

# The Value That Infectious Diseases Physicians Bring to the Healthcare System

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While a career in infectious diseases (ID) has always been challenging and exciting, recognition of the value that ID physicians provide to the healthcare system as a whole, over and above the value they provide to individual patients, has been poor in this system. In response to this disparity, the Infectious Diseases Society of America Clinical Affairs Committee has long endeavored to quantify the value of ID physicians to the system, which is challenging in part because of the many avenues through which they influence healthcare. We discuss data showing that ID physicians improve clinical outcomes, positively impact transitions of care, and direct system-level improvements through infection prevention and antimicrobial stewardship. We identify areas where value-based care provides additional future opportunities for ID physicians. A Clinical Affairs Committee–sponsored study of ID physicians' positive impact on patient outcomes shows that few medical specialties are better positioned to positively impact the Triple Aim approach—better health, better care, and lower per capita cost—that is the principle tenet of healthcare system reform.

**Keywords.** ID physician; value; infection prevention; antimicrobial stewardship; OPAT; MACRA.

While a career in infectious diseases (ID) has always been challenging and exciting, recognition of the value ID physicians provide to the healthcare system as a whole, over and above the value they provide to individual patients, has been poor in this system. In response to this disparity, the Infectious Diseases Society of America (IDSA) Clinical Affairs Committee (CAC) has long endeavored to quantify the value of ID physicians to the system, which is challenging in part because of the many avenues through which they influence healthcare. Under Petrak et al in 2003 and McQuillen et al in 2008, the CAC reviewed the available literature demonstrating the major role ID physicians play in patient care, infection prevention and antimicrobial stewardship [1, 2]. Evidence in the literature regarding clinical outcomes suggested that when an ID physician is involved in a patient's care and the physician in charge follows ID recommendations, patients more often receive a correct diagnosis, have shorter lengths of stay, receive more-appropriate therapies, have fewer complications, and may use fewer antibiotics overall [3–8]. ID physician interventions have been associated with reduced hospital mortality rates in patients with *Staphylococcus aureus* bacteremia [9, 10]. ID physicians have been shown to have a positive impact on the appropriate use of antibiotic therapy in patients with trauma, bacteremia, and skin and soft-tissue infections [8]. Data regarding the impact of ID physicians

on hospital length of stay and costs had been mixed, with both positive and negative effects seen (Table 1) [5, 8, 11].

## ID PHYSICIANS IMPROVE OUTCOMES

While prior data largely showed positive effects, constraints in sample size and methods limited the generalizability of the conclusions. To address this and provide a more broadly applicable data set, Schmitt led CAC colleagues in an investigation of the impact of ID physician intervention on any of 11 infections in the Medicare claims database [12]. Cohorts (101 991 stays with and 170 336 stays without ID physician interventions during 2008–2009) were propensity-score matched for patient demographic characteristics, comorbidities, and hospital characteristics. Regression models compared ID physician to non-ID physician intervention and early versus late ID physician intervention. Unadjusted Medicare data suggested that ID physicians routinely care for a very complex patient population. Notably, unadjusted data revealed that ID physician intervention was associated with a lower index-stay mortality rate (odds ratio, 0.95; 95% confidence interval [CI], .93–.98). After risk adjustment, ID physician care of patients with ID diagnoses was associated with better outcomes (fewer days of intensive care unit stay and index stay [ $P < .001$ ], a lower 30-day mortality rate [ $P < .001$ ], and a lower 30-day readmission rate [ $P = .009$ ]) and a lower index-stay cost of care ( $P < .001$ ). These benefits were greatest when ID physician involvement started within the first 2 days of hospital admission (Table 2).

More recently, the CAC studied a national database of insurance claims from privately insured individuals aged <65 years to identify inpatient acute-care stays in 2014 for any of 11 infections (CAC, unpublished data). A total of 29 050 observations,

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**Table 1. Roles of Infectious Diseases (ID) Physicians in the Healthcare System**

