Advancing Antimicrobial Stewardship in Outpatient Dialysis Centers Using the Positive Deviance Process

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“Microbes themselves are hardly monolithic or permanently settled beings. For every attempt we make to destroy or weaken them, they respond with an equal and opposite force. The goal of both sides is to assume leadership of the evolutionary waltz ever in progress.”
— Howard Markel, *When Germs Travel*

Antimicrobial-resistant organisms are a known and growing threat to health in the United States and around the world. According to the Centers for Disease Control and Prevention (CDC) (2017a), 2,049,442 illnesses and 23,000 deaths per year in the U.S. occur due to infections caused by antimicrobial-resistant organisms. The CDC (2017b) has identified 18 microbes it considers serious threats and is monitoring several more emerging antimicrobial-resistant organisms (CDC, 2017b).

Up to 50% of antimicrobials are prescribed inappropriately, which contributes to antimicrobial resistance (Fleming-Dutra et al., 2016). Improper antimicrobial use includes doses that are not indicated, incorrect dosages and treatment durations, and prescription of the wrong antimicrobial agent (CDC, 2017a). Inappropriate antimicrobial use extends to patients receiving chronic hemodialysis (CHD) treatment. Research has shown that over 30% of antimicrobial doses administered to patients receiving outpatient hemodialysis are not indicated, and up to 43% of empiric doses of antimicrobials in this population do not meet the national guidelines for initiating therapy (Snyder et al., 2013). Similar rates of antimicrobial misuse were shown in a recent Australian study, in which 34.9% of antimicrobials prescribed in outpatient hemodialysis units were inappropriate (Hui et al., 2017)

Infections are the second highest cause of death and the second most common reason for hospital admission among patients receiving CHD treatment (United States Renal Data System [USRDS], 2018). These patients are also at high risk for antimicrobial-resistant bacterial infections. National surveillance data for methicillin-resistant *Staphylococcus aureus* (MRSA) have shown an incidence rate of 2332.85/100,000/year among patients

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Note: The Learning Outcome, additional statements of disclosure, and instructions for CNE evaluation can be found on page 519.
on CHD versus 19.45/100,000/year among patients not on hemodialysis (CDC, 2014a). These infections significantly increase morbidity and mortality among patients on CHD. Mortality rates among patients with invasive MRSA infections range up to 30% (Kaye et al., 2008). A meta-analysis of MRSA colonization and infection in patients on CHD demonstrated that 6.2% of patients on CHD were colonized and that these patients had a higher risk of developing MRSA infections compared to patients on CHD who were not colonized (RR = 11.5). In addition, hospitalized patients on CHD who were hospitalized were significantly more likely to be colonized than patients receiving CHD treatments in the outpatient setting (14.2% vs. 5.4%) (Zacharioudakis, Zervou, Aiskas, & Mylonakism, 2014). The need for frequent hospitalizations among patients on outpatient hemodialysis has implications for transmission of antimicrobial-resistant bacteria between hospital and community settings. Misuse of antimicrobials in hospitals and hemodialysis units, therefore, has the potential to foster the spread of resistant organisms throughout the community. The high incidence of infections caused by antimicrobial-resistant bacteria in the population of patients receiving CHD suggests that efforts to improve antimicrobial prescribing patterns in outpatient hemodialysis units should be a priority.

Antimicrobial stewardship refers to efforts to achieve optimal clinical outcomes while decreasing undesired consequences of antimicrobial use, including antimicrobial resistance. Improving antimicrobial prescribing patterns is a critical issue for public health and patient safety (CDC, 2014b).

Core elements of antimicrobial stewardship programs published by the CDC include:
- Leadership commitment.
- Accountability for program outcomes.
- Drug expertise.
- Implementation of at least one recommended intervention.

- Monitoring antimicrobial prescribing and resistance patterns.
- Reporting prescribing and resistance information back to relevant personnel.
- Clinician education (CDC, 2014b).
- These guidelines were developed for inpatient hospital settings and nursing homes. Antimicrobial stewardship in the hospital setting has been shown to decrease inappropriate use (Baur et al., 2017; Davey et al., 2017; Johnson & Banks, 2017; Wagner et al., 2014).

This project aimed to improve antimicrobial utilization patterns in outpatient hemodialysis units by implementing a multifaceted antimicrobial stewardship intervention, which included elements recognized by the CDC (CDC, 2014b). A behavioral change intervention, known as Positive Deviance, was employed to facilitate and sustain changes in antimicrobial prescribing patterns. This article describes the intervention, focusing on the Positive Deviance aspect. Details of the study results have been published previously (D’Agata et al., 2018).

