The Infectious Diseases Society of America Emerging Infections Network: Bridging the Gap Between Clinical Infectious Diseases and Public Health

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In 1995, the Centers for Disease Control and Prevention granted a Cooperative Agreement Program award to the Infectious Diseases Society of America to develop a provider-based emerging infections sentinel network, the Emerging Infections Network (EIN). Over the past 17 years, the EIN has evolved into a flexible, nationwide network with membership representing a broad cross-section of infectious disease physicians. The EIN has an active electronic mail conference (listserv) that facilitates communication among infectious disease providers and the public health community, and also sends members periodic queries (short surveys on infectious disease topics) that have addressed numerous topics relevant to both clinical infectious diseases and public health practice. The article reviews how the various functions of EIN contribute to clinical care and public health, identifies opportunities to further link clinical medicine and public health, and describes future directions for the EIN.

Keywords. public health; emerging infectious diseases; infectious diseases physicians.

In 1992, the Institute of Medicine issued a report on emerging infections as a public health threat [1]. Following the1993 outbreak of hantavirus pulmonary syndrome, a physician noted that this syndrome might not have come to the attention of the public health community if 2 young people had not died within a week of each other [2]. Soon after, the concept for an emerging infections network was articulated in the Centers for Disease Control and Prevention's (CDC) Emerging Infections Plan (April 1994) and included a strategy for provider-based sentinel networks [3, 4]. In 1995, the Infectious Diseases Society of America (IDSA) received a Cooperative Agreement Program award from the CDC to develop such a network. The next year, IDSA launched a sentinel network comprised of clinical infectious disease physicians called the Emerging Infections Network (EIN) [5].

The EIN has evolved into a flexible network of infectious disease consultants who respond to queries from their colleagues and from members of the public health community about emerging infectious diseases (EIDs) and related phenomena. In addition, members spontaneously contribute questions and clinical observations. The overarching goal of the EIN is to assist the CDC and other public health authorities with surveillance. The EIN attempts to gather relevant clinical data that complement traditional surveillance systems. To achieve its goals, the EIN has undertaken the following tasks: (1) detecting new or unusual clinical events in its members' practices; (2) identifying cases to help public health authorities investigate outbreaks; (3) gathering information about clinical aspects of EIDs; (4) connecting EIN members and the CDC and other public

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health investigators; and (5) informing EIN members about EIDs and the surveillance needs of the public health community. All of these tasks are important for public health reporting systems [6].

This paper describes the EIN membership and current EIN activities. We also describe how these activities help inform both infectious disease clinicians and the public health community. Finally, we outline future opportunities for the EIN to bridge gaps between clinical infectious diseases and the public health community.

EIN MEMBERSHIP

The only requirement for membership in the EIN is to be either an IDSA physician member actively involved in the practice of infectious diseases or a member of the public health community. EIN membership currently consists of 1590 practicing infectious disease physicians from all 50 states and the District of Columbia (Figure 1). Among members, 76% care for adults, 19% care for children, and 5% serve both age groups. Members are divided equally among those with <5 years of infectious disease experience (including fellows-in-training), 5–14 years of experience, 15–24 years of experience, and ≥25 years of experience. Members report primary affiliation with a university/medical school (39%); a hospital or clinic (28%); a private/group practice (28%); or Veterans Affairs, federal, or military hospitals (5%). Membership has recently been growing by approximately 10% per year, and currently represents approximately 18% of IDSA physician members and 20% of infectious disease physicians certified by the American Board of Internal Medicine. Current public health membership consists of approximately 135 members from federal (35 from the CDC), state, and local public health agencies. Finally, there are at least 137 members who reside outside North America, and 13 members report a background in veterinary medicine.

EIN members participate in 2 major activities: (1) an active and moderated electronic mail conference (listserv), and (2) periodic queries about various aspects of infectious disease clinical practice (both described below).