Role	Comment(s)	Reference(s) or Source
Improve outcomes		
Patient care	More correct diagnoses, shorter lengths of stay, more-appropriate therapies, fewer complications, may use fewer antibiotics overall	[3–8]
<i>S. aureus</i> bacteremia	Reduced mortality	[9, 10]
Medicare recipients (272 327 stays)	Early ID physician intervention lowers costs, decreases length of stay and readmissions, decreases mortality	[12]
Privately insured patients (29 050 stays)	Early ID physician intervention shortens length of stay, lowers cost, lowers mortality, lowers chance of readmissions, lowers total healthcare costs over 90 d	Unpublished data
Influence transitions of care		
Inpatient consultations (263) for community-based OPAT	Treatment optimized in 84%, significant change in assessment in 52%, additional medical care contribution in 71%, OPAT unnecessary in 27%, effective care transition to outpatient in 86%	[13]
Multicenter private practice OPAT (6120 patients)	57% started therapy in hospital, 94% successfully treated as outpatients, only 3% hospitalized after starting therapy, 19% had therapeutic complication	[14]
ID physician–staffed vs ED physician–staffed ED cellulitis clinic	40% in ID physician–staffed clinic given noncellulitis diagnosis vs 11% in ED physician–staffed clinic, recurrence and hospitalization rates lower in ID physician–staffed clinic, no difference in mortality	[15]
Lead infection prevention and antimicrobial stewardship programs		
CDC IP 2016 data	50% decrease in CLABSI, 17% decrease in SSI, 8% decrease in hospital-acquired CDI	[16]
ID physician–led AS program 70-bed rural hospital over 3 years	42% decrease in antiinfection expenditures, improved <i>P. aeruginosa</i> susceptibility	[17]
24-hospital network over 7 years	50% decrease in HAI rates, decreased costs, prevented 52–105 deaths from CLABSI or VAP	[18]
AS in LTAC hospital via remote EHR access	Decreased antibacterial use, decreased CDI rates	[19]

Abbreviation: AS, antimicrobial stewardship; CDC, Centers for Disease Control and Prevention; CDI, *Clostridium difficile* infection; CLABSI, central line–associated bloodstream infection; ED, emergency department; EHR, electronic health record; HAI, healthcare-associated infection; IP, infection prevention; LTAC, long-term acute care; OPAT, outpatient antimicrobial therapy; *P. aeruginosa*, *Pseudomonas aeruginosa*; *S. aureus*, *Staphylococcus aureus*; SSI, surgical site infection.

half with early ID physician intervention (by day 3 of the index hospital stay) and half without, were propensity score matched. Relative to others, people with early ID involvement had shorter lengths of stay, lower costs, and lower mortality rates during the index stay. After discharge, they experienced a lower likelihood of readmission and lower total healthcare costs over the next 30 days. Taken together, these 2 studies provide powerful data demonstrating the value of ID physician care of patients with infections in the inpatient setting, especially when viewed in the framework of the Triple Aim approach—better health, better care, and lower per capita cost—that is the driving principle

of healthcare system reform [20]. Additionally, as we evolve toward a more value-based payment model in which health systems assume more financial risk for the care of patients (as seen in the various cardiac and orthopedic procedure bundled payments), the value that ID physicians can provide within healthcare systems becomes easier to characterize. Even if an ID physician is consulted early, the rescue care that they can provide to a patient who has an infection associated with one of these procedures can make a dramatic difference in terms of outcomes, not only for the individual patient but potentially for the health system itself. Hospital administrators should

**Table 2. Risk-Adjusted Outcomes for Stays Receiving Early Versus Late Intervention by Infectious Diseases Physicians**

Outcome	Early Intervention <sup>a</sup>	Late Intervention	<i>P</i>	Percentage Difference (95% CI)	OR (95% CI)
Index stay, length of stay, d	13.2	13.8	<.001	–3.8 (–4.8 to –2.9)	...
Index stay, length of ICU stay, d <sup>b</sup>	7.6	8.1	<.001	–5.1 (–7.7 to –2.4)	...
Index stay, mortality, %	7.1	7.5	.122	...	0.94 (.88–1.02)
30-d mortality, % <sup>c</sup>	8.6	9.6	<.001	...	0.87 (.82–.93)
30-d readmission rate, % <sup>c</sup>	24.6	26.1	<.001	...	0.92 (.89–.96)
ACH charge for index stay, \$	95 135	98 015	<.001	–2.9 (–4.1 to –1.7)	...
Medicare payments to ACH for index stay, \$	18 111	18 728	<.001	–3.3 (–4.3 to –2.3)	...
Medicare payments for index stay, \$	21 453	22 207	<.001	–3.4 (–4.3 to –2.5)	...
Medicare payments for 30-d episode, \$ <sup>c</sup>	8739	9318	<.001	–6.2 (–8.8 to –3.5)	...

Adapted from the article by Schmitt et al [12].

Abbreviations: ACH, acute-care hospital; CI, confidence interval; ICU, intensive care unit; OR, odds ratio.

<sup>a</sup>Within 2 days.

<sup>b</sup>Only patients with ≥1 d of stay in the ICU.