### Box 1
#### The Vietnam Story

The stimulus behind the creation of Positive Deviance as a change method was a daunting issue Jerry and Monique Sternin confronted in 1990: achieve a measurable improvement in childhood nutrition in poor Vietnam villages in six months or be expelled from the country (Pascale & Sternin, 2005). The Sternins, working for Save the Children, were familiar with Positive Deviance as a method used by nutrition researchers to identify impoverished children in developing countries who were healthier than their peers and the specific practices responsible for their better nutritional status (Zeitlin, 1990). Drawing on their community health experience, they elaborated Positive Deviance into a social and behavioral change process. Working with villagers, they found the norm was to feed young children rice twice each day. Families with healthy children fed them three or four times a day and supplemented the rice diet with fresh-water shrimp, crabs, and sweet potato greens. Equipped with these discoveries, villagers devised a program for families to practice the deviant behaviors. Family members gathered the new ingredients, and mothers of malnourished children met and practiced cooking and feeding children the new foods in the homes of the positive deviant families. Progress was rapid. In six months, two-thirds of the malnourished children gained weight. After 24 months, 85% of the village’s children were adequately nourished (Marsh, Schroeder, Dearden, Sternin, & Sternin, 2004). A later study documented that these results were sustained and benefited the next generation of children (Mackintosh, Marsh, & Schroeder, 2002). The community had discovered, diffused, and sustained hidden solutions.

### Overview of Positive Deviance

Positive Deviance is a change process premised on the belief that in each organization, there are individuals whose atypical (deviant) practices lead to better (positive) results than those of their peers who have the same resources (Pascale & Sternin, 2005, 2010; Zeitlin, 1990). This approach differs from other health care improvement methods in that its focus is on the discovery and diffusion of what is already working, as opposed to the more traditional focus on implementing newly designed processes or importing best practices developed elsewhere.

Positive Deviance was initially developed to address childhood malnutrition in Vietnam (see Box 1), and subsequently, employed to confront other intractable health-related challenges in the developing world, such as HIV/AIDS prevention, maternal and neonatal mortality, and female genital cutting (Mackintosh, Marsh, & Schroeder, 2002; Marsh, Schroeder, Dearden, Sternin, & Sternin, 2004; Masterson & Swanson, 2000). These early successes inspired Positive...
Deviance efforts to reduce infection rates from multidrug-resistant organisms, improve hand hygiene adherence, and tackle surgical site infections in hospitals in North and South America (Awad et al., 2009; Jain et al., 2011; Lindberg, Norstrand, Munger, DeMarsico, & Buscell, 2009; Marra et al., 2011, 2013; Singhal, Buscell, & Lindberg, 2010). Positive Deviance has also been successfully implemented in outpatient hemodialysis units to decrease access-related bloodstream infections in a dialysis center (Downham et al., 2012; Lindberg et al., 2013), resulting in an 88% decrease in access-related bloodstream infections over a 16-month period (2.04/100 patient months to 0.24/100 patient months, p < 0.01). This dramatic improvement was achieved through implementation of a panel of infection prevention strategies developed by the CDC and supported by the behavior change methods of positive deviant. The process triggered a major change in cleaning procedures and an increase in accountability for infection prevention, including initiation of procedures to disinfect the entire treatment area between shifts. Drawing on positive deviant behaviors of several staff members, the practice of intervening with colleagues and medical staff to prevent them from breaking unit standards for infection prevention became widespread. Successful results of this study inspired the incorporation of positive deviance into this research project.

Positive Deviance is based on three assumptions (Lindberg & Schneider, 2013):

1. Knowledge and experience required for change exists in every organization.
2. Change is best led from within an organization by staff with firsthand knowledge of an institution’s processes, history, and behavioral norms.
3. Broad adoption of new behaviors requires widespread and genuine engagement of personnel, especially those at the frontlines.

The four steps in the process are:

1. Define the problem and establish a measurable outcome goal.
2. Determine if there are individuals or groups who achieve better outcomes than their peers in the same setting. According to the Positive Deviance Collaborative (2017), these individuals are referred to as “positive deviants.”
3. Discover the behaviors and strategies that enable the positive deviants to achieve the better outcomes.
4. Design a process to enable other individuals in the organization to practice behaviors and strategies utilized by the positive deviants in the organization.

