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# Infectious Disease Providers' Knowledge of and Engagement in Quality Improvement

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**Background.** Although engagement of infectious disease physicians has been demonstrated to improve clinical outcomes in a variety of disease states, the extent of infectious disease (ID) physician engagement in quality improvement (QI) or their knowledge of QI has not been assessed.

**Methods.** A 12-question, web-based survey was distributed to members of the Infectious Diseases Society of America (IDSA) between August and October 2019 to assess knowledge of and engagement in QI. The survey link was sent to IDSA members who self-identified patient care as their primary professional activity.

**Results.** Responses were received from 200 individuals (5.4% response rate, which is just below the standard IDSA survey response rate of 6%), consisting of 175 adult infectious disease physicians (IDPs). Most respondents were employed in a hospital or clinic (41%), private or group practice (25%), or university/medical center (24%). Fifty-eight percent of respondents currently participate in QI projects, while 38% serve on QI oversight committees. Among respondents, 27% reported not being engaged in QI. Infection prevention/hospital epidemiology (77%), stewardship (72%), and antimicrobial resistance (56%) were the most commonly reported measure types. Respondents reported barriers that limited participation in QI, including cost (61%), lack of time (56%), lack of data collection resources (48%), and lack of an ID-specific registry (46%). IDPs report significant interest in additional training in QI and new quality measures.

**Conclusions.** Although IDPs participate in QI, there are gaps in QI knowledge and measurement systems. The low response rate of our survey also suggests a lack of engagement in QI among IDPs. Closing these gaps will benefit ID in a value-driven health care economy.

**Keywords.** clinical practice; measurement; quality; value.

Infectious diseases (ID) specialists in the United States have expressed concern about the future of the specialty [1, 2] due to a decline in the number of ID fellowship trainees [3] and low reimbursement compared with other specialties [4, 5]. One of the ways to improve the appeal of ID to trainees and to promote compensation comparable to the impact and work of infectious disease physicians (IDPs) is to demonstrate the value of IDPs, a top priority of the Infectious Diseases Society of America (IDSA) [6]. Demonstrating value requires measurement of the impact of IDPs on patient care and institutional success. Thus, promoting a culture of quality improvement and

measurement within the specialty of ID is critical to the future of the specialty.

Literature has demonstrated that involvement of IDPs in patient care for a multitude of diseases improves patient outcomes, improves quality of patient care, reduces cost of care, and benefits population health [7–10]; in order to translate this evidence into measurement of quality and performance for the care of patients, both well-defined measures and engagement of IDPs in quality and performance measurement are needed. Other medicine specialties have made this successful transition from evidence that an intervention is beneficial to quality and performance improvement in the workplace, and subsequently to demonstration of value within an institution. For example, literature-based quality measures were developed for cardiology, implemented through quality improvement, and ultimately reflected in national institutional reputation [11–13]. With the shift to value-based reimbursement, properly designed measures also provide the benefit of use for pay-for-performance reimbursement [14], another way to demonstrate IDP value. In sum, developing a culture of measurement in infectious diseases requires both measures of IDP-impacted quality and engagement of IDPs in quality improvement and measurement.

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The current level of interest or involvement in quality improvement among IDPs has not been adequately assessed. A review of the literature indicates that IDPs are involved in local and collaborative quality improvement efforts [7–10]. In addition, many of the institutional positions of IDPs such as hospital epidemiology, antimicrobial stewardship, and outpatient parenteral antibiotic therapy require some degree of understanding of quality improvement. Due to the paucity of existing national ID-specific measures and lack of benchmarked goals for the few existing measures, IDPs do not appear superficially to be heavily involved in quality improvement nationally [14, 15]. To more thoroughly assess the current involvement of IDPs in QI and measurement, we surveyed IDP members of the Infectious Diseases Society of America. Herein, we review the survey results and propose strategies for addressing gaps so that IDPs can move toward a culture of measurement and quality improvement that will promote the success of the specialty.

## METHODS

The target population for the survey was physician IDSA members based in the United States whose primary professional activity was patient care, primary employment affiliation was at a university/medical school, hospital/clinic, private/group practice, federal government, state/local government, military, correctional facility, or other, and specialization was in adult infectious diseases. The target population was contacted by direct email with a personalized SurveyMonkey Inc. (San Mateo, CA, USA) link that contained a custom identifier that enabled linkage to the IDSA membership database to include demographic data in our analysis. The target population amounted to 3685 contacts out of ~12 000 total IDSA members (October 2019). Additional survey responses were solicited through the IDSA's Volunteer Manager web portal, which lists all IDSA volunteer opportunities. The survey collection period was from August 2019 to October 2019, with a total of 200 respondents (5.4% response rate). As a comparator, the average response rate for IDSA member surveys is ~6%. The survey has been reviewed by the authors' affiliated institutional review boards and was designated as an exempt study.