ELECTRONIC MAIL CONFERENCE

The EIN listserv is open to infectious disease physicians and to members of the public health community, including CDC

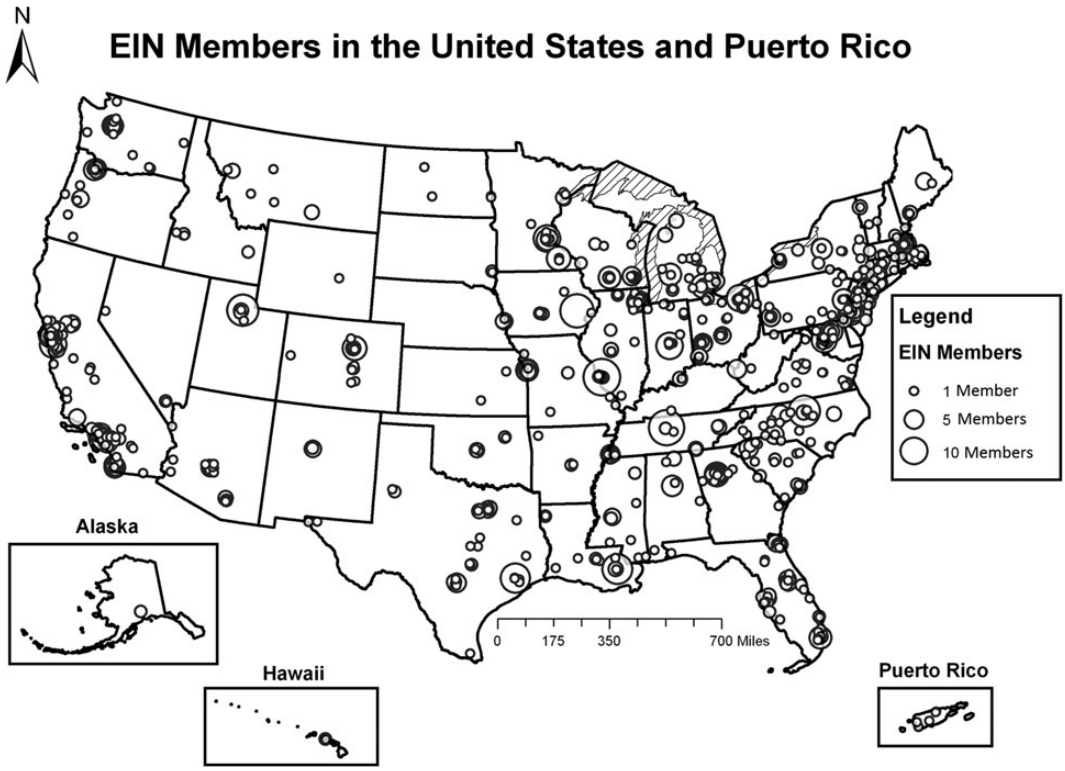

Figure 1. Emerging Infections Network (EIN) members in the United States and Puerto Rico. This map shows member practice location as determined by practice zip code. The map was created using ArcGIS version 10.1 (Redlands, California) by Michael Lash of the University of Iowa Department of Computer Science. Data sources: EIN, US Census Bureau.

investigators, state epidemiologists, and other public health officials with backgrounds in epidemiology, clinical medicine, veterinary medicine, and microbiology. Currently, 1930 individuals subscribe to the listserv. The EIN Program Office quickly posts members' observations, questions, and replies on the listserv, which enables communication with and learning from many other infectious disease physicians, and is the primary incentive for members to join. The listserv has facilitated an average of 240 threads (new topic/separate discussions) per year since 2000, including 222 in 2012 that generated an average of 4.70 responses per thread, and has operated without interruption since 1997 [5]. The EIN listserv is moderated. All submissions are screened, potential patient identifiers are removed, and a disclaimer is attached to all posts. The listserv moderator identifies each thread with a general type (eg, epidemiology, clinical, infection control, HIV, pediatrics), and then attaches a specific thread name describing the post. Subsequent posts after the initial question share the same label, and contain an abbreviated version of the initial posting and responses since the previous post. This continues until the related discussion stops.

The majority of posts are clinical in nature and topics of discussion revolve around a variety of member-proposed concerns. Common topics include antimicrobial issues, including stewardship and prophylaxis; viral infections including the hepatitides, West Nile virus, and herpesviruses; infection control/prevention issues; vaccine-related issues; treatment of a variety of nontuberculous mycobacteria; pediatric issues; yeasts/fungi/molds, including cryptococcal disease and histoplasmosis; and staphylococcal issues including prevention and treatment of methicillin-resistant *Staphylococcus aureus* (MRSA). Emerging treatment approaches have also been discussed (eg, treatment of recurrent *Clostridium difficile* with fecal microbiota transplant).

