Journal of HOSPITAL MEDICINE www.journalofhospitalmedicine.com

REVIEW

Transitioning Antimicrobial Stewardship Beyond the Hospital: The Cleveland Clinic's Community-Based Parenteral Anti-Infective Therapy (CoPAT) Program

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Disclosures: Dr. Gordon received an honorarium from Merck & Co., Inc. for time and expertise spent in the composition of this article.
Drs. Shrestha and Rehm have not received any funding for their contribution to this article.

One of the tenets of value-based health care is a focus on providing benefits to patients, as measured by better health outcomes per dollar spent rather than minimizing costs. In fact, proponents of value-based health care argue that the best way to reduce health care costs is through a focused approach to improving health outcomes. Associated with this approach is the need to measure outcomes over the full cycle of care, not simply for services rendered while an inpatient. This article examines the community-based parenteral anti-infective therapy program at the Cleveland Clinic as a model for antimicrobial stewardship for patients requiring parenteral antimicrobial therapy at the time of discharge from the inpatient setting. The program is a patient needs-focused, coordinated team effort that mandates inpatient infectious disease consultation for patients requiring community-based parenteral anti-infective therapy. An examination of some of the features of the Cleveland Clinic program should provide guidance for other institutions seeking to improve the care of their patients requiring parenteral anti-infectives when transitioning care from the acute setting. ***Journal of Hospital Medicine*** **2011;6:S24–S30.** © *2011 Society of Hospital Medicine.*

KEYWORDS: antimicrobial stewardship, CoPAT, OPAT, quality of medical care, value-based health care.

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". . . For the secret of the care of the patient is caring for the patient."—Francis W. Peabody, October 21, 1925[1]

Collaboration between members of a multidisciplinary team is a key component of an effective institutional antimicrobial stewardship program, which itself is a key component of optimizing the care of hospitalized patients being treated with antimicrobial agents for proven or suspected infectious diseases. However, patient care does not and should not end once the patient is discharged from the hospital. In fact, high-quality, value-based health care across the full range of a medical condition depends on planning for optimization of care within the hospital as well as transitions of care to the outpatient setting. This extended care plan includes collaboration with multiple members of the health care community, both inside and outside the institution. The current review examines 3 aspects of patient care across the full cycle of an infectious disease condition: (1) value-based health care, (2) stewardship of antimicrobials, and (3) community-based parenteral anti-infective therapy (CoPAT) as a model for antimicrobial stewardship outside the institutional setting.

Value-Based Health Care

Patients first want to know that the health care professionals treating them actually care about them as individuals, and only then are patients concerned about how much the medical team knows. Patient-centered care is a critical component of "value-based health care," a term that was bandied about quite a bit during the recent and ongoing health care debate in the United States. But what exactly does it mean? First, "value" in health care is defined by health care outcomes as a function of or divided by the cost of delivery of care. As Dr. Michael Porter and Dr. Elizabeth Olmsted Teisberg delineated in their 2007 article in the *Journal of the American Medical Association*,[2] as well as in the 2006 book *Redefining Health Care*,[3] "The purpose of the healthcare system is not to minimize costs but to deliver value to patients, that is, better health per dollar spent." As they discuss "value," it is a patient-centric measure, and is focused on individual patient (not just diagnosis-related group) outcomes and the cost of care across the full cycle. In this way of looking at things, an "episode of care" goes beyond the treatment provided during the acute admission to also include the transition of care to the outpatient or posthospital setting.

The reforms proposed by Porter and Teisberg are best achieved when the participating health care institutions have developed an information technology platform able to integrate and fully measure care across the full cycle of a medical condition. Furthermore, there is strong evidence that patient value increases with physician and team experience and volume for a particular condition.[2] High volumes tend to correlate with the development of better information technology, as well as the formation of dedicated teams with tailored facilities, and with a greater capacity for constructive

2011 Society of Hospital Medicine DOI 10.1002/jhm.867
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feedback to improve patient outcomes. The more experience a physician and team have with the management of a particular medical condition, the greater is the opportunity to learn and refine practices to provide greater value to the patient.