The survey asked respondents a total of 12 questions. The complete list of questions and answer options is available in Table 1.

## RESULTS

We surveyed members of the IDSA through their member registry system. A total of 200 respondents completed the survey, with 199 completing all 12 questions. Of the respondents, 175 practice adult ID, 13 practice pediatric ID, and 2 practice internal medicine. Specialty field data were not available from 9 respondents. Most of the respondents were employed in a hospital or clinic (41%), private or group practice (25%), or in a university/medical center (24%). Ninety-four percent of the respondents reported patient care as their primary job role, with

inpatient practice being the most common (78%). Teaching (34%) followed by clinical research (19%) and hospital epidemiology (17%) were the most common secondary job roles. Fifty-eight percent of the respondents reported that they participate in quality improvement projects, with 38% serving on a quality improvement oversight committee. Twenty-seven percent of the respondents are not actively involved in quality improvement (Figure 1).

Most respondents reported that their facility collects data to be used for hospital-based quality improvement efforts (54%) and Centers for Medicare and Medicaid Services (CMS), Health Resources and Services Administration, or private payer quality programs (46%). Data may also be used to promote improvement in the quality of patient care delivered either via ongoing professional performance evaluation (OPPE; 29%) or via self-directed improvement (16%). Thirty-three percent of the respondents reported that the data are also used for hospital-based incentive programs. However, 23% of the respondents did not know how the data collected by their hospital/practice are used (Figure 2).

Infection prevention/hospital epidemiology (77%), stewardship (72%), and antimicrobial resistance (56%) are the most commonly reported measure types. Antimicrobial utilization (73%) was the most commonly collected data point. Mortality rates and readmission rates for patients who are provided care are also commonly reported, though these are not specific to patients with infectious disease conditions such as *Staphylococcus* bacteremia. Guideline & treatment standard adherence are commonly measured as well. Those working in a federal or state/local government position were more likely to report also being measured on adherence to treatment standards for non-ID-related disease states, such as tobacco cessation.

Several barriers to participation in quality improvement were identified. A deficiency in knowledge on how to collect quality data was not a major barrier for any subgroup. The lack of support for data collection, access to the data, and lack of time to complete QI work were major barriers for all (Figure 3). Specifically, the lack of ID-specific measures and the lack of an ID data registry were barriers, with the majority of respondents reporting that they would be very likely to use ID-specific quality metrics if more existed (Figure 4). Many respondents also reported that they would utilize QI resources through the IDSA, such as webinar trainings (77%), IDWeek lectures (73%), a data registry (51%), or fellowship-directed educational tools (29%).

## CONCLUSIONS

Health care payment models in the United States have historically been based on payment for volume. However, the growing trend toward value-based care provides incentive for health care