Listserv topics that intersect public health and clinical practice cluster in 4 major subject areas, outlined below.

Identification of New or Emerging Health Concerns

Many of the discussions do not involve emerging infectious disease issues directly, but monitoring the daily discussions of busy physicians may provide leading indicators of emerging problems in public health. Take 2 of the larger trends in infectious diseases during the past decade: the emergence of *C. difficile* and community-associated MRSA. A number of posts regarding difficult-to-treat *C. difficile* infections and several cases requiring colectomies were contributed in 2003. Similarly, many members reported their experiences with community-associated MRSA that same year. Thus, the EIN listserv can provide real-time information regarding potential changes in the epidemiology of infections, giving public health practitioners who subscribe to the EIN listserv a "finger on the pulse" of clinical infectious diseases.

Identifying Cases of Public Health Importance

The EIN listserv provides an opportunity for public health subscribers to interact directly with the infectious disease community by both initiating and responding to listserv posts. Standard public health posts involve requests for clinicians to identify potential cases (ie, case finding). For example, the CDC used the listserv in September 2012 to report an initial cluster of fungal meningitis cases following spinal injection procedures and requested help from the EIN members to identify additional cases. Some other examples of case finding have involved unusual infections, including nontubercular mycobacterial infections associated with a variety of procedures including surgery (August 2009), knee replacements (January 2010), neurosurgical procedures (March 2010), and tattooing (February 2012). Additional case-finding examples include infections related to more uncommon procedures, such as endophthalmitis after intravitreal angiogenesis inhibitor use (March 2009), or potential outbreaks related to a medical practice including healthcare-associated *Pantoea* bloodstream infections (February 2013).

Monitoring Trends in the Burden of a Disease

Clinical observations also provide novel information to the public health community or help confirm and provide external validity to other reports. Below are 2 examples of novel information relevant to emerging infections that have resulted from clinical observations reported via the EIN listserv:

1. *Cryptococcus gattii*: In 2012, an EIN member reported caring for an immunocompetent patient with disseminated *C. gattii* infection who had never left Florida. The patient had presented with a pathologic fracture of the femur with a soft tissue mass. This post generated a discussion on the listserv, with multiple cases identified outside the Pacific Northwest. An epidemiologist from the CDC's Mycotic Diseases Branch responded to the posts and provided information about available laboratory diagnostics. She encouraged physicians to submit isolates suspected to be *C. gattii* to the CDC for molecular identification.
2. New Delhi metallo-β-lactamase 1 (NDM-1) in Washington: In 2011, an EIN member from Seattle, Washington, initiated a thread asking for treatment advice for a patient infected with multidrug-resistant gram-negative bacilli (MDRO). Another EIN member with a research interest in MDRO saw this posting and contacted the originally posting member. The organisms were sent to the research laboratory of another member and were identified as the first case of recognized infection on the West Coast with an NDM-1–expressing gram-negative organism (*Escherichia coli*).

Communicating the Opinions of Clinicians Regarding Public Health Policy

The listserv has also functioned to communicate concerns of clinicians regarding public health recommendations during an

outbreak. Listserv traffic during the 2009 novel H1N1 influenza pandemic began in April 2009 and provides such an example. The single longest thread on this topic asked about infection control precautions for the novel influenza strain. Nineteen members responded to debate related to the need for airborne precautions and other issues related to infection control. Over the next 11 months, members from 42 states and 7 foreign countries including Ecuador, Singapore, and Jordan participated in 71 member-generated threads on various 2009 H1N1 influenza topics.

More recently, the Food and Drug Administration (FDA) has used the listserv to communicate information about antimicrobial drug shortages. Members of the FDA/Center for Drug Evaluation and Research/Drug Shortage group have joined the listserv both to monitor traffic about antimicrobial products and to provide information needed by EIN members. Finally, the EIN office disseminates some information not generated by members (eg, CDC health alerts, Gorgas course material).