<sup>c</sup>Excludes patients dying in the hospital.

recognize the value of early ID consultation for any procedures that are under bundled payment. The healthcare system also potentially benefits from the lesser recognized and difficult to quantify value of the ID physicians' curbside consultative expertise. An analysis conducted by Grace et al of 1001 curbside consultations (involving both inpatients and outpatients) identified that these consultations represented 2480 work relative value units, or 17% of the clinical work value of the ID unit of an academic center [21]. Many potential curbside discussions with ID physician go beyond individual patient care to involve infection prevention and stewardship activities that tie into health system efficiencies. Additionally, ID physicians impact outcomes through development of protocols for specific patient groups at high risk for infection, such as recipients of hematopoietic stem cell transplants and solid-organ transplants, as well as patients with rheumatic, gastroenterologic, and dermatologic illnesses being treated with biologic disease-modifying agents. Such protocols anticipate and prevent considerable morbidity from infection and extend far beyond simple infection prevention and antimicrobial stewardship.

### **ID PHYSICIANS IMPACT TRANSITIONS OF CARE**

Another important area where ID physicians are uniquely qualified by virtue of their training to provide value to their medical systems resides in care transition between the inpatient and outpatient settings. ID physicians are often the only providers who span this continuum of care for infections and are vital in the prevention of readmissions. Shrestha et al used electronic order entry to identify 263 ID consultations for community-based outpatient antimicrobial therapy (OPAT) over 3 months at a large multispecialty medical center [13]. Antimicrobial treatment was optimized in 84%, a significant change in patient assessment was made in 52% of consultations, and additional medical care contribution was provided in 71%. In 33% of consultations, there were contributions in all 3 domains. OPAT was deemed unnecessary in 27%. For patients requiring OPAT, effective care transition from the inpatient to the outpatient settings was ensured at least 86% of the time. A recent study of the value of OPAT in a multicenter ID private practice setting analyzed 6120 patients treated over 32 months in 19 outpatient ID offices in 6 states [14]. Forty-three percent of patients initiated therapy in an outpatient office, and 57% began therapy in a hospital. The most-common diagnoses treated were bone and joint infections (32.2%), abscesses (18.8%), cellulitis (18.5%), and urinary tract infections (10.8%). Ninety-four percent of patients were successfully treated, and only 3% were hospitalized after beginning therapy. The most common cause of treatment failure was relapse of primary infection (60%), progression of primary infection (21%), and therapeutic complication (19%). Finally, a retrospective cohort study was conducted that compared 149 patients referred over 4 months from 3 emergency departments to a central cellulitis clinic staffed by an emergency department

physician (EDMC) to 136 patients referred over the ensuing 3 months to an ID physician-supervised clinic (IDMC) [15]. Fifty-four of 136 patients (40%) in the IDMC were given an alternative diagnosis (noncellulitis), compared with 16 of 149 (11%) in the EDMC ( $P < .0001$ ). Logistic regression demonstrated that rates of disease recurrence were lower in the IDMC than in the EDMC (hazard ratio [HR], 0.06;  $P = .003$ ), as were rates of hospitalization (HR, 0.11;  $P = .01$ ). There was no significant difference in mortality. These studies confirm that ID physician-supervised OPAT programs are safe, efficient, and clinically effective across the entire spectrum of care. To support IDSA members in establishing, maintaining, and improving OPAT programs, the OPAT Workgroup of the CAC recently published a digital OPAT eHandbook, available free to IDSA members on the IDSA website (available at: <http://www.idsociety.org/opat-ebook/>), that serves as a practical resource enabling ID physicians to lead efforts to use OPAT within accountable care organizations and clinically integrated networks where they practice. As we move from fee-for-service to fee-for-value payments, an ID physician-led OPAT program has the potential to contribute considerably to readmission reductions, value-based purchasing goals, and integrated care delivery.