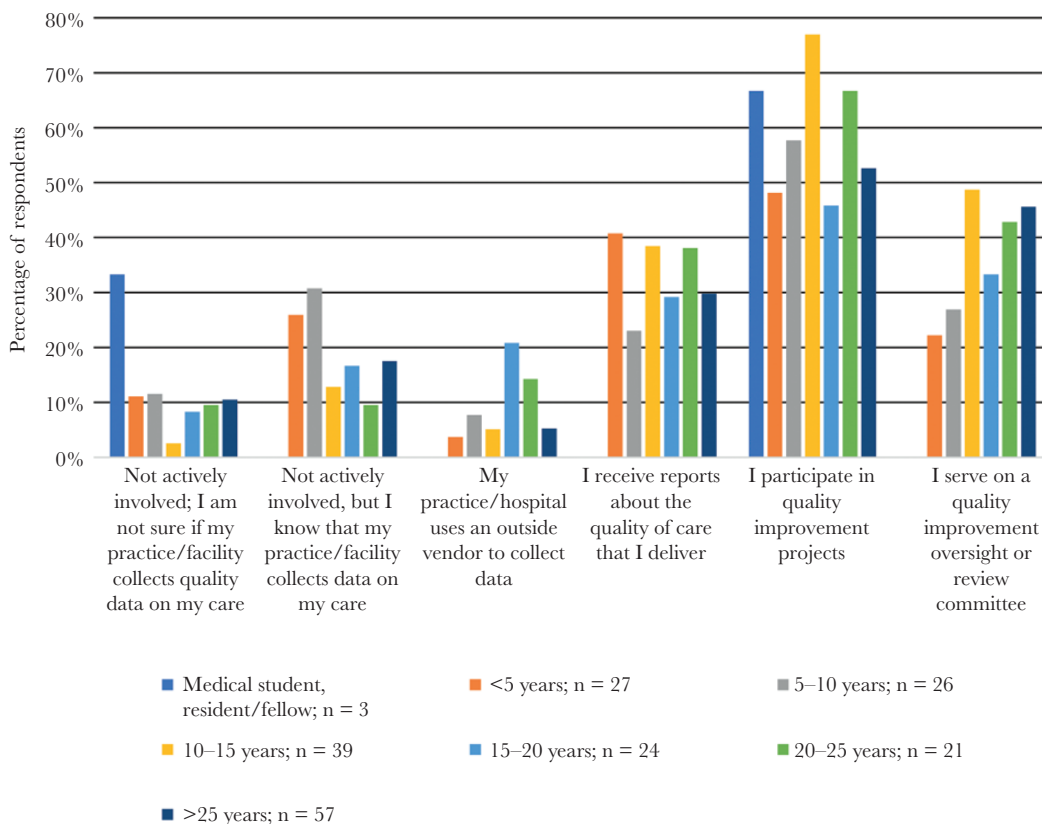
**Table 1. Survey Questions and Answers**

Question	Answer Options
1. How are you currently involved in quality measurement or improvement work at your hospital/practice? (select all that apply)	<ul style="list-style-type: none"> <li>A. Not actively involved; I am not sure if my practice/facility collects quality data on my care</li> <li>B. Not actively involved, but I know that my practice/facility collects data on my care</li> <li>C. My practice/hospital uses an outside vendor to collect data</li> <li>D. I receive reports about the quality of care that I deliver</li> <li>E. I participate in quality improvement projects</li> <li>F. I serve on a quality improvement oversight or review committee</li> </ul>
2. Select all the barriers to your participation in quality improvement. If you participate in quality improvement, select the barriers that prevent you from greater or more successful participation.	<ul style="list-style-type: none"> <li>A. Mortality for all patients you provide care to</li> <li>B. Mortality for patients with specific infectious disease conditions (eg, <i>Staphylococcus bacteremia</i>)</li> <li>C. Readmission rates for all patients you provide care to</li> <li>D. Readmission rates for patients with specific infectious disease conditions</li> <li>E. Adherence to guidelines from professional societies</li> <li>F. Utilization of hospital-specific treatment pathways/order sets</li> <li>G. Antimicrobial utilization</li> <li>H. Health maintenance (eg, smoking cessation counseling)</li> <li>I. Adherence to treatment standards for non-ID-related conditions (eg, beta-blocker use after MI, smoking cessation)</li> <li>J. Other</li> </ul>
3. Select all quality data that you or your primary practice/hospital collect to measure the safety or quality of care that you deliver.	<ul style="list-style-type: none"> <li>A. Ongoing professional practice evaluation</li> <li>B. CMS, HRSA, or private payer quality programs</li> <li>C. Hospital-based incentive programs</li> <li>D. Hospital-based quality improvement effort</li> <li>E. Self-directed care improvement</li> <li>F. I don't know</li> <li>G. Other</li> </ul>
4. If you or your hospital/practice collects quality data, what are the data used for? (Select all that apply.)	<ul style="list-style-type: none"> <li>A. Lack of validated metrics that reflect ID care</li> <li>B. Lack of access to data</li> <li>C. Lack of support for data collection and/or reporting</li> <li>D. Unclear benefit to participating in QI</li> <li>E. Lack of time to complete QI work</li> <li>F. Lack of knowledge on how to improve quality</li> <li>G. Cost of resources for reporting</li> <li>H. Lack of ID-specific data registry</li> <li>I. Infectious disease quality measurement is not an institutional priority</li> </ul>
5. How likely are you to use the following safety and quality metrics if they existed? (1—very unlikely, 5—very likely)	<ul style="list-style-type: none"> <li>A. Antimicrobial use/stewardship</li> <li>B. OPAT use and safety</li> <li>C. <i>Clostridium difficile</i> guideline adherence</li> <li>D. <i>Staphylococcus aureus</i> bacteremia guideline adherence</li> <li>E. Adherence to other IDSA-endorsed guideline</li> <li>F. Adherence to HIV care standards (eg, antiretroviral use, OI prophylaxis)</li> <li>G. Development of antimicrobial resistance</li> <li>H. Other (specify)</li> </ul>
6. Would you utilize any of the following resources to improve your knowledge of quality improvement if provided by IDSA? (Select all that apply.)	<ul style="list-style-type: none"> <li>A. Webinars/trainings</li> <li>B. Fellowship educational tools</li> <li>C. Data registry</li> <li>D. IDWeek lectures/workshop</li> </ul>
7. Select all measures that you/your practice reports on either externally or internally.	<ul style="list-style-type: none"> <li>A. Stewardship</li> <li>B. OPAT</li> <li>C. HIV</li> <li>D. Infection prevention/hospital epidemiology</li> <li>E. Antimicrobial resistance</li> <li>F. <i>Staphylococcus aureus</i> bacteremia</li> </ul>
8. Rate your familiarity with these quality programs or methods. (1—not at all familiar, 5—extremely familiar)	<ul style="list-style-type: none"> <li>A. Merit-based Incentive Payment Program (MIPS)</li> <li>B. Alternative Payment Models (APMs)</li> <li>C. Model for Improvement</li> <li>D. Lean Methodology</li> <li>E. Six Sigma</li> </ul>