The Institute of Medicine has recommended that "all healthcare professionals should be educated to deliver patient-centered care as members of an interdisciplinary team emphasizing evidence-based practice, quality improvement, and informatics."[4] As has been demonstrated for patients with congestive heart failure[5–9] and other conditions,[10,11] outcomes improve when components of care are integrated (often by nurse-directed teams), preparing for the transition of care from the hospital to the home.[12] This concept is the basis for the community-based parenteral antiinfective therapy program (CoPAT) at the Cleveland Clinic as a model for antimicrobial stewardship for patients requiring parenteral antimicrobial therapy at the time of discharge from the inpatient setting.

Stewardship of Antimicrobials

The Merriam-Webster dictionary alternatively defines a "steward" as: (1) an employee on a ship, airplane, bus, or train who manages the provisioning of food and attends to passengers or (2) one who actively manages affairs (manager).[13] In the context of health care within an institution, one can think of clinicians as stewards or employees charged with managing patients and the drugs and other care they receive while they are attendants (passengers) at the institution. In the value-based approach just discussed, where medical practice is organized around managing medical conditions for the entire care cycle, a medical steward would also be charged with managing or planning for patient care after discharge from the hospital or other institutional setting. Management or stewardship of antimicrobial agents is a key component of the care for patients with infectious diseases. In 2007, the Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America (IDSA/SHEA) presented guidelines to aid institutions in the development of an effective hospital-based antimicrobial stewardship program (a more detailed overview of antimicrobial stewardship is presented in the accompanying supplemental article by Dr. Ohl).[14] The focus of the IDSA/SHEA guidelines was on development of programs within hospitals. Although the authors acknowledged that antimicrobial stewardship is also important in outpatient clinics and long-term care facilities, transition of antimicrobial management after patient discharge from the hospital was not a focus of the 2007 guidelines.

A key objective of antimicrobial stewardship is to optimize antimicrobial drug selection and dosing to improve clinical outcomes while reducing drug toxicity and other potential untoward consequences of antimicrobial therapy, including selection of opportunistic organisms (eg, *Clostridium difficile*) or emergence of multidrug resistance in pathogens.[14] A secondary objective is to reduce overall health care costs,[14] which ideally would include inpatient as well as outpatient costs and those related to hospital readmission due to the initial infection or its outpatient treatment. Useful metrics for evaluation of an antimicrobial stewardship program include measures of pathogen/drug mismatch, antimicrobial costs, incidence of redundant therapy, compliance with antimicrobial drug restrictions (if applicable), days undergoing antimicrobial therapy, and number of cases of intravenous to oral conversion.[14]

Although the IDSA/SHEA guidelines for institutional antimicrobial stewardship programs suggest that an infectious diseases physician and clinical pharmacist with infectious diseases training should be core members of a multidisciplinary stewardship team,[14] many community hospitals or smaller institutions do not have an infectious diseases physician or a readily available infectious diseases specialist for consultation. Hospitalists are often very effective advocates of appropriate use of antimicrobials and may play a leadership role on institutional antimicrobial stewardship teams. A recent study demonstrated that a hospitalist-delivered academic detailing intervention (which included an individual appraisal of the provider's prescription pattern) significantly improved patterns of antibiotic prescribing for inpatients.[15]

Community-Based Parenteral Anti-Infective Therapy as a Systems-Based Approach to Antimicrobial Stewardship

A systems-based approach for antimicrobial stewardship, CoPAT has been in operation at the Cleveland Clinic, a 1200-bed hospital in downtown Cleveland, Ohio, since November 1979. The experiences of the authors and their colleagues demonstrate it to be a value-based proposition for the patient that uses an antimicrobial stewardship platform. Also known as outpatient parenteral antimicrobial therapy (OPAT), CoPAT refers to the practice of administering antimicrobial therapy in the home or other outpatient settings, first introduced by Rucker and Harrison in 1974 in the context of outpatient management of cystic fibrosis.[16] In the United States, CoPAT is a common practice today, and the IDSA has created practice guidelines for it.[17]

In 1983, Rehm and Weinstein coauthored an article describing their experiences at the Cleveland Clinic, in which selected patients were trained for home-based antimicrobial therapy.[12] Figure 1 illustrates the astronomical growth that has occurred over the years at the Cleveland Clinic in the number of patients discharged from the acute care center undergoing CoPAT (Gordon, unpublished data). It is anticipated that this growth will continue and in large part reflects the complexity of patients being seen and the desire to reduce length of stay. Evaluating the quality of any medical care is difficult, but there are 3 general approaches to assessing or measuring the quality of medical care: assessing the structure of care, assessing processes of care, and assessing outcomes.[18] The quality of the CoPAT program at the Cleveland Clinic can be examined in the context of these 3 areas of assessment.

