Pandemic Preparedness Needs Assessment Report

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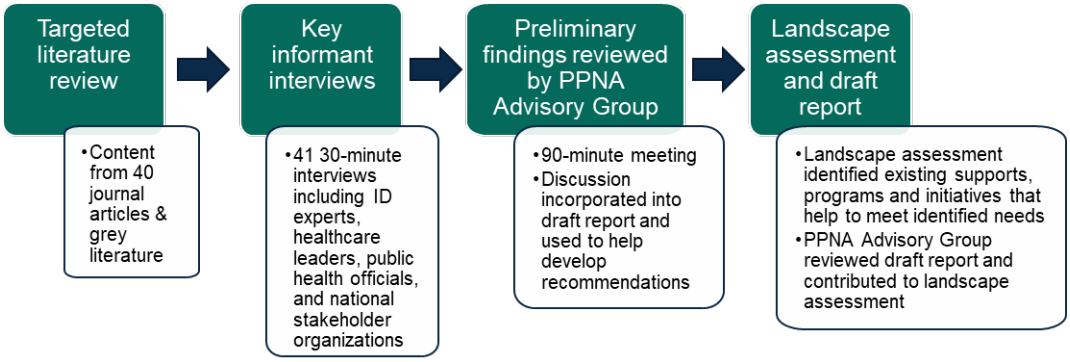
Executive Summary

Since the start of the COVID-19 pandemic in 2020, experts in infectious diseases (ID) have played essential roles in responding to the pandemic.[1] To better understand what supports and resources the next pandemic will require, the Infectious Diseases Society of America (IDSA) engaged Mathematica to conduct a needs assessment of the resources, infrastructure, education, and technical assistance needed to support the ID expert community to engage optimally in pandemic preparedness and response. The pandemic preparedness needs assessment (PPNA) will be used to inform IDSA's future planning with CDC by validating the need, interest, demand, and environmental readiness for a Pandemic Preparedness Centers of Excellence (CoE) Program. The project was part of IDSA's Cooperative Agreement with the Centers for Disease Control and Prevention (CDC), which led to the establishment of a COVID-19 Real-Time Learning Network. As envisioned, a Pandemic Preparedness CoE Program would help to support CDC's long-term COVID-19 and pandemic preparedness work. It would be a natural outgrowth of the COVID-19 Real-Time Learning Network in educating and training clinicians on COVID-19, as well as the Emerging Infections Network, also funded by CDC and administered by IDSA, in providing timely communication and connection between the public health and medical communities on emerging infectious threats.

Key informant interviews were central to the methods. They were framed by a targeted literature review, discussed with an Advisory Group, and complemented by a landscape assessment. Exhibit ES.1 summarizes the project's methods.

Exhibit ES.1. Methods used for PPNA needs assessment project



ID = infectious diseases; PPNA = Pandemic Preparedness Needs Assessment

ID expert roles during and after the pandemic

During the COVID-19 pandemic, many ID experts continued to fulfill the same roles and responsibilities as they did before the pandemic while taking on new integral roles and responsibilities within their health care organizations and, in many cases, within the public health and community response to the COVID-19 pandemic. Some of their pandemic roles and responsibilities were what the ID experts expected, such as consulting on care for patients with COVID-19 and developing protocols for diagnosis and treatment. Other roles, such as communicating with the public and consulting for and supporting other health care

[1]ID experts include ID physicians, healthcare epidemiologists, ID pharmacists, and clinical microbiologists.

settings without access to ID expertise, felt unplanned to the experts, and few predicted the extended length and magnitude of these roles and responsibilities.

Many ID experts shared that their roles from the height of the pandemic lasted for a long time, from one-and-a-half to two years. During this time, ID experts reported working long hours every day, including on weekends, with a workload exacerbated by the dearth of ID experts across the country. Exhibits ES.2 and ES.3 summarize common roles of ID physicians and other ID experts during the pandemic.