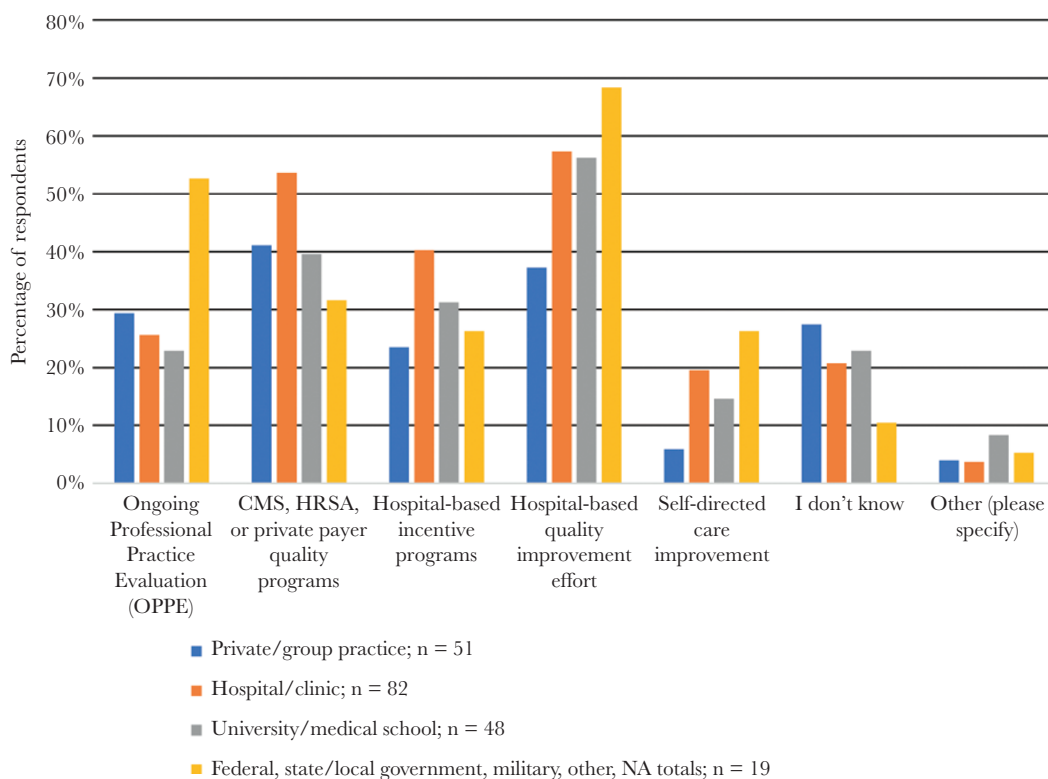
**Table 1. Continued**

Question	Answer Options
9. Please describe the location where you deliver the majority of your ID care.	A. Inpatient B. Outpatient C. Other (specify)
10. How many years have you been in practice?	A. Medical student B. Resident/Fellow C. <5 years out of fellowship D. 5–10 years out of fellowship E. 10–15 years out of fellowship F. 15–20 years out of fellowship G. 20–25 years out of fellowship H. ≥25 years out of fellowship
11. What is the size of the facility where you spend the majority of your time?	A. <50 beds B. 50–100 beds C. 100–200 beds D. 200–400 beds E. 400–600 beds F. 600–800 beds G. 800–1000 beds H. >1000 beds
12. Would you be willing to participate in a follow-up survey about quality & safety reporting metrics?	A. Yes B. No