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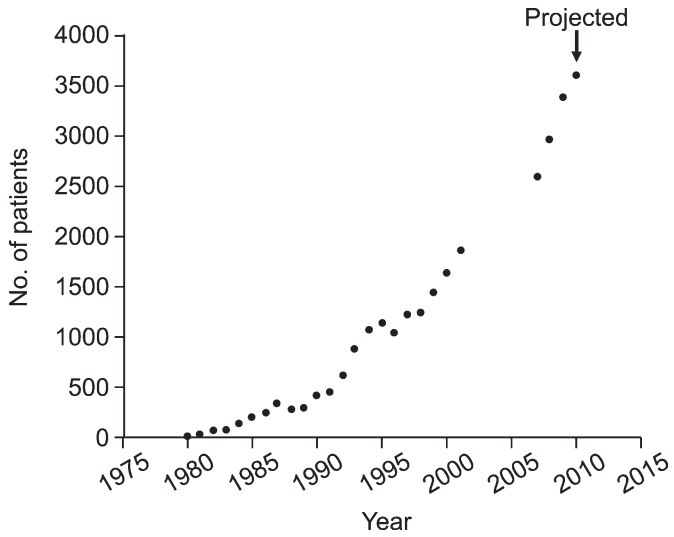

FIGURE 1. Cleveland Clinic Community-Based Parenteral Anti-Infective Therapy (CoPAT) volumes by year (Gordon, unpublished data).

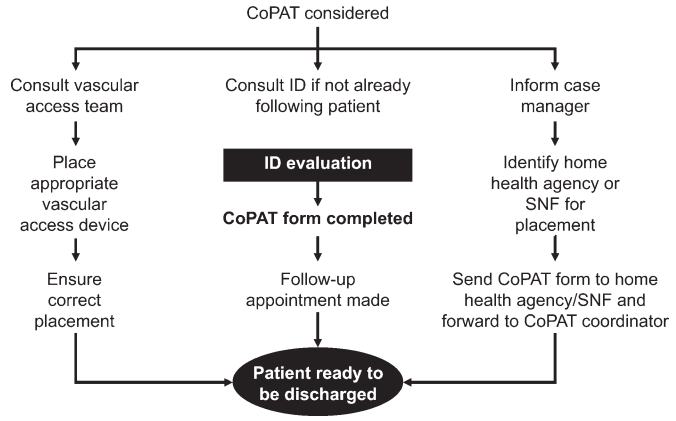

FIGURE 2. Schematic of the Community-Based Parenteral Anti-Infective Therapy (CoPAT) initiation process at the Cleveland Clinic.

Settings or the Structure of Care

In a 1966 publication on quality of medical care evaluations, Donabedian described assessment of the structure of care as one of the primary approaches to measuring the quality of care.[18] By structure, Donabedian meant the settings in which medical care takes place, including the adequacy of facilities and equipment, qualifications or expertise of medical staff and their organization, the administrative structure of the institution or institutional program of interest, and other administrative and related processes supporting and directing the delivery of care. Although the structure of care has the advantage of being concrete and relatively easy to assess, to be most meaningful, it ultimately needs to be related to the processes and outcomes of care.

With respect to the CoPAT program at the Cleveland Clinic main hospital, infectious diseases consultation is required for every patient being considered for discharge with parenteral antibiotics, whether the patient is going home or to another facility, including the clinic's own skilled nursing facility (SNF). Arrangements are then made for the delivery of antibiotics at home or in SNFs or long-term acute care (LTAC) centers. The Cleveland Clinic CoPAT program does not use an outpatient infusion center.