Exhibit ES.2. Common responsibilities of infectious diseases physicians during the pandemic

In their health care settings	Within the public health response
• Diagnosing and managing infectious diseases directly and consulting on other clinicians' patients as needed[a] • Holding leadership or subject matter expert roles within the hospital incident command system • Leading cross-department task forces or committees to coordinate pandemic response efforts across departments • Guiding operating policies and procedures • Guiding ethical allocation of scarce resources • Leading antibiotic stewardship programs[a] • Overseeing infection prevention[a] • Conducting research[a]	• Developing COVID-19 guidance and recommendations for the population • Identifying and advising on outreach to medically vulnerable and underserved populations • Communicating with the public about the virus • Providing guidance to schools and businesses • Participating in task forces, committees, and work groups convened by local, state, and federal governments or professional organizations

[a] Infectious diseases physicians had these responsibilities before as well as during the pandemic.

Exhibit ES.3. Common responsibilities of epidemiologists, ID pharmacists, and clinical microbiologists during the pandemic

Health care epidemiologists	ID pharmacists	Clinical microbiologists
• Preventing and controlling infections • Investigating cases and outbreaks • Contact tracing • Forecasting infection spread and predicting patient volume • Interpreting public health guidance	• Keeping up to date on rapidly emerging new research and sharing key takeaways with others • Developing treatment guidelines • Performing therapeutic management • Overseeing the drug supply chain and managing drug shortages • Developing protocols for vaccines and helping manage vaccine clinics • Leading and supporting clinical trials	• Developing and running COVID-19 tests • Contributing to diagnostic stewardship efforts, including deciding how tests would be used, how frequently tests would be administered, and who would get tests • Obtaining samples of the virus to help develop tests and work with state and federal regulators, such as the Food and Drug Administration • Managing the supply chain for testing and laboratory supplies, including dealing with shortages

Key informants and PPNA Advisory Group members strongly recommended that ID experts play a much larger role in pandemic preparedness activities in their health care organizations and public health departments going forward, with direct involvement in planning and preparation rather than being pulled in after an outbreak or pandemic occurs.

Actual and needed supports for pandemic roles

Actual support. Many types of networks supported ID experts during the COVID-19 pandemic. Examples included recurring calls among ID physicians and epidemiologists in a state, a statewide collaborative, normally competing health systems working together to serve their community, and networks with peers in the same system or cross-disciplinary networks built by individual leaders extending outside their system. In addition, CDC, medical specialty societies, and other national organizations such as the National Association of Community Health Centers and National Rural Health Association supported ID experts and organizations without local ID expertise. Virtual peer-sharing approaches, including synchronous and asynchronous sharing, also helped. Lastly, ID experts drew heavily on internal support, particularly their professional training and personal and professional experience.

Training needed but not received. Key informants commonly cited three types of training as needed: (1) communications training, (2) incident command training, and (3) leadership training. Many key informants also suggested enhancing ID physician fellowships to better prepare the next generation of ID experts for future pandemics. To better prepare those already in the field, some suggested developing an online curriculum.

Other support needed but not received. Key informants commonly cited three types of supports other than training as important: (1) supports to better utilize ID expertise; (2) increased capacity of ID experts, related professionals, and public health professionals and more staff and supplies in general; and (3) a playbook to guide response across multiple levels: physicians, patients, employees, and the community.

PPNA Advisory Group input on needed training and supports

After hearing the results of the key informant interviews, the PPNA Advisory Group identified three major issues that should be addressed and two additional types of supports that will be necessary to support better future pandemic preparedness and response.

Issue 1: Bridging the gap between the public health and ID expert communities. Training for ID experts should include core public health knowledge, how to engage with public health departments, and how to advocate for themselves to get a seat at the table at health care coalitions or other public health structures. In addition, there should be more training and support for network building to maintain or build new relationships between public health departments and their organizations. Each health care organization should have its own Hospital Incident Command System (HICS) that feeds into a network structure and ultimately into a coalition led by public health.