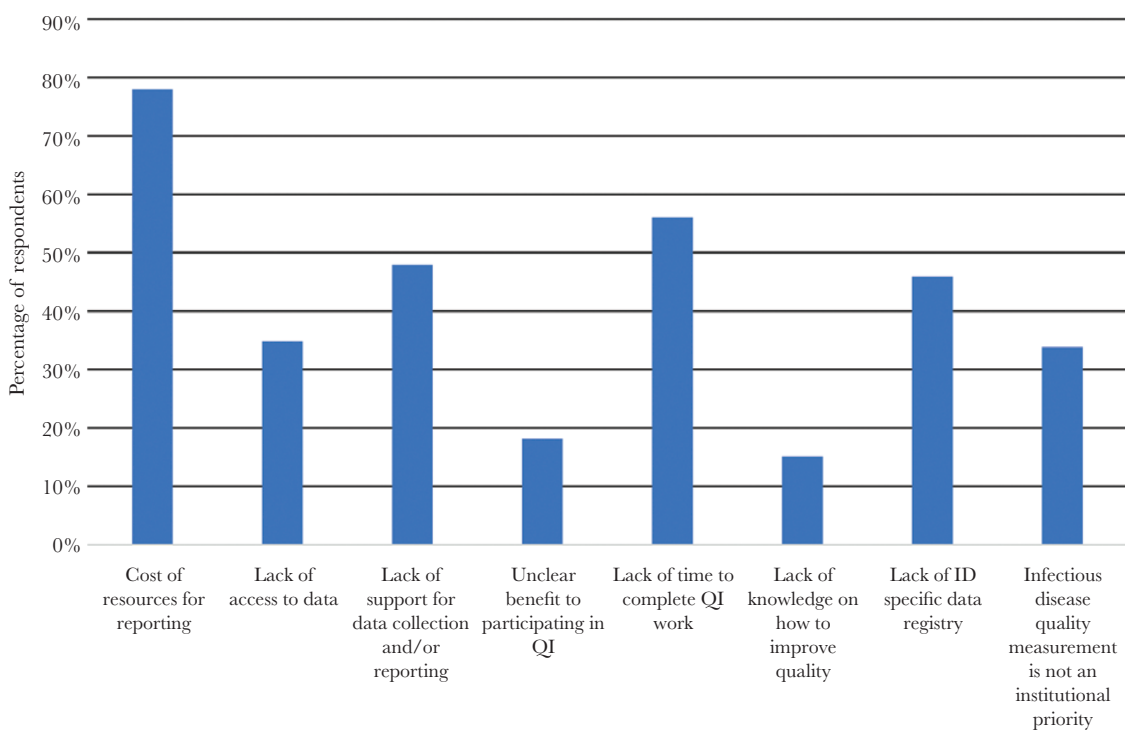
Abbreviations: CMS, Centers for Medicare and Medicaid Services; HRSA, Health Resources and Services Administration; ID, infectious disease; IDSA, Infectious Diseases Society of America; MI, myocardial infarction; OI, opportunistic infection; OPAT, outpatient parenteral antibiotic therapy.