**Methods**

**Study Sites**

Six dialysis units in the eastern United States owned and operated by a single dialysis provider participated in the study. Combined, the units had an average patient census of 400 patients, with the individual census by unit ranging from 35 to 95 patients. Each unit had between 18 and 21 dialysis stations and 7 to 14 staff members. The total staff contingent was 65. Institutional Review Board approvals were obtained from all relevant institutions prior to initiation of the intervention.

**Optimizing Antimicrobial Stewardship Intervention**

The Optimizing Antimicrobial Stewardship Intervention had five components:

1. Engagement of dialysis unit leaders.
2. Education of dialysis personnel, including nurses, dialysis technicians, nephrologists, nurse practitioners, social workers, and a nutritionist.
3. Implementation of the Positive Deviance process.
5. Debrief of intervention experience.

Operationalization of the five components is described below. Timing and staff participation in each intervention component are shown in Table 1.

**Engagement of dialysis unit leaders.** Goals of this aspect of the intervention included orienting unit clinical managers and the regional director of operations to the research project, gaining their support for the project, and acquainting them with the Positive Deviance concept and processes. In addition, the research team sought collaboration and guidance from unit leaders on the best ways to implement the antimicrobial stewardship intervention and foster learning across the sites. The primary vehicle for engaging leaders was the Antimicrobial Stewardship Steering Committee, whose members included unit clinical managers, the regional director of operations, and research team members. Over the course of the intervention, the Steering Committee met five times.

**Education of hemodialysis unit personnel.** The education component was designed to acquaint unit leaders and staff with the growing problem of antimicrobial resistance and risks of inappropriate antimicrobial use, as well as to familiarize them with evidence-based guidelines for antimicrobial use. The problem of inappropriate prescribing of antimicrobials in outpatient hemodialysis settings was emphasized. This component also served to engage hemodialysis unit personnel in the research study. The educational component included an interactive presentation developed by a nurse educator (CML). During July 2015, the research team offered the interactive educational program to staff groups at each of the six hemodialysis units.

All staff members at each dialysis unit were invited to participate in the educational offering. Continuing education credits were offered as an incentive for participation. Physicians and nurse practitioners who worked in the units were informed of the project and its theoretical background by the principal investigator (EMCD). Reinforcement for educational ses-
sions was provided to all staff in the form of laminated pocket cards containing practice guidelines. Posters containing identical information were displayed on each unit. The Practice Guidelines Pocket Card and Poster are shown in Figure 1.

**Implementation of Positive Deviance process.** The Positive Deviance component of the research intervention focused on uncovering and diffusing positive deviant practices. The Positive Deviance intervention was developed and guided by a member of the research team with extensive experience in using the process in healthcare (CCL). A nurse researcher (CML) and an infection control practitioner (GD) with training in Positive Deviance participated in development and implementation of the process (CML). In facilitating implementation of the intervention with unit staff and leaders, the research team was guided by Positive Deviance principles articulated earlier. In February and March 2016, Discovery and Action Dialogues, small group conversations facilitated by research staff members, were held at all six units. Forty-two staff members participated in these sessions designed to help staff identify colleagues (positive deviants) who were employing uncommon behaviors and strategies to reduce inappropriate antimicrobial use. Questions used in these dialogue sessions are shown in Table 2.

The Discovery and Action Dialogues uncovered the following positive deviant behaviors and strategies:

3. Outside Prescriber Outreach, Engagement and Education.
4. Obtaining Culture Results.

**Patient Assessment, Second Opinion, and Recommendation to Prescriber.** An important positive deviant behavior involved nurses conducting a thorough patient assessment and gathering all needed background information in preparation for talking with a nephrologist or nurse practitioner about a suspected infection, and treatment options for the condition, including possible need for antimicrobials versus watchful waiting. If any uncertainty about the assessment or recommendations existed, a second opinion from a colleague was sought. Results of assessments and recommendations for optimizing antimicrobial use based on clinical guidelines were shared with the prescribing practitioner.

**Outside Prescriber Outreach, Engagement and Education.** Positive deviants provided education to help patients understand the risks and side effects of unnecessary or inappropriate antimicrobial use, basing these recommendations on their knowledge and understanding of individual patients, and their medical and social situations.

**Obtaining Culture Results.** Another positive deviant behavior centered on building new or closer relationships with hospital staff and consulting practitioners to more readily obtain microbiology reports and other needed information related to antimicrobial use. Important to this positive deviant behavior was persistent follow up until necessary information was obtained.