Issue 2: Getting ID experts a seat at the table at hospital incident command and in overall preparedness and response work. Hospital incident command training would empower the ID community to become more actively involved in their HICS at the preparedness stage rather than just being tapped for response to an outbreak. Leadership training could help ID experts achieve greater participation in high-level decision making for preparedness and response.

Issue 3: Supporting ID experts with skill-building and education to optimize their role in pandemic preparedness and response. Creating a pandemic preparedness curriculum would directly address the needs of practicing ID experts that key informants described. ID experts who might or will hold leadership roles at their organization during a pandemic may require a more intense curriculum than others,

including case studies and lectures from subject matter experts. Priority topics include training on communication, training and support for ethical allocation of scarce resources during a pandemic, training on how to best support colleagues in under-resourced areas, and training and support for data collection and interpretation.

New trainings and resources must be accessible and equitable, avoiding travel and substantial time away that some ID experts may not be able to take. In addition, the Advisory Group supported enhancing fellowships by consistently including pandemic preparedness components and including rotations in congregate settings to better understand the transmission of diseases in those settings. Doing so will better equip ID experts to support these settings in future pandemics.

Additional support 1: Peer sharing. Peer sharing should provide support before and during pandemics, through networks such as the University of New Mexico's Project ECHO; the Administration for Strategic Preparedness and Response's (ASPR) Technical Resources, Assistance Center, and Information Exchange (TRACIE); and IDSA's Emerging Infections Network (EIN).

Additional support 2: Playbook. Some form of a playbook, which will ultimately be adapted locally, that preserves institutional knowledge and lessons learned from the COVID-19 pandemic is necessary to prepare ID experts and their health care organizations for pandemics.

Avoiding unintended consequences of burnout and rise in antimicrobial-resistant infections

Key informants and PPNA Advisory Group members suggested ways to minimize the unintended consequences of burnout and a rise in antimicrobial-resistant infections, including defining ID experts' pandemic response roles in advance, building in plans for shared responsibility and respite for ID experts, developing a plan for mental health support, focusing upstream on antibiotic stewardship, educating community providers and the public to reduce demand for antibiotics, tracking of antimicrobial-resistant infection metrics, and establishing a patient triage system.

Considerations for evaluating preparedness at health care organizations

When asked about developing a program that will evaluate preparedness at health care organizations, such as within a Centers of Excellence program, the PPNA Advisory Group emphasized that such a program would need to secure **leadership support and buy-in** at all levels. The group advised that IDSA and CDC **partner to plan** such a program, with additional partners to include federal agencies including the Administration for Strategic Preparedness and Response (ASPR), Centers for Medicare & Medicaid Services (CMS), and Federal Emergency Management Agency (FEMA), and national organizations including the Society for Healthcare Epidemiology of America (SHEA), the Council of State and Territorial Epidemiologists (CSTE), and the American Public Health Association (APHA). The approach should **build on the existing Hospital Preparedness Program**, and could include supporting Federal Emergency Management Agency regional directors in organizing pandemic preparedness systems in their region. Engaging with CMS about its emergency preparedness rules within the Conditions of Participation might be an opportunity to encourage organizations to participate in such a program.

Information flow between public health and health care organizations

Lack of a unified voice transmitting information to health care organizations was an issue for many key informants; they recommended something be done to better harmonize messaging. To improve information flow, key informants focused on development of more effective messages—such as strengthening ID involvement with state public health and then reaching people better with the messages—by creating points of contact and a mechanism for frequent state-level (or city-level for large cities) status updates by web platform or phone.

Strategies to meet identified needs

Chapter V presents the strategies that follow in more detail and identifies relevant existing initiatives from the project's landscape assessment to help consider next steps.

