs. This report was used on a twice weekly basis to identify patients who met criteria to be discussed by the nurse and rounds team. The second tool was an editable database for tracking interventions made by the nurse and rounds team. Both tools were linked to the hospital electronic medical record.

Three additional individuals (an ID pharmacist, an IP, and a critical care nurse practitioner) were included to complete the rounds team alongside the nurse coordinator and bedside nursing staff. The roles of these additional clinicians were to provide real-time therapeutic and diagnostic expertise to the nursing staff during rounds and assist in patient assessment and formulation of recommendations for primary physicians as described below. Protected time for these individuals to participate in rounds was granted by the departments of pharmacy, infection prevention, and nursing.

Nurse-driven rounds were performed on a twice-weekly basis on Mondays and Thursdays. During rounds, bedside nurses would individually present their patient to the interdisciplinary rounds team if their patient was receiving antimicrobial or acid suppressant medications or had an active urinary catheter or CVC and provide their assessment of those therapies (Appendix 1, available in online article). Recommendations developed by the rounds team would be communicated directly by the bedside nurse to the patient's treating physician either by phone or though face-to-face discussion. If potential opportunities for therapy modification were identified by the nurse and rounds team but required additional clinical assessment, they were referred to the ID pharmacist for later audit-and-feedback rounds with the ID physician. In such cases, the ID physician would communicate any recommendations to the patient's treating physician as part of the preexisting audit-and-feedback practice of the hospital ASP, in which the patient case was reviewed in detail on formal audit-and-feedback rounds with the ID pharmacist.

As previously mentioned, the task force was formed in January 2016. The task force's nurse-driven rounds proposal received approval as a pilot initiative by the hospital ASP committee and Nursing Practice Council in May 2016. Throughout June 2016, the nurse coordinator and ID pharmacist systematically educated all participating unit nursing staff on the purpose and expectations of the initiative, how to appropriately assess their patients, and the roles of the members of the rounds team. The nurse-driven rounds were launched in July 2016.

## Study Outcomes and Statistical Analysis

Primary outcome measures were unit antimicrobial and acid suppressant medication use (days of therapy per 1,000 patient-days) and invasive catheter use (urinary catheter or CVC-days per patient-day). Antimicrobial medication use was measured in four aggregate clinical groups outlined by CDC National Healthcare Safety Network (NHSN) Antibiotic Use and Resistance Module, NHSN Groups 1 through 4. NHSN Group 1 represented broad-spectrum antibacterial agents predominantly used for hospital-onset/multidrug-resistant infections. NHSN Group 2 represented broad-spectrum antibacterial agents predominantly used for community-acquired infections. NHSN Group 3 represented anti-MRSA (methicillin-resistant *Staphylococcus aureus*) antibacterial agents. NHSN Group 4 represented antibacterial agents predominantly used for surgical site infection prophylaxis.[13]

Secondary outcomes were the incidence of unit HO-CDI, CAUTI, and CLABSI and unit length of stay. Continuous variables were compared using Student's *t*-tests. A $p$ value $< 0.05$ was considered significant; all statistical tests were two-tailed. Analyses were performed using SAS 9.4 (SAS Institute Inc., Cary, North Carolina).

Process measures collected were the total number of patient encounters and therapy reviews performed by the nurse and rounds team. Therapy reviews were defined as documented active discussions between the nurse and rounds time regarding indication and appropriateness of any of four distinct therapies: (1) antimicrobial medications, (2) acid-suppressant medications, (3) urinary catheters, and (4) CVCs.