After identifying the positive deviant strategies and behaviors, a small task force of staff members, clinical managers, the regional operations director, and research staff developed

### Table 1
**Timing and Participation in Intervention Activities**

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<tr>
<th>Intervention Component</th>
<th>Number of Staff</th>
<th>Timing</th>
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<tr>
<td>Engagement of Unit Leaders</td>
<td>6 Clinical Managers and Regional Director of Operations</td>
<td>June 2015-April 2016 5 meetings</td>
</tr>
<tr>
<td>Education of Unit Staff on Optimizing Antimicrobial Use</td>
<td>47 Unit Staff Members 4 Medical Directors and 1 Nurse Practitioner</td>
<td>July 2015</td>
</tr>
<tr>
<td>Implementation of Positive Deviance Process</td>
<td>41 Unit Staff Members and 1 Nurse Practitioner 47 Unit Staff Members</td>
<td>February-March 2016 August 2016</td>
</tr>
<tr>
<td>Collection and Review of Antimicrobial Use Information</td>
<td>6 Clinical Managers and Regional Director of Operations</td>
<td>September 2015-October 2016</td>
</tr>
<tr>
<td>Debrief of Intervention Experience</td>
<td>4 Clinical Managers and Regional Director of Operations</td>
<td>November 2016</td>
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a scenario to demonstrate the above positive deviant behaviors and provide an opportunity for staff to practice positive deviant behaviors by engaging in role-play. The scenario, titled “Pain in the Foot,” focused on a patient under treatment by a podiatrist for a wound infection. In the scenario, an order for vancomycin was received on a Friday afternoon without an accompanying microbiology report. The scenario included roles for a patient, dialysis technician, nurse, podiatrist, and nurse practitioner.

In August 2016, research staff, clinical managers, and several staff members identified as positive deviants brought the scenario to each unit and role played the positive deviant behaviors, after which unit staff members were recruited to play the key roles and reenact the scenario. A short, facilitated discussion was held after each scenario to highlight demonstrated positive deviant behaviors, uncover other strategies that could have been used, and solicit ideas for spreading the positive deviant behaviors.

**Collection and review of antimicrobial use information.** An antimicrobial log was developed to track antimicrobial use on each dialysis unit. Using a form designed by research staff, nursing staff recorded every antimicrobial administered during the research study and documented the indication for the order, the prescriber, the antimicrobial start date, culture results, and adjustments in antimicrobial prescriptions that resulted from communication between nursing staff and prescribers.

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**Table 2**

*Discovery and Action Dialogue Questions*

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<th>Question</th>
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<td>1. Can you recall a case where a patient was given an antimicrobial that was not needed? Do you remember the steps that led to the decision to prescribe it?</td>
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<tr>
<td>2. What do you do to prevent unnecessary antimicrobial use?</td>
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<td>3. Are there colleagues you respect for their ability to ensure antimicrobials are only used when needed? What specifically do they do?</td>
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<tr>
<td>4. Are there barriers that prevent you or others from taking these actions all the time?</td>
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<tr>
<td>5. Do you have any ideas for dealing with this issue?</td>
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<tr>
<td>6. What initial steps need to be pursued to make it happen? Any volunteers?</td>
</tr>
<tr>
<td>7. Who else needs to be involved?</td>
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Monthly conference calls to review log data were held with clinical managers, the regional operations director, and the research staff, including the principal investigator, and an infectious disease physician. These “log calls,” as they became known, provided ongoing education about antimicrobial use and appropriateness, and provided a forum for group problem-solving. Areas for discussion with individual prescribers were identified for follow up by the clinical managers.  

Debrief of intervention experience. Following the completion of the first four components of the intervention (engagement, education, Positive Deviance, and microbial use review), a debriefing interview session was held with clinical managers, regional director of operations, and research staff. The debriefing interview was designed to help the leaders learn from their experience, plan next steps, and sustain the initiative. Some questions used to guide the debriefing were:

- To what do you attribute the improvements in appropriate antimicrobial usage?
- What were the most significant challenges faced by your units in following the antimicrobial practice guidelines?
- What is your assessment of the role of the antimicrobial log in this project?
- Did you notice any changes in interactions and relationships among staff, including prescribers, about antimicrobial use as a consequence of this project?
- If you were designing the next phase of this effort, what do you suggest as the focus?
- What steps should be considered for sustaining improvements in antimicrobial use you have seen in your units?