The Cleveland Clinic uses a mandatory infectious diseases consultation for CoPAT because there are a number of important issues that need to be addressed before the patient is discharged, and for our system this is best accomplished by an infectious diseases specialist.[12] For example, is antimicrobial therapy actually required in the first place? If it is, what is the optimal type, route, and duration of therapy? Are there other medical issues that need to be addressed? Decisions also need to be made about optimal vascular access and antimicrobial selection and administration, as well as arrangements being made for monitoring clinical and laboratory aspects. It is important that there is a smooth transition of care and prescheduled follow-up in the outpatient clinic. The identification and use of an infectious diseases clinician directing the process leads to accountability. Notably, mandatory infectious disease consultation for outpatient parenteral antibiotic therapy has been used at Baystate Medical Center with improvement in reducing costs.[19]

The Process of Care

Assessments of the process of care involve examination of the particulars of medical care delivery, or whether what is recognized or accepted as good medical care has been applied. As discussed by Donabedian, process of care deals with issues such as the appropriateness and completeness of information obtained through clinical history, physical examination, and diagnostic tests; justification of diagnosis and therapy; technical competence in the performance of diagnostic and therapeutic procedures; and coordination and continuity of care.[18]

The CoPAT initiation process at the Cleveland Clinic is illustrated in Figure 2. It is a bundled process. As already mentioned, an infectious diseases consultation and evaluation is scheduled for all patients considered for CoPAT, after which a CoPAT form is completed and a follow-up appointment made before the patient is discharged. In addition, the vascular access team is consulted and an appropriate vascular access device is placed in the patient prior to discharge. Likewise, a case manager is enlisted to identify a health care agency or SNF for patient placement or to determine whether the patient will receive home treatment. Once the appropriate setting is identified, the case manager transmits a completed CoPAT form to the health care agency or SNF, while forwarding a copy to the CoPAT nurse coordinator in the infectious disease department.

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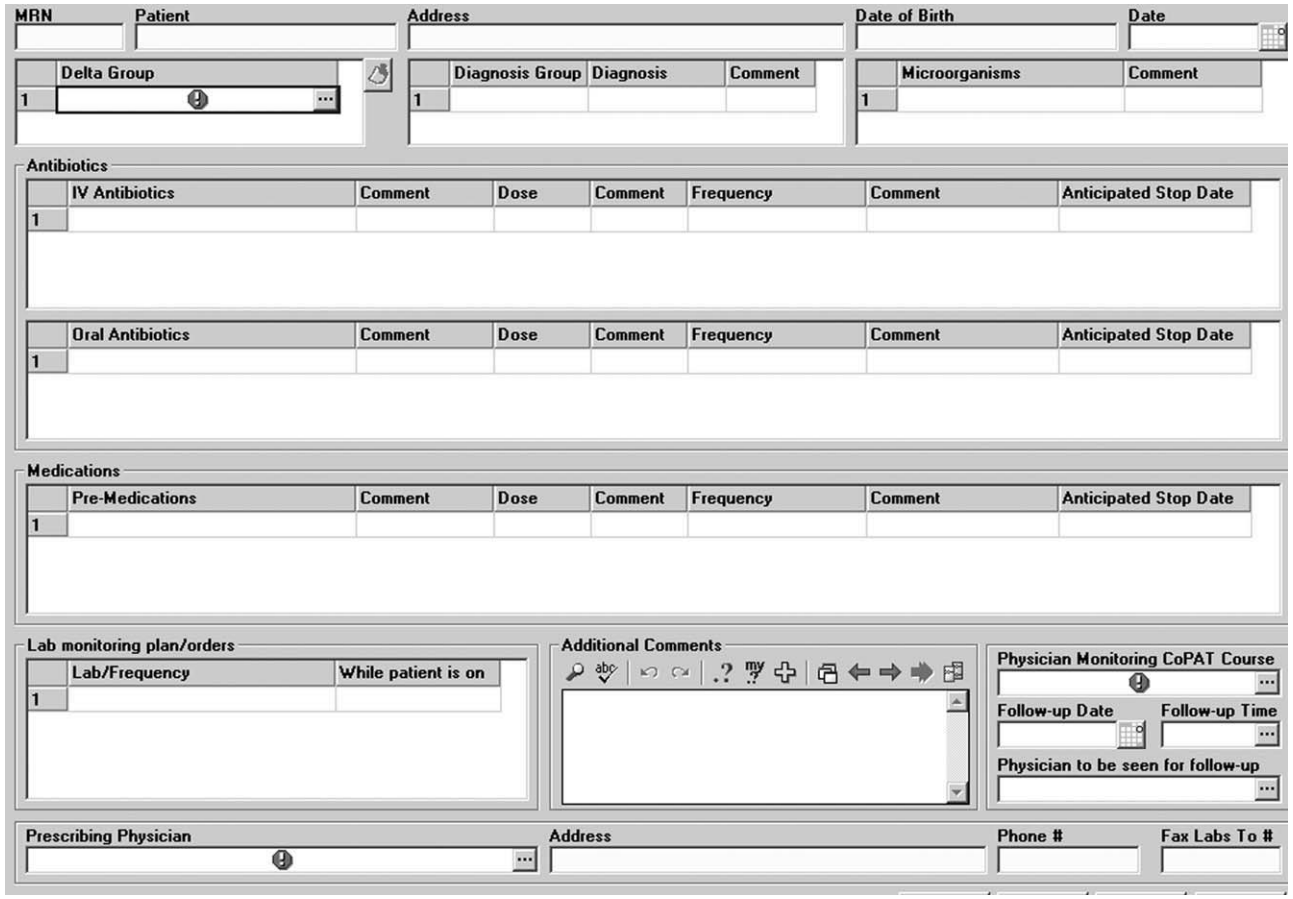