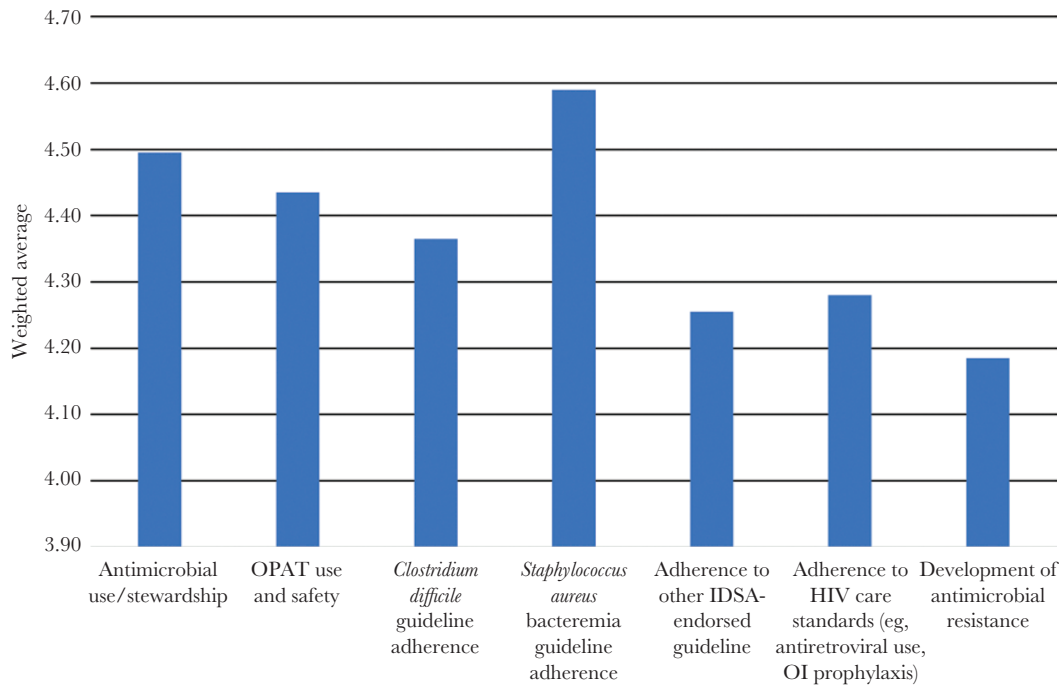
**Figure 1.** Current level of involvement in quality measurement or improvement, by years of practice.



**Figure 2.** Reported use of quality data, by employment type. Abbreviations: CMS, Centers for Medicare and Medicaid Services; HRSA, Health Resources and Services Administration.



**Figure 3.** Barriers to participating in quality improvement. Abbreviations: ID, infectious disease; QI, quality improvement.



**Figure 4.** Likeliness to use potential ID quality and safety metrics (Likert scale). Abbreviations: ID, infectious disease; IDSA, Infectious Diseases Society of America; OI, opportunistic infection; OPAT, outpatient parenteral antibiotic therapy.

providers to engage in quality measurement and improvement activities that allow for the demonstration of value as well as improvements in care. In order to demonstrate value, there must be systems of measurement that accurately reflect care delivery and participation of clinicians to engage in data-driven care improvement. This survey assesses infectious disease physicians' knowledge of and engagement with quality measurement and improvement.

Our survey indicates that many IDPs (58%) already participate in quality improvement projects; an additional 38% of respondents serve on quality improvement oversight or review committees. However, there is variation in engagement in quality improvement projects based on employer, with only 33% (n = 17) of those in private or group practices reporting participation in quality improvement projects. This is in contrast to those employed directly by a hospital (66% of respondents) or university/medical school (69% of respondents). This difference in engagement with QI projects may be a reflection of how participation in these activities is compensated in different settings. Compensation models that are fully supported by the volume of patients seen will disincentivize participation in uncompensated activities, like participation in QI initiatives. Conversely, direct employment by a university or hospital may weaken the link between patient volume and compensation, thus reducing the disincentive to participate in activities that do not directly generate revenue.

Participation in QI projects is not surprising given the demonstrated benefits that the engagement of an IDP has on

infection prevention and antimicrobial stewardship programs [16]. Respondents indicated that infection prevention (77%), antimicrobial stewardship (72%), and antimicrobial resistance (56%) were the most frequently reported infectious disease-related measures collected by their facilities. By comparison, a minority of respondents indicated that their facility reported data on adherence to treatment guidelines (21%), hospital-based treatment pathways or order sets (33%), or health maintenance measures (33%). Although the CMS reports 30-day readmissions and 30-day mortality for selected conditions, including pneumonia, few IDPs were aware that data were collected on these measures. Only 23% of respondents indicated that mortality data on all patients to whom they provided care were collected, while only 11% reported knowledge that mortality for specific infectious disease conditions were collected. Thirty-four percent of respondents were aware that data on readmission rates were collected for patients to whom they had provided care.

IDPs reported that the most common use for quality data was hospital-based improvement (54%), while only 46% reported that the data were used for CMS or other payer quality programs. Twenty-three percent of respondents were unsure how quality data were used. IDPs reported modest knowledge of the 2 components of CMS' Quality Payment program, the Merit-Based Incentive Payment System (MIPS) and Alternate Payment Models (APMs). Among respondents, 50.6% and 71.3% were slightly or not at all familiar with MIPS and APMs, respectively.