EIN QUERIES

Queries are distributed to all 1590 EIN members involved in clinical practice every 2–3 months. Public health members not involved in patient care do not receive queries. Five percent of members still receive paper queries by facsimile; the remaining members receive an email message with a link to a Web-based query. Two reminders are sent to nonresponding members, approximately a week apart. Query topics are selected based on suggestions from the IDSA EIN membership and CDC collaborators, with the final decision made by the EIN Program Office in consultation with the IDSA EIN Executive Committee, an oversight committee that meets 2–3 times per year. Membership in the IDSA EIN Executive Committee consists of the IDSA EIN program director, IDSA members, and representatives from the CDC, the National Institutes of Health, the Council of State and Territorial Epidemiologists, and the FDA. EIN queries are designed to collect practice-based information regarding EIDs or infectious disease practices and trends. The queries, by design, do not contain or request any patient identifiers. Overall response rates remain high at 45%–52%. EIN Program staff continues to limit the number of questions per query and number of queries per year, acknowledge participation of members, and ensure that all members receive a final report soon after the query closes by email. Results can also be viewed on the EIN website and can be distributed to members on request. All data are de-identified and reported in aggregate, and no specific practice location is identifiable in the results.

The goal of these queries is to gather information quickly and to provide either novel or confirmatory information. In many cases, the results can inform more traditional investigations or determine if more detailed investigations are warranted. Since 1996, the EIN has distributed 112 queries. Table 1 displays a list of sample query topics. Routine queries take approximately 5–10 minutes to complete and can be broadly classified into 4 types.

First, diagnostic queries are designed to investigate how infectious disease physicians diagnose specific infectious diseases or related syndromes. For example, a 2013 query focused on diagnosis of *Streptococcus pneumoniae* in community-acquired pneumonia and asked about physicians' use of both blood cultures and the pneumococcal urinary antigen test in this setting. As current US surveillance for invasive pneumococcal disease is based on culture results, use of the urinary antigen rather than sterile site isolates for diagnostic purposes could significantly affect this surveillance. Such queries are done in consultation with the CDC because how and when diagnostic tests are used may greatly affect surveillance results. Indeed, a better understanding of contemporary clinical practice can help inform the evaluation of prevention and disease control programs [6].

Table 1. A Sample of Emerging Infections Network Queries by Category

Diagnostic queries (how infectious disease physicians diagnose specific infectious diseases or related syndromes)
Diagnosis of central line–associated bloodstream infections [7]
Determining unmet microbiologic diagnostic needs
Diagnosis and management of *Neisseria meningitidis* infections [8]
Diagnosis and management of cryptococcal infections [9]
Patient management queries (how infectious disease physicians manage specific infectious diseases with a focus on diseases where there is limited treatment information from randomized trials or large observational studies)
Management of recurrent *Clostridium difficile* infection
Management of prosthetic joint infections in adults [10]
Treatment of resistant microorganisms: What is the greatest unmet medical need? [11]
Perioperative *Staphylococcus aureus* screening and decolonization [12]
Management dilemmas in syphilis [13]
Programmatic queries (policies or procedures at the institution where the member practices)
Influenza vaccination programs [14, 15]
Antimicrobial stewardship programs [16, 17]
Pediatric outpatient parenteral antibiotic therapy [18]
Safety or quality queries (observations at either the patient level or institutional level that are related to patient safety)
Serious infections and biologic therapies [19]
Antimicrobial drug shortages [20]
Antibiotic allergies and infectious disease practice [21]
Donor-related transplant infections [22]
Cosmetic procedures and lipotourism
Outpatient parenteral antibiotic therapy safety
Linezolid toxicity [23]

Second, management queries are designed to describe how infectious disease physicians manage specific infectious diseases when there is limited treatment information from randomized trials or large observational studies. Such queries have been generated to assist with guideline development. For example, the EIN developed a syphilis query to help gather expert opinion regarding treatment approaches for neurosyphilis prior to release of new sexually transmitted disease treatment guidelines [13].

Third, programmatic queries ask about policies or procedures at the institution where the members practice. Examples include approaches to antimicrobial stewardship [16, 17], vaccination policies [14], and policies regarding antiviral stockpiling.

Fourth, safety or quality queries relate to observations at either a patient level or an institutional level that are related to patient safety. Examples of previous queries have involved case finding for adverse events for specific medications or medication classes (eg, linezolid [23], biologic therapeutics [19]) or programs to enhance patient safety.