FIGURE 3. Electronic Community-Based Parenteral Anti-Infective Therapy (CoPAT) form at the Cleveland Clinic.

An electronic health record system is used at the Cleveland Clinic to provide real-time information relevant for patient management. In 2007, a structured data form for CoPAT start-of-care was created within the Cleveland Clinic hospital electronic health record (EHR). This form contains a number of elements relevant for setting up patients for transition to CoPAT. In particular, the electronic CoPAT form contains information about the infection(s) and microorganism(s) being treated, intravenous antibiotic(s) prescribed (including treatment stop date), concurrent oral antibiotics, premedication recommendations (if appropriate), and recommended monitoring of laboratory tests. In addition, the form contains the telephone and fax numbers of the CoPAT coordinator and the name of the responsible physician, including a scheduled appointment for follow-up (Fig. 3). The staff physician is responsible for completing the electronic CoPAT form or prescription. This CoPAT prescription then becomes part of the patient's electronic record and is transmissible and viewable by anyone with access to the EHR. This is important in terms of follow-up and care accountability: an infectious disease staff clinician is identified as the contact person for clinical issues when a patient is on CoPAT.

After the patient is discharged, the CoPAT coordinator in the infectious disease department becomes responsible, together with the clinic's outpatient pharmacy, for reviewing laboratory results and notifying clinicians of potential problems that need to be addressed. These issues can pertain to laboratory findings, vascular access, or new symptoms or signs observed by the home nurse or patient. All this information is communicated via electronic health record messaging and/or through direct calls to the physician, when needed.

The CoPAT program has been widely accepted by internal customers of the Cleveland Clinic, which include hospitalists. This is probably because there is autonomy and accountability with the infectious diseases staff, the program or team is available 7 days per week, and the EHR facilitates communication. In addition, the use of infectious disease-specific subspecialty groups (eg, bone marrow and solid-organ transplant, bone and joint, and infective endocarditis groups) increases clinical credibility, as well as value received by patients of the clinic. Furthermore, the electronic CoPAT script facilitates discharge planning. CoPATs constitute approximately 25% of all ID consultation requests at the Cleveland Clinic and help to justify the 20 clinical ID clinical FTEs.

Outcomes of Medical Care

Assessment of medical care outcomes is another frequently used approach for measuring the quality of medical care.[18]

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Medical care outcomes that have been examined as measures of quality of care include survival, number of hospital readmissions, time between discharge and readmissions, length of initial hospital stay and subsequent readmissions, quality of life, and health care costs. As has often been said, "If you cannot measure it, you cannot manage it." The CoPAT program using the EHR has facilitated retrieval of structured reports in a format that provides clinicians with real-time data enabling assessment of outcomes. By examining this data, the CoPAT team is in a better position to contemplate potential interventions for improving outpatient care and the value patients receive.