1. Support more effective inclusion of ID experts in pandemic preparedness and response by
    a. **Modifying relevant CMS Conditions of Participation or interpretive guidance and/or HPP guidance** through working with ASPR and CMS to incorporate ID experts within preparedness and response.
    b. **Promoting better linkage to public health departments** through working with the following entities:
        / State and large city public health departments to better communicate with ID experts in their jurisdiction and encourage them to plan for large-scale frequent (for example, weekly) calls in a pandemic and to include Q&A time.
        / National public health organizations to better bridge their work with ID experts.
2. Prepare ID experts for effective pandemic preparedness and response by
    a. **Enhancing ID physician fellowships** to include and strengthen preparedness aspects, including communication and leadership training, and include rotation in congregate care and under-resourced care settings.
    b. **Developing a pandemic preparedness curriculum** for ID physicians based on a defined pandemic response role for ID physicians, with a more extensive version for those who are or will be leaders.
    c. **Guiding development of a local pandemic playbook,** including partnering with other national stakeholder organizations.
3. **Promote a consistent and effective two-way flow of information between public health and ID experts and their health care organizations** by sustaining and enhancing national-level mechanisms hosted by CDC, IDSA, and many other health professional organizations and health care organization membership organizations, which were reported to be well-used during the pandemic and remain as mechanisms for use in the future.
    a. **Select, refine, and promote one key website as a one-stop-shop for ID experts** to access trainings, engage in sharing with peers, and where anyone can find key contacts for committed, leader-level ID expertise at a regional or sub-state level.

4. **Support peer sharing mechanisms** for preparedness as well as response, such as Project ECHO; the Technical Resources, Assistance Center, and Information Exchange (TRACIE); and the Emerging Infections Network (EIN).
5. Support a rapid start to research during a pandemic by
    a. **Advancing the skill set for epidemiologists** by encouraging them to update their methods training.
    b. **Supporting continuation of research networks for special pathogens**, including long-term care and pediatric research networks formed during the COVID-19 pandemic.
    c. **Supporting robust dissemination of tools for a quick start to research**, such as a master protocol and other tools being developed by NETEC.
6. Expand the supply and capacity of ID experts, reducing risk of burnout and avoiding unintended consequences, by
    a. **Working to adjust payment to ID physicians** to correct their undervaluation relative to procedural specialties.
    b. **Expanding availability of ID pharmacy fellowships.**
    c. **Establishing a full-time equivalent requirement for ID pharmacist staffing** to enhance antibiotic stewardship capacity and overall ID expertise in a pandemic.
    d. **Encouraging ID physicians to engage in additional digital and informatics training** as a way to see more patients and help with pandemic-level surges.
7. After some of the strategies above have been implemented, **develop a Centers of Excellence program** in collaboration with federal agencies and other national stakeholders to recognize health care organizations that meet criteria for pandemic preparedness and are committed to serving as an information and assistance resource for ID experts and organizations who need additional ID expertise in surrounding communities.
8. **Plan and develop additional strategies, programs, policies, and other initiatives that will enhance the effectiveness of ID experts in a pandemic**, such as the following:
    a. Federal, state, and local governments should plan for more effective communication with the public, provide adequate funding to public health departments, and clearly highlight changes in guidance during a pandemic.
    b. Collaboration should be strengthened across local and state public health officials, CMS, and CDC, so that messaging to health care organizations and clinicians is consistent, as well as CMS and state reporting requirements.
    c. The federal government should work with the private sector to develop systems solutions, such as a national dashboard for finding beds and key equipment, a system to accurately notify when scarce treatments will become locally available, and an electronic health record flag noting an outbreak in the area.
    d. Federal and state governments should develop programs or initiatives to support linkages (for example, telemedicine) between organizations with and without enough ID experts.

I. Introduction and Methods

A. Introduction

During 2020–2022, infectious disease (ID) experts—including ID physicians, health care epidemiologists, ID pharmacists,, and clinical microbiologists—played essential roles in responding to the COVID-19 pandemic. To better understand what supports and resources are needed to be ready for the next pandemic, the Infectious Diseases Society of America (IDSA) engaged Mathematica to conduct a pandemic preparedness needs assessment (PPNA) project to validate the need, interest, demand, and environmental readiness for a Pandemic Preparedness Centers of Excellence (CoE) Program. The project is part of IDSA's Cooperative Agreement with the Centers for Disease Control and Prevention (CDC) and has a timeline of March–December 2023. Project findings and recommendations will inform IDSA's future planning with the CDC to support COVID-19 and pandemic preparedness efforts in U.S. health care settings, including understanding how to better support ID experts in their various roles in pandemic preparedness and response.