Theses queries are all subject to limitations including recall bias and generalizability. However, the queries represent a quick and convenient approach to gathering data that would be difficult to obtain using alternative approaches. To date, 50 peer-reviewed papers have been published based on EIN query results. Although the EIN is based at the University of Iowa, >57 different collaborators from both academic and community-based practices and 46 collaborators from the CDC have helped design queries. Nonetheless, there are still groups at the CDC with which the EIN has not yet collaborated. For example, among 17 divisions in the CDC's Office of Infectious Diseases, only 8 collaborated in a query between 2006 and 2011. Thus, efforts are currently under way to expand knowledge of EIN at the CDC.

EIN WEBSITE

The EIN website (http://ein.idsociety.org/) includes a searchable archive, a list of all queries since 2005, and the final report for each, a list of all publications and presentations since 2006, and a "Frequently Asked Questions" page. The members-only areas of the site are synchronized with members' IDSA password and login data. The EIN website also has a mechanism for suggesting new query topics.

FUTURE DIRECTIONS

Since the network started, communication methods have changed. Email was once novel but is now ubiquitous, and the explosion of mobile computing devices (smartphones and tablets) provides new opportunities to communicate rapidly. For example, a mobile application could allow members to circulate "quick queries" with near-real-time feedback. We anticipate, for example, that members of the public health community will be able to ask if members have seen a case of a certain infection. Although the current listserv offers this option, it requires members to reply to an email, and only people who have seen a case typically reply. We hope that a mobile app will facilitate a quick reply and will provide a signal with both yes and no answers, to move beyond case counts and gather data on the proportion of providers seeing cases. In addition, quick queries could follow interesting listserv posts.

The EIN also provides a community that can enable or "crowd-source" the writing of case series. Two case series examples in our pediatric infectious disease community include the largest case series of pediatric *S. pneumoniae*–associated hemolytic uremic syndrome (37 cases) [24] and the largest case series of colistin use among pediatric patients (92 cases) [25]. In the future, these case-based activities could be greatly expanded. Case series provide early clinical information that can inform both treatment approaches and public health investigations. For rare diseases, case series might represent the only feasible option in the absence of a formal registry, as timely randomized controlled trials may not be feasible. If the EIN can continue to lower the transaction costs for gathering cases and linking interested collaborators, then the number of such series could grow dramatically.

These projects could easily be driven by infectious disease physicians-in-training, who could help gather preliminary data for more detailed future investigations. In the past, EIN queries have helped junior investigators gather preliminary data for successful NIH Career Development awards. Finally, the EIN also provides a platform for clinical educators or infectious disease physicians in private practice to participate in and initiate investigations that would not be possible in a single center.

As noted previously, the EIN also has the potential to enhance public health surveillance by (1) functioning as an additional source of data to search for cases, (2) providing a clinical "reality check" on public health messaging and programs, and (3) serving as a forum where clinicians and public health practitioners can discuss issues that overlap both domains. The EIN has participated in and can continue to monitor outbreaks, inquire about additional cases of device or product-related infections, disseminate clinical guidance information to infectious disease physicians, and assist in hypothesis generation for epidemiologic investigations. However, all of these activities require active involvement of the public health community, and both federal, state, and local public health agencies could use the EIN more frequently. For the EIN to continue to be useful to the public health community, both clinicians and the public health community will need to continue to support the network. Indeed, the EIN is uniquely situated to strengthen links between public health and clinicians, a major initiative among public health leaders [26].

CONCLUSIONS

The EIN has repeatedly demonstrated that it can respond quickly to issues related to emerging infectious diseases and facilitate communication between clinicians and public health practitioners. However, the EIN continues to be a work in progress, responding to the changing needs of both its members and the public health community. Over the years, the EIN has improved its ability to gather, analyze, and share information. The network would not be possible without the support of the members who continue to donate their time and expertise. Future goals include recruiting new members from around the world from a variety of backgrounds, especially public health veterinarians, and building relationships with other organizations (eg, ProMED). By doing so, we hope to increase opportunities for collaborations between infectious disease clinicians and public health practitioners worldwide. Interested practicing infectious disease physicians and public health practitioners can complete the online application at: http://ein.idsociety.org/members/sign_up/.

Notes

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