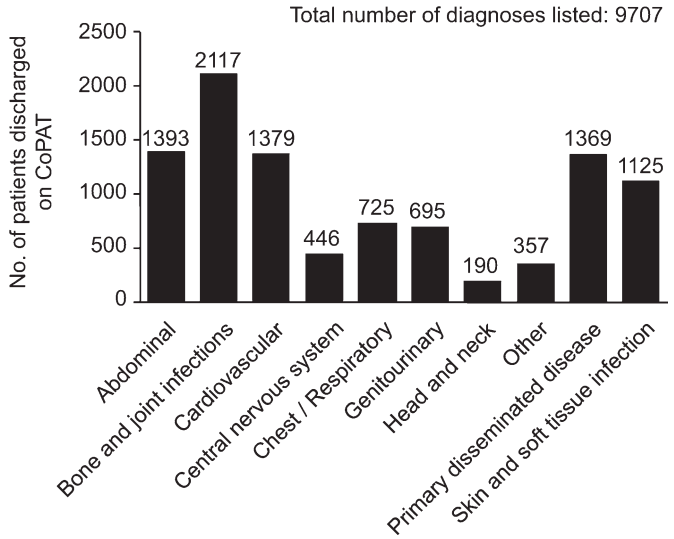

FIGURE 4. Community-Based Parenteral Anti-Infective Therapy (CoPAT) distribution by anatomic site of infection for patients at the Cleveland Clinic during 2007–2009.

A 36-month review of Cleveland Clinic CoPAT patient demographics from July 2007 to June 2010 demonstrated 6287 patients (56% male) had been prescribed 9471 courses of CoPAT (Gordon, unpublished data). Seventy-nine percent of the patients were white, 16% African American, and 5% of other races. Most patients received 1 antibiotic per CoPAT course (79.1%), whereas 18.2%, 2.5%, and 0.2% received 2, 3, and 4 antibiotics per CoPAT course, respectively. Figure 4 highlights CoPAT distribution by source for anatomic site of infection. Bone and joint infections were the most common diagnoses associated with CoPAT at the Cleveland Clinic, followed by abdominal, cardiovascular, primary disseminated disease (eg, catheter-associated bloodstream infections), and skin and soft-tissue infection.

Figure 5 highlights the top-10 pathogenic microorganisms in patients being discharged from the Cleveland Clinic with CoPAT, and the top-10 antimicrobials prescribed for these patients. As can be seen, *Staphylococcus aureus* (methicillin susceptible and methicillin resistant) was the number one pathogen identified for patients undergoing CoPAT, followed by coagulase-negative *Staphylococcus* and *Enterococcus* species. The most commonly identified gram-negative bacteria among discharged patients was *Pseudomonas aeruginosa*. Only 2 of the top 10 pathogens were non-bacterial: *Candida* species and cytomegalovirus (CMV), the latter being the result of the high volume of transplantations performed at the clinic. With respect to the intravenous antimicrobials prescribed for patients undergoing CoPAT, the most commonly prescribed agent was vancomycin, followed by piperacillin/tazobactam. Of the 10 agents, only micafungin and ganciclovir were not antibacterial agents, indicating that the vast majority of patients discharged from the Cleveland Clinic with CoPAT had had bacterial, rather than fungal or viral, infections.