### **ID PHYSICIANS LEAD INFECTION PREVENTION AND ANTIMICROBIAL STEWARDSHIP PROGRAMS**

Infection prevention and antimicrobial stewardship programs represent ID physician-led population health programs where ID physicians provide essential value to healthcare systems. Although these are separate programs that require their own infrastructure, each influences the success of the other. Healthcare-associated infections (HAIs) are among the leading causes of death in the United States, with 1 in 25 patients developing an HAI during their hospitalization and >200 Americans dying of HAIs daily [22]. Multiple studies have demonstrated the beneficial effect of ID physician-led infection prevention programs in effecting beneficial reductions in the incidence of HAIs, as reviewed elsewhere [2]. The Centers for Disease Control and Prevention published data in 2016 evidencing progress in infection prevention, noting a 50% decrease in central line-associated bloodstream infections, a 17% overall decrease in surgical site infections after 10 select procedures, a 13% decrease in hospital-onset methicillin-resistant *S. aureus* bacteremia, an 8% decrease in hospital-onset *Clostridium difficile* infections, and no change in catheter-associated urinary tract infections between baseline and 2014 [16]. While excellent infection prevention is essential for hospital systems to function, opportunities for infection prevention intervention span the continuum of care, from hospitals and long-term-care facilities to households and the community. Regional and global outbreaks involving agents such as SARS coronavirus, MERS coronavirus, Ebola virus, and Zika virus offer clear opportunities where ID physicians are ideally suited to lead biopreparedness

and containment efforts in addition to their role in the early identification of pathogens of concern through surveillance efforts rendered via consultative services. Antimicrobial stewardship programs, dovetailing with infection prevention efforts, are centerpieces of the ID physician's ability to provide population-level benefit in reducing antimicrobial resistance.

Recognizing the growing threat of antimicrobial resistance has led several government agencies to issue rules and regulations that underscore the importance of the ID physician in leading the efforts against antimicrobial resistance. Beginning with the President's Council of Advisors on Science and Technology's Report on Combating Antibiotic Resistance and with the National Strategy for Combating Antibiotic Resistant Bacteria and Presidential Executive Order issued in September 2014, the importance of this growing challenge was brought to the forefront [23]. Since then, the Centers for Medicare and Medicaid Services (CMS) published revised conditions of participation requirements for long-term-care facilities in October 2016 that specify that such facilities must establish and maintain an infection prevention and control program that includes an antimicrobial stewardship program with antibiotic use protocols and a system to monitor antibiotic use [24]. In June 2016, the CMS issued a proposed rule for acute-care hospital conditions of participation that, for a statutorily mandated 25-bed critical access hospital, would require the services of a physician (preferably an ID physician or a physician with training in antibiotic stewardship) a clinical pharmacist (preferably with training in ID or antibiotic stewardship), and a network data analyst at the following proportions of full-time employee salaries: 0.05, 0.10, and 0.025, respectively [25]. Effective 1 January 2017, the Joint Commission on Accreditation of Hospitals approved a new antimicrobial stewardship standard that requires hospitals, critical access hospitals, and nursing centers to have a multidisciplinary antimicrobial stewardship team comprising an ID physician, infection preventionist(s), pharmacist(s), and practitioners [26]. These regulations clearly recognize that the problem of antimicrobial resistance is most appropriately addressed by teams that are led by individuals with the best training to address the problem: ID physicians. Joint evidenced-based guidelines published by the IDSA and Society for Healthcare Epidemiology of America in 2016 provide an excellent roadmap for how to implement an effective antimicrobial stewardship program across multiple types of inpatient settings [27]. ID diagnostic methods and techniques are also a critical and rapidly evolving area where ID physicians play an important stewardship role. Healthcare systems can benefit from having ID physician expertise to assist in developing institutional or healthcare professional understanding of the novel technologies and their use/applicability in the day-to-day care of patients.

Pertinent to the reality that 45% of hospitals in the United States have <100 beds, an antimicrobial stewardship program in a 70-bed rural hospital, led by a board-certified ID physician,

achieved a 42% decrease in antiinfection expenditures and improved antimicrobial susceptibility of *Pseudomonas aeruginosa* over 3 years [17]. The ability to provide on-the-ground leadership at these hospitals will be a big challenge that can be answered by approaches such as the Duke Infection Control Outreach Network, which provides infection prevention services to 24 community hospitals and, in a 7-year prospective, observational cohort study, showed that network participation decreased rates of significant HAIs by approximately 50%, decreased costs, and collectively may have prevented 52–105 deaths from central line-associated bloodstream infections or ventilator-associated pneumonia [18]. Alternatively, such institutions can be well served by antimicrobial stewardship/infection prevention programs delivered via telehealth services. As an example, an antimicrobial stewardship program using remote accessed electronic health records in a long-term acute-care hospital observed significant decreases in antibacterial use and *C. difficile* infection rates, suggesting the potential for expansion into settings with limited local ID resources [19]. The Telehealth Workgroup of the CAC recently published an IDSA position statement that explores the issues and considerations involved in establishing telehealth and telemedicine services to provide timely, cost-effective specialty care to resource-limited populations [28]. Importantly, the Joint Commission standard for antimicrobial stewardship programs recognizes that a significant number of hospitals may not have an on-site ID physician [26]. Telehealth offers an opportunity for ID physicians to increase their reach to the 45% of US hospitals that may not already benefit from their expertise, as well as fertile ground for expansion of ID consultative services. Establishing telehealth-based ID consultative services could potentially provide a disincentive to having an on-site ID physician but may be the only viable option for remote hospitals. Asynchronous electronic consultations have been used in some hospital systems in the United States and Canada as a means to triage simple questions in a way that allows documentation and can permit compensation in such systems [29, 30]. To date, the CMS and some private payers remunerate actual consultative services rendered under telehealth but do not remunerate asynchronous electronic consultations, although the situation is fluid.