The timing and staff participation in each intervention component are shown in Table 1.

Result

Detailed results of the study have been published (D’Agata et al., 2018).

Here, we provide a brief summary. During the pre-intervention period, 591 patients received hemodialysis in the six units as compared to 626 during the intervention phase. Demographic and clinical characteristics of the two groups were not significantly different between the two time periods.

Data were collected on antimicrobial use during the 12-month intervention period and compared to use during the 12 months prior to implementation of this multifaceted stewardship program. Results showed a significant 6% month to month decrease in antimicrobial doses/100 patient months ($p = 0.02$) over the 12 months of the intervention period. In addition, the observed mean monthly rate of antimicrobial use decreased to 10.5 doses/100 patient months at the end of the intervention period from 22.6 doses/100 patient months at the beginning. Importantly, there were no significant differences in mean rates of negative outcomes between the pre-intervention and intervention periods. Negative outcomes were defined as mean rates of hospital admissions, bloodstream infection, methicillin-resistant *Staphylococcus aureus* bloodstream infections, and facility-level quality measures.

Discussion and Recommendations

Positive Deviance, by definition, draws upon local wisdom and internally generated good practices, discovering these practices, and encouraging their dissemination to improve behavioral patterns and associated outcomes throughout a system. By building on what works, Positive Deviance may be particularly well-suited to fostering long-term change in clinical practices.

During this intervention, several major positive deviant behaviors were discovered and shared across the six outpatient hemodialysis units and resulted in important advances in antimicrobial stewardship. Study results demonstrated that Positive Deviance, as part of a multifaceted intervention, was effective in engaging both clinical management and frontline hemodialysis unit staff in improving antimicrobial use. Results showed a significant decrease in the number of antimicrobials prescribed/month over the course of the intervention period.

This intervention is highly compatible with CDC recommendations regarding antimicrobial stewardship (CDC, 2014a). Staff and unit leadership learning was at the core of the intervention. Tracking and accountability, additional elements of CDC recommendations, were manifested by the antimicrobial log and the log calls. Log calls also provided nurses with expert consultation from the principal investigator, an infectious disease physician. Improvements from this intervention were made possible by strong support of management.

This second known application of Positive Deviance in the outpatient hemodialysis setting adds evidence to the value of this novel approach to quality improvement for hemodialysis centers. In this six-site research study, Positive Deviance was well-received by managers and staff, and proved feasible and adaptable to the unique nature of outpatient hemodialysis care and organizations.

It should be noted that the focus of study interventions was on unit nursing staff, including nurse managers, nurses, and dialysis technicians, and their role in ensuring that patients received high-quality, safe care related to antimicrobial use. In this study, nursing staff were the primary targets of the educational and behavioral interventions. The intervention focused on improving nursing staff knowledge of appropriate antimicrobial use and encouraging nurses to use their assessment and communication skills to take appropriate actions to improve antimicrobial use on the units. As a result, prescribing practices of unit physicians, nurse practitioners, and even outside consultants were positively influenced by unit staff, demonstrating the power education and behavioral support in improving prescribing practices.

Limitations of this study were that...
the small number of hemodialysis units (six units) enrolled in the study were all part of a single dialysis provider corporation and that all enrolled centers provided outpatient services only, which limits generalizability to other outpatient hemodialysis centers and to other types of hemodialysis providers. An essential element of this intervention was the involvement of the principal investigator, an infectious disease physician, for log calls and consultations, a resource that may not be available to other hemodialysis units. Lastly, the intervention consisted of multiple elements, so it is not possible to determine the precise contribution of individual elements to the outcomes.

**Conclusion**

This study demonstrates the value of promoting Positive Deviance as a strategy for advancing antibiotic stewardship. Given the strong positive results of this study, others in the outpatient hemodialysis community should consider adopting a Positive Deviance-informed multifaceted strategy to address the challenge of inappropriate antimicrobial use and antimicrobial resistance. Because these challenges are regional in nature, hemodialysis units would be wise to join with local hospitals, nursing homes, infectious disease physicians, podiatrists, public health agencies, and other dialysis facilities to build a regional antimicrobial stewardship collaboration. Since Positive Deviance is a unique and relatively new intervention that requires special knowledge and skills to implement, dialysis facilities should consider obtaining assistance from experienced facilitators skilled in Positive Deviance. Finally, researchers should partner with dialysis facilities to support implementation, study the process, and assess outcomes.

**References**