**Table 1.** Nurse-Driven Antimicrobial Stewardship Rounds Outcomes

| Variable | Preintervention | During Intervention | *p* Value |
|---|---|---|---|
| **Intervention Unit Demographics** | | | |
| Patient-days, mean monthly days | 717.2 | 777.3 | 0.12 |
| Cumulative mortality index, mean monthly | 1.9 | 1.7 | 0.10 |
| **Antibiotic Therapy Outcomes, mean monthly days of therapy per 1,000 patient-days** | | | |
| All NHSN Groups* | 791.2 | 697.1 | 0.03† |
| NHSN Group 1 | 225.6 | 223.2 | 0.89 |
| NHSN Group 2 | 359.1 | 300.5 | 0.006† |
| NHSN Group 3 | 170.5 | 145.7 | 0.11 |
| NHSN Group 4 | 36.1 | 27.7 | 0.15 |
| **Acid Suppressant Therapy Outcomes, mean monthly days of therapy per 1,000 patient-days** | | | |
| All acid suppressants | 708.1 | 372.4 | 0.0001† |
| Histamine-2 receptor antagonists | 341.1 | 72.07 | < 0.0001† |
| Proton pump inhibitors | 367.0 | 300.3 | 0.10 |
| **Catheter Use Outcomes, mean monthly catheter-days per patient-day** | | | |
| Urinary catheter | 0.3 | 0.2 | 0.002† |
| Central venous catheter | 0.2 | 0.1 | 0.06 |
| **Health Care–Associated Infections, mean monthly infections** | | | |
| Health care facility–onset *Clostridium difficile* infection | 1.4 | 0.8 | 0.33 |
| Catheter-associated urinary tract infection | 0.3 | 0.08 | 0.29 |
| Central line–associated bloodstream infection | 0.2 | 0 | 0.17 |
| **Health Care–Associated Infections, mean monthly rates** | | | |
| Health care facility–onset *Clostridium difficile* infection per 10,000 patient-days | 17.8 | 11.0 | 0.35 |
| Catheter-associated urinary tract infection per 1,000 urinary catheter-days | 1.48 | 0.8 | 0.55 |
| Central line–associated bloodstream infection per 1,000 CVC-days | 1.62 | 0 | 0.17 |
| **Length of Stay** | | | |
| Unit length of stay, mean monthly days | 5.0 | 4.3 | 0.09 |

NHSN, National Healthcare Safety Network; CVC, central venous catheter; MRSA, methicillin-resistant *Staphylococcus aureus*.

* NHSN Group 1: broad-spectrum antibacterial agents predominantly used for hospital-onset/multidrug-resistant infections; NHSN Group 2: broad-spectrum antibacterial agents predominantly used for community-acquired infections; NHSN Group 3: anti-MRSA antibacterial agents; NHSN Group 4: antibacterial agents predominantly used for surgical site infection prophylaxis.

† $p$ value $< 0.05$.

## RESULTS

In the intervention period, the nurse-driven rounds team reviewed a total of 472 antibiotic, 480 acid suppressant, 321 urinary catheter, and 61 CVC therapies over 867 total patient encounters. Statistically significant reductions in antimicrobial use were observed between baseline and intervention periods for all antimicrobial groups in aggregate and in broad-spectrum antibacterial agents predominantly used for community-acquired infections (NHSN Group 2). Histamine-2 receptor antagonist (H2RA) use also significantly decreased from baseline to intervention periods. Urinary catheter use significantly decreased following the intervention. Reductions in CVC use, proton pump inhibitor (PPI) use, unit length of stay, HO-CDI, CAUTI, and CLABSI were observed but did not reach statistical significance. (Table 1)

## DISCUSSION

To our knowledge, this is the first study to describe quantitative outcomes of a bedside nurse–driven AMS intervention. We demonstrated significant reductions in antibiotic, acid suppressant, and urinary catheter use. Reductions in antibiotic and acid suppressant use, both of which have been linked to *Clostridium difficile* infections (CDIs), may have contributed to a trend toward decreased CDI in our intervention patient cohort.[14] These findings demonstrate that bedside nurses can meaningfully enhance outcomes of existing ASPs when provided both clinical support from traditional AMS clinicians, including ID pharmacists, IPs, and ID physicians, as well as peer support from bedside nurse champions and nursing management.

Nurses have always performed various tasks central to the functions of AMS in all health care settings, including patient triage and isolation, reporting laboratory results to prescribers, and administering and monitoring response to antimicrobial therapy.[11,15] However, nurses are rarely included in AMS activities, and literature on *how* to engage nurses in AMS activities is limited.[9,11,12] This appears to be due to both a perceived lack of knowledge and confidence among nurses themselves surrounding antimicrobial use and to a "siloing" of these nursing functions apart from the traditional ASP structure.[12,16,17] In an effort to overcome such barriers, the nursing community has recognized that there must be a change in nursing education and practice, in which the "passive" role of nurses must be replaced by the integration of nurses into the clinical decision-making team.[18]

By incorporating bedside nurses into the clinical decision-making process with real-time expertise provided on rounds as well as coaching from the nurse coordinator, we observed an enhancement of nurses' clinical assessment skills and an increase in their confidence to facilitate discussions with the AMS team. More efficient and better informed management of patients occurred, with nurses alerting the ID pharmacist of patients requiring more detailed assessment, which produced additional cases for audit-and-feedback interventions by the AMS ID pharmacist and ID physician. The quantity of these audit-and-feedback interventions trended upward after launching the intervention (by approximately 30% over the intervention period; $p$ not significant). This suggested that nurse interventions did not simply shift stewardship responsibilities from one discipline to another and may have provided added value to the hospital's existing ASP. Instead of assessing antimicrobial therapy indications generally, using such as terms *sepsis*, or *infection*, we observed nurses learning to evaluate specific presumptive sources of infection along with available culture and susceptibility data to assess appropriate therapy. As a specific example of this, nurses were educated on the high rates of local resistance to fluoroquinolone antimicrobials and advocated for reconsideration of such therapies in certain infections.