## VALUE-BASED CARE PROVIDES OPPORTUNITIES

Current payment models in healthcare in the United States are based on payment for volume. Under this system, the majority of clinical revenue generated by ID physicians derives from evaluation and management services rendered directly to patients. Although evaluation and management services are valued on a relative scale through the American Medical Association's Current Procedural Technology code book and resource-based relative value scale process, the ultimate value of the relative value units of these services is far less than the values of many procedural services, which account for the higher cost of equipment

and other resources required to provide procedural services. CAC members have represented the IDSA in this process for well over a decade and, together with other cognitive specialties, have been able to achieve some gains in evaluation and management services payment, along with payment for physician supervision of OPAT services delivered in an office setting; however, these do not address the underrecognition of the ID physicians' value to their healthcare systems in the delivery of high-quality value-based care. Moreover, given the implementation of bundled payments, it is unclear how physician services that fall within the bundle will be paid out in the future, thereby placing more importance on highlighting the value that ID physicians provide to the system. To that end, the CAC has developed the concept of ID-focused hospital efficiency improvement plans (HEIPs) in the areas of infection prevention, antimicrobial stewardship, OPAT, and biopreparedness/emerging infections. ID-focused HEIPs treat such programs as hospital service lines, much like a hospital may treat orthopedic or cardiology service lines. ID-focused HEIPs position ID physicians as accountable, strategic physician executives who lead key facility/system-wide service lines that promote efficient, appropriate use of resources and mitigate the risk of HAI-related complications. The ID physician executive develops the overall plan that aligns with the overall facility or system strategic plan. Hospitals view the compensation arrangement for physician executives differently than they would for medical directors. Accordingly, the ID physician, as a medical executive HEIP leader, may be offered higher compensation than that associated with a traditional medical directorship. In addition, goals (in the form of targets such as reduced HAI rates and decreased antimicrobial use) can be set on the basis of the program's quality metric targets, for which shared savings can be distributed to the HEIP under the safe harbor of accountable care organizations and newer alternative payment models detailed in the Medicare Payment and CHIP Reauthorization Act of 2015 [31]. Further defining the value of an ID physician that combines both administrative and clinical care is one of the CAC's goals and is an ongoing, fluid process. The CAC continues to develop resources, including detailed HEIP business plans and sample comanagement agreements, providing guidance for establishing ID-focused HEIPs that are accessible to IDSA members in the ID Physician Leadership of Population Health Services section of the IDSA website (available at: [http://www.idsociety.org/uploaded-Files/IDSA/Manage\\_Your\\_Practice/ID\\_Physician\\_Leadership\\_of\\_Population\\_Health\\_Services/ID\\_HEIP\\_Concept\\_Final.pdf](http://www.idsociety.org/uploaded-Files/IDSA/Manage_Your_Practice/ID_Physician_Leadership_of_Population_Health_Services/ID_HEIP_Concept_Final.pdf)). The shift from volume-based to value-based payment for services changes the parameters of healthcare reimbursement to a system structure in which the ID physician is uniquely trained and qualified to succeed. Given the substantial impact that government regulatory initiatives can have on these activities, CAC members and IDSA leadership continue to actively advocate for appropriate government regulatory oversight with the CMS and on Capitol Hill.

The wide-ranging and substantial value provided by ID physicians in the healthcare system remains a significant challenge to quantify, largely because ID physicians perform a variety of roles, rather than discrete activities such as procedures, which are more conducive to evaluation and management. Better defining this expansive value is crucial to the success of efforts to recruit future ID physicians to address the healthcare system's growing needs in the realms of infection prevention and control, antimicrobial stewardship, transitions of care, OPAT, diagnostic technologies, population health, and, most importantly, clinical outcomes. As exemplified by a CAC-sponsored study of ID physicians' positive impact on patient outcomes [12], few medical specialties are better positioned to positively impact the Triple Aim approach [20].

## Notes

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