Additionally, there was limited knowledge of QI methodologies; 77.1%, 63.5%, and 60.5% were slightly or not familiar at all with the Model for Improvement, lean methodology, or Six Sigma, respectively. Although both internal medicine residency [17] and infectious disease fellowship programs [18] are required to provide training in quality improvement, these findings suggest that this goal may not be sufficiently met. A systematic review of QI curricula for physician trainees found that quality of QI training varied widely [19]. Lickhus et al. found that QI training did not improve family medicine residents' ability to lead QI initiatives [20]. However, there are examples of QI training improving an individual's knowledge of QI [21, 22]. A majority of respondents to our survey would participate in additional training in QI through webinars (77%) or lectures/workshops during IDWeek (73%), suggesting an interest in acquiring more knowledge about QI.

While knowledge deficits about QI can be overcome by making training more available, there are other barriers that IDPs identified that limit broader participation in QI activities (Figure 3). Notably, the cost of reporting (78%), the lack of time to participate in QI initiatives (56%), and lack of support for data collection (48%) were identified as significant barriers. The lack of an ID-specific registry was reported as a barrier by 46% of respondents. Some medical specialties have developed their own registries for collecting quality data. The American College of Rheumatology has created the Rheumatology Informatics System for Effectiveness (RISE), which captures data electronically [23]. The RISE registry has been used to benchmark care practices and identify opportunities for improvement. For example, 28 802 patients who were initiated on biologic or new synthetic disease-modifying antirheumatic drugs (DMARDs) were assessed for receipt of appropriate health screenings before DMARD initiation; only 15.5% of all patients received appropriate screening for all relevant infections before DMARD initiation [24]. The RISE registry has also been able to demonstrate improvements in most measures of rheumatoid arthritis care at the clinic level [25]. Likewise, the American Heart Association (AHA) supports multiple registries that track the quality of care and outcomes of patients with cardiovascular disease and stroke [26]. Patients treated at hospitals participating in the AHA's Get with the Guidelines–Stroke Registry and program were more likely to receive care consistent with evidence-based guidelines than those treated at hospitals that did not participate in the registry [27]. The lack of an infectious disease-specific registry was identified by 46% of respondents as a significant barrier to engaging further in QI. While the development of an ID-specific or condition-based registry would require significant investment, creation of a registry would address a significant barrier for IDPs. Respondents indicated a high degree of support for multiple quality metrics if they were to be developed (Figure 4). Although IDPs have interest in new quality metrics, there has been an explosion of quality metrics that health care

organizations must devote resources to. More than one-third of respondents to our survey indicated that ID quality measures were not an organizational priority (Figure 3). In addition to providing insight into an ID physicians' care, new quality measures must provide value to the health care organizations, which are often balancing the demands of multiple quality measurement systems with the limited resources available for data collection, reporting, and improvement.

Our study does have limitations. We had a low response rate, at only 5.4%, which may be reflective of a low level of engagement in QI among IDPs. Although survey respondents represented a broad array of ID practice types and care settings, it is possible that participants are not representative of all ID providers. Additionally, the survey largely assesses knowledge of inpatient quality measures. There are several HIV-related quality measures that assess the quality of ambulatory HIV care. Additionally, the survey was targeted toward individuals who reported patient care as their primary professional activity. ID physicians who serve in safety- or quality-related administrative roles as their primary activity may have been excluded from this study. The results reflect the knowledge and engagement in QI of a more broadly generalizable IDP population when compared with those who are predominantly in safety or quality administrative roles.

Our study suggests that while there is interest in more ID-related quality measures, there currently are knowledge and other barriers that limit the ability of IDPs to participate in quality initiatives. Initiatives to make quality improvement training more available may benefit IDPs. Access to an ID registry may also be beneficial to advancing the role of IDPs in QI.

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**Patient consent.** This study does not include factors necessitating patient consent.

### References

1. Fuchs GJ 3rd. The future of the discipline of infectious diseases. *Clin Infect Dis* 2017; 65:1597–8.
2. Walensky RP, Del Rio C, Armstrong WS. Charting the future of infectious disease: anticipating and addressing the supply and demand mismatch. *Clin Infect Dis* 2017; 64:1299–301.
3. Chandrasekar P, Havlicek D, Johnson LB. Infectious diseases subspecialty: declining demand challenges and opportunities. *Clin Infect Dis* 2014; 59:1593–8.
4. Trotman R, Kim AI, MacIntyre AT, Ritter JT, Malani AN. 2017 Infectious Diseases Society of America physician compensation survey: results and analysis. *Open Forum Infect Dis* 2018; 5:XXX–XX.
5. Ritter JT, Lynch JB 3rd, MacIntyre AT, Trotman R. Infectious diseases physician compensation: an improved perspective. *Open Forum Infect Dis* 2016; 3:XXX–XX.