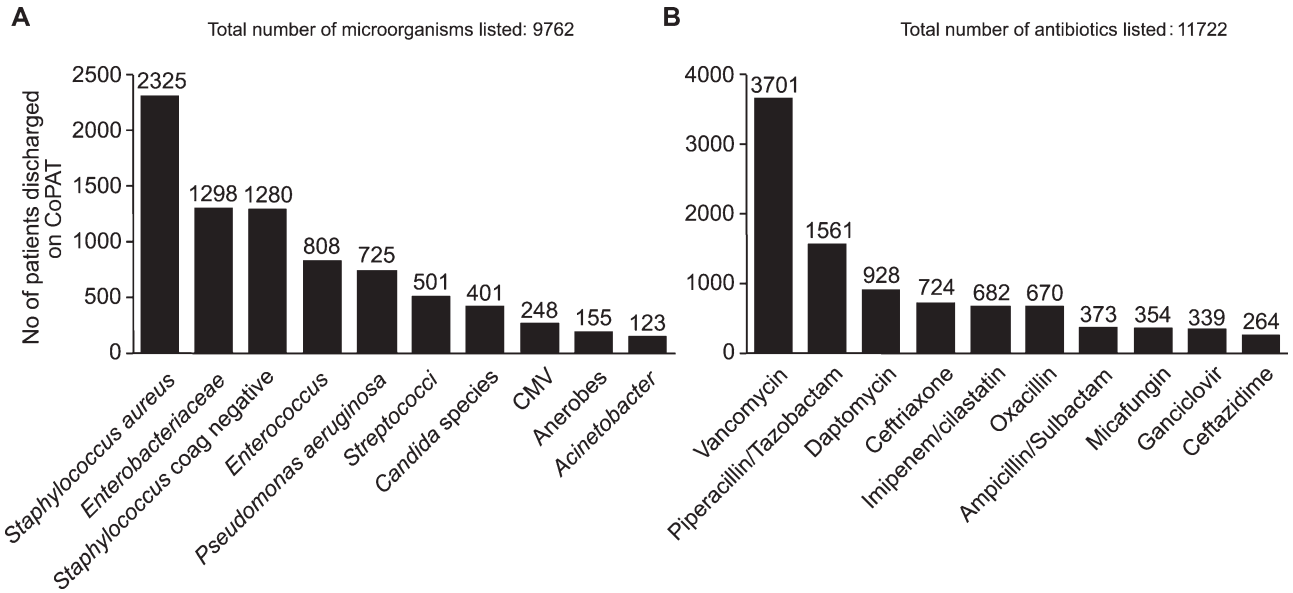

FIGURE 5. Top 10 microorganisms (A) and antimicrobials (B) prescribed for patients on Community-Based Parenteral Anti-Infective Therapy (CoPAT) at the Cleveland Clinic during 2007–2009.

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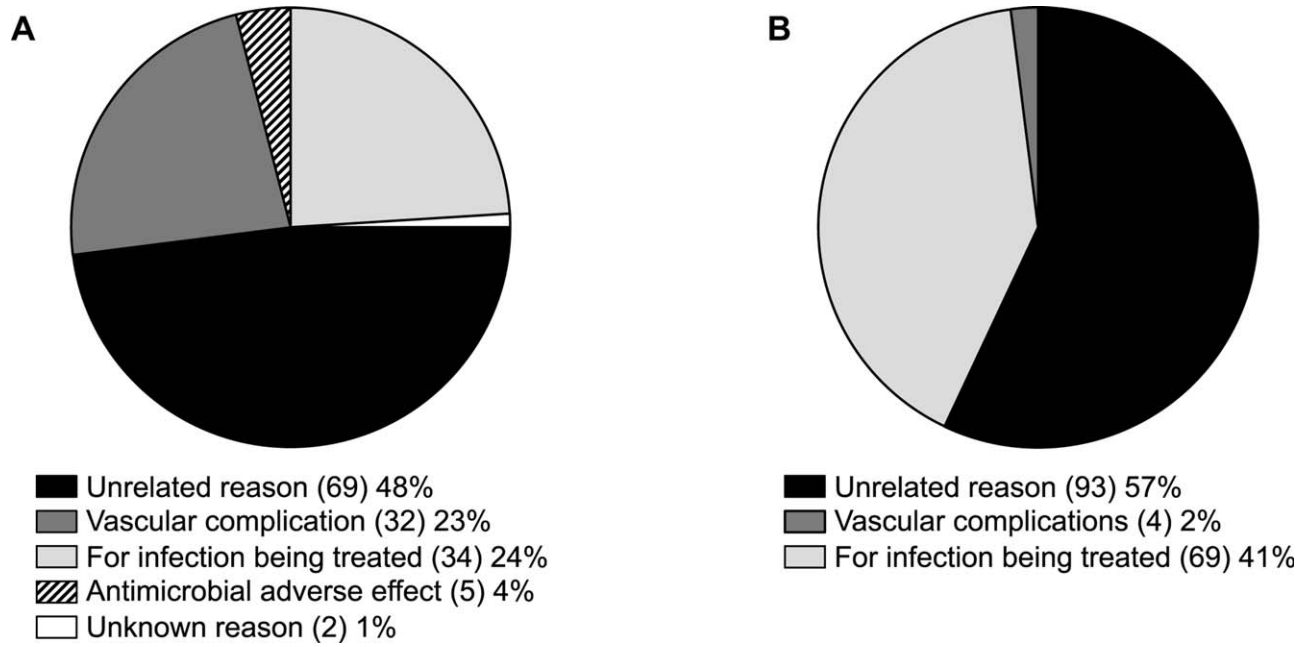

FIGURE 6. Reasons for Emergency Department visits (A) or readmission to the hospital (B) while on Community-Based Parenteral Anti-Infective Therapy (CoPAT) or within 30 days of its completion of patients receiving CoPAT at home through Cleveland Clinic Home Care, January 1, 2008, to December 31, 2008.