Keys to the success of this intervention were (1) structuring the intervention around routine bedside nurse work flow, (2) provision of expert guidance, and (3) aligning the program with institutional goals of the hospital. It is also important to highlight the multidisciplinary nature of our intervention. Among those involved, nurse champions proved to be most critical—two in particular. The first was the unit nurse manager [V.A.], who was a believable leader and effective educator and trusted to represent the bedside nurse's perspective. The nurse manager was able to demonstrate to unit nursing staff that their efforts represented working smarter, not harder. The second was the bedside nurse coordinator [M.B.F.], who was trained in AMS by the ID physician and ID pharmacist and served as educator, organizer, and peer advocate to the unit nursing staff. The coordinator's position as a peer to fellow nurses validated the intervention as a grassroots effort further meriting their support.

The central roles of nursing leadership and the nurse coordinator in our study are also corroborated by a recent qualitative study of four Canadian hospitals that incorporated intensive care nurses into AMS activities. This study found three strategies critical in their efforts: (1) using nurses' enthusiasm to use antimicrobials appropriately, (2) standardizing AMS activities in everyday nursing practice, and (3) engaging nurse leaders to maintain and increase AMS activities.[19] The development, implementation, and maintenance of our intervention employed these strategies along with several others as mentioned earlier.

At the outset of this pilot, we recognized the importance of open and effective communication between the bedside nursing staff and the existing AMS ID pharmacist and ID physician. We encouraged a two-way conversation. Education about AMS flowed to the nurses from the ASP team both directly and via the nurse manager and coordinator, while patient information and management issues traveled back to the ASP team from the individual bedside nurse on rounds. This bidirectional communication was crucial to program success. It also had an unplanned, but beneficial

consequence. Positive feedback from the pilot telemetry unit also spread laterally to the nursing staff of other hospital units. Other nursing staff equated AMS involvement with good nursing care rather than regulatory imposition, and they approached the AMS team to be included in the quality initiative. At the time of writing, the nurse-driven AMS rounds continue as described on the intervention telemetry unit and have also been adopted on two other telemetry units. This has promoted a broader awareness and acceptance of a culture of AMS throughout the hospital. This phenomenon of self-seeking appropriate training on how to best perform one's job is an integral component of Robust Process Improvement® (RPI®) and a core element of high reliability health care organizations.[20]

Our study has several limitations. First, the study was performed over a one-year period, so longer-term effects, such as impact on AMR, were not assessed. However, a one-year period was used for both pre- and during-intervention cohorts based on availability of historical data and in an attempt to address seasonal variations in studied outcomes. A second limitation, given our pre- and during-intervention design, was the possibility that other hospital initiatives or changing patient population could have influenced outcomes. However, there were no new or retired programs that directly targeted the intervention unit during the period of study, and cumulative mortality index was not significantly different between groups. In addition, no control group was used; however, this was due to the fact that the intervention was adopted on other telemetry units during the study period, which invalidated their use as controls. Third, our intervention was performed only twice weekly, so many patients and excess days of treatment would not be formally exposed to the intervention. Fourth, the program relied on highly engaged nursing staff and team members, and outcomes were demonstrated on a single hospital medical step-down telemetry unit, which may limit generalizability of certain aspects of this intervention and results. Finally, therapy reviews performed by the nurse and rounds team were used as process metrics, but more detailed measures such as specific interventions and their rates of acceptance would have provided more complete data to causally support our findings.

## CONCLUSION

Staff nurses are gaining acceptance as valuable contributors to AMS efforts, but literature to describe how to integrate them is limited.[9,11,12] We successfully engaged bedside nurses through nurse-driven, multidisciplinary AMS and infection prevention rounds and observed significant reductions in antimicrobial, acid suppressant, and urinary catheter use. Our approach can serve as a model for institutions to actively incorporate bedside nurses into their ASPs. Future research should clarify best practices to engage bedside nurses in AMS activities with focus on patient-centered outcomes, nurse education and training, and interdisciplinary collaboration.

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**Conflicts of Interest. All authors report no conflicts of interest.**

## APPENDIX 1. SUPPLEMENTARY MATERIALS

Supplementary materials to this article can be found online at https://doi.org/10.1016/j.jcjq.2019.03.003.

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