6. Sears CL, File TM, Alexander BD, et al. Charting the path forward: development, goals and initiatives of the 2019 Infectious Diseases of America Strategic Plan. *Clin Infect Dis* **2019**; 69:e1–7.
7. Bai AD, Showler A, Burry L, et al. Impact of infectious disease consultation on quality of care, mortality, and length of stay in *Staphylococcus aureus* bacteremia: results from a large multicenter cohort study. *Clin Infect Dis* **2015**; 60:1451–61.
8. Arias Arias C, Tamayo Betancur MC, Pinzón MA, et al. Differences in the clinical outcome of osteomyelitis by treating specialty: orthopedics or infectology. *PLoS One* **2015**; 10:e0144736.
9. Viale P, Tedeschi S, Scudeller L, et al. Infectious diseases team for the early management of severe sepsis and septic shock in the emergency department. *Clin Infect Dis* **2017**; 65:1253–9.
10. Schmitt S, MacIntyre AT, Bleasdale SC, et al. Early infectious diseases specialty intervention is associated with shorter hospital stays and lower readmission rates: a retrospective cohort study. *Clin Infect Dis* **2019**; 68:239–46.
11. Chen J, Radford MJ, Wang Y, et al. Do “America’s Best Hospitals” perform better for acute myocardial infarction? *N Engl J Med* **1999**; 340:286–92.
12. Mehta RH, Das S, Tsai TT, et al. Quality improvement initiative and its impact on the management of patients with acute myocardial infarction. *Arch Intern Med* **2000**; 160:3057–62.
13. Marciniak TA, Ellerbeck EF, Radford MJ, et al. Improving the quality of care for Medicare patients with acute myocardial infarction: results from the cooperative cardiovascular project. *JAMA* **1998**; 279:1351–7.
14. Eby JC, Lane MA, Horberg M, et al. How do you measure up: quality measurement for improving patient care and establishing the value of infectious diseases specialists. *Clin Infect Dis* **2019**; 68:1946–51.
15. Horberg MA, Aberg JA, Cheever LW, et al. Development of national and multi-agency HIV care quality measures. *Clin Infect Dis* **2010**; 51:732–8.
16. McQuillen DP, Petrak RM, Wasserman RB, et al. The value of infectious diseases specialists: non-patient care activities. *Clin Infect Dis* **2008**; 47:1051–63.
17. ACGME. ACGME Common Program Requirements (Residency). ACGME; **2020**.
18. ACGME. ACGME Common Program Requirements (Fellowship). ACGME; **2020**.
19. Windish DM, Reed DA, Boonyasai RT, et al. Methodological rigor of quality improvement curricula for physician trainees: a systematic review and recommendations for change. *Acad Med* **2009**; 84:1677–92.
20. Lichkus J, Fang B, Peterson LE. Family medicine residency graduates’ preparation for quality improvement leadership. *J Grad Med Educ* **2019**; 11:558–64.
21. Baxter K, Petz C, Middleton JL, Chan M. Re-thinking how we teach quality improvement: adding meaning to an ACGME requirement. *J Gen Intern Med* **2019**; 34:1662–7.
22. Johnson KM, Fiordellisi W, Kuperman E, et al. X + Y = time for QI: meaningful engagement of residents in quality improvement during the ambulatory block. *J Grad Med Educ* **2018**; 10:316–24.
23. Francisco M, Johansson T, Kazi S. Overview of the American College of Rheumatology’s Electronic Health Record-Enabled Registry: the rheumatology informatics system for effectiveness. *Clin Exp Rheumatol* **2016**; 34:102–4.
24. Schmajak G, Li J, Evans M, et al. RISE registry reveals potential gaps in medication safety for new users of biologics and targeted synthetic DMARDs. *Semin Arthritis Rheum* **2020**; 50:1542–8.
25. Izadi Z, Schmajak G, Gianfrancesco M, et al. Rheumatology Informatics System for Effectiveness (RISE) practices see significant gains in rheumatoid arthritis quality measures. *Arthritis Care Res (Hoboken)*. **In press**.
26. LaBresh KA, Gliklich R, Liljestrand J, et al. Using “get with the guidelines” to improve cardiovascular secondary prevention. *Jt Comm J Qual Saf* **2003**; 29:539–50.
27. Howard G, Schwamm LH, Donnelly JP, et al. Participation in get with the guidelines—stroke and its association with quality of care for stroke. *JAMA Neurol* **2018**; 75:1331–7.