Of particular note, data collected from July 2007 through December 2008 demonstrated that more than 80% of patients discharged from the hospital with CoPAT did so with a prescheduled follow-up visit. This patient-centric measure is important because patients may not follow through with establishing appointments for follow-up visits once discharge has already occurred. The Cleveland Clinic prides itself on making sure that a follow-up appointment is actually made before the time of discharge for the vast majority of patients. The process also facilitates continuity of care with a specific infectious disease physician.

The various outcomes data collected by the Cleveland Clinic CoPAT Registry puts it in the position of being able to use the data to identify areas for improvement. Some of the projects made possible by the CoPAT Registry include analysis of: (1) outcomes of CoPAT in patients with bone and joint infections, (2) intensity of care in patients with cardiac and cardiac device infections while undergoing CoPAT, (3) *C. difficile* infections in patients undergoing CoPAT, and (4) emergency department (ED) visits or unanticipated readmissions in patients undergoing CoPAT. With respect to the last point, a 2009 article by Jencks and colleagues reported that 19.6% of the approximately 12 million Medicare beneficiaries who had been discharged from a hospital were rehospitalized within 30 days.[20] Moreover, more than a third (34%) were rehospitalized within 90 days of discharge. It was estimated that no more than 10% of these readmissions were scheduled. More than 50% of patients with a medical condition who were rehospitalized within 30 days of discharge had not been billed for a physician visit between the time of discharge and hospitalization.[20] This suggests that scheduling a follow-up visit at the time of discharge might have reduced the need for many of these rehospitalizations. Unplanned rehospitalizations among the Medicare patients examined were not only relatively common but were also costly, resulting in an estimated $17.4 billion in additional Medicare costs.[20] A *New York Times* editorial accompanying publication of the Jencks article noted that rehospitalizations and accompanying costs might be reduced by better discharge planning and closer cooperation between hospitals and physicians to ensure follow-up care.[21]

At the Cleveland Clinic, data have recently been collected on the reasons for ED visits or hospital readmissions for patients receiving CoPAT at home through the Cleveland Clinic home care program. As illustrated in Figure 6, 24% of ED visits[22] and 41% of hospital readmissions (Gordon, unpublished data) were for the infection being treated. Vascular access complications accounted for 23% of ED visits but only 2% of hospital readmissions. Nearly 50% of ED visits and 60% of hospital readmissions were for a reason unrelated to the infection being treated or CoPAT. It is hoped that closer examination of the data and perhaps additional analyses will suggest interventions to further reduce preventable readmissions or ED visits among patients discharged from the Cleveland Clinic on CoPAT.

Conclusions

Attention to antimicrobial stewardship and patient care should not end once the patient is discharged from the hospital or other institutional setting. Patients expect and should receive value-based health care across the full cycle

2011 Society of Hospital Medicine DOI 10.1002/jhm.867
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of their medical condition, and it is the responsibility of those caring for them to prepare for and provide such care during as well as after hospital discharge. The CoPAT program at the Cleveland Clinic provides a model for the extension of antimicrobial stewardship into the outpatient setting. The effectiveness of the program depends on a patient-centric approach involving coordination and use of the expertise of multiple members of a team dedicated to patient value and facilitated by hospital-based EHRs specialized for optimizing the transition of care into the outpatient setting for all patients scheduled to receive CoPAT. The quality of medical care provided by the Cleveland Clinic or other hospitals can be accessed through measurements of the structure, processes, and outcomes of care provided by the respective institutions. The data obtained can then be used to further refine care to optimize outcomes and provide high value for the patients treated at the institution. Achieving and then maintaining high-quality medical care that provides value to patients is an ongoing process that should never be taken for granted.

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Received 6 August 2010; revision received 22 September 2010; accepted 23 September 2010.

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 DOI 10.1002/jhm.867
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