Objectives

- To identify the roles and responsibilities of ID experts during the COVID-19 pandemic
- To assess the supports, resources, and training ID experts need to fulfill their pandemic roles
- To develop strategies for how to support ID experts and their health care settings in preparing for future pandemics

This final report synthesizes the findings from the needs assessment, which includes a targeted literature review, key informant interviews, landscape assessment, and a series of meetings with the PPNA Advisory Group, convened for the project by IDSA. The methods used (see Appendix A) provide broad-based input from diverse sources to gain important insights but were not designed to produce generalizable findings.

B. Methods

The needs assessment began with a targeted literature review, which was used to inform interview guides for key informant interviews with 41 selected individuals, as shown in Exhibit I.1. The key informant interview plan was approved by the HML IRB on June 27, 2023. The team also conducted a landscape assessment to identify existing programs, infrastructure, or supports to ensure that any needed additional supports could be designed to build on or enhance the set of supports already in place. Input from the PPNA Advisory Group augmented the key informant interviews and helped guide the development of recommendations.

ID experts definition: For purposes of this project, we defined ID experts as ID physicians, health care epidemiologists, ID pharmacists, and clinical microbiologists.

Targeted literature review

We conducted a targeted literature review focused on the role of ID experts in pandemic or emergency preparedness and response within their health care organizations. We reviewed the titles and abstracts of more than 450 journal articles and included articles that related to the role of the ID expert and were grounded within the topic of pandemic or emergency preparedness. We also reviewed grey literature from Nexis Newsdesk and a Google search using the same inclusion criteria for journal articles. We found only three journal articles that specifically discussed the role of the ID expert in preparedness or response

to infectious disease outbreaks or pandemics (Herstein et al. 2021; Nematollahi et al. 2021; Norrby 2005). After working with IDSA to expand our search and outline the desired literature review deliverable, we incorporated content from 40 relevant journal articles and grey literature in total.

Key informant interviews

We conducted 41 interviews with key informants from four groups: ID experts, health care leaders, public health department officials, and national stakeholder organizations (NSOs) (see Exhibit I.1). **ID experts** shared insights on the roles that they played during the COVID-19 pandemic, including the supports and training that prepared them for their roles and what is needed to prepare ID experts for future pandemics. **Health care leaders** provided observations from a leadership perspective of the roles ID experts played in their health care settings. **Public health department officials** provided insight into the roles ID experts played in supporting public health efforts and facilitating the relationship between public health departments and their health care settings. **Representatives from national stakeholder organizations** summarized the perspectives of their respective memberships as they knew it. These representatives were not full-time staff of the NSOs, so they also offered perspectives from their experience within their health care settings. Because the key informants offered broad-based rather than personal perspectives, and the discussion topics were quite broad, when we say "many" key informants in the text that follows, we mean at least four.

Exhibit I.1. Key Informant Groups	#
ID experts (ID physicians, ID pharmacists, health care epidemiologists, and clinical microbiologists) • Including: urban and rural locations, academic medical centers (AMCs), community hospitals, private practice, underserved communities, pediatric focus, mix of geographic regions	13
Health care leaders • Including: AMCs, other tertiary hospitals, public, rural, mix of geographic regions	7
Public health department officials • Including: local and state, varied geography and populations	7
National stakeholder organizations • Including: – American College of Emergency Physicians (ACEP) – American Correctional Association (ACA) – American Hospital Association (AHA) – Association of State and Territorial Health Officials (ASTHO) – Council of State and Territorial Epidemiologists (CSTE) – Indian Health Service (IHS) – National Association of Community Health Centers (NACHC) – National Association of County and City Health Officials (NACCHO) – National Rural Health Association (NRHA) – Pediatric Infectious Diseases Society (PIDS) – Society for Healthcare Epidemiology of America (SHEA) – Society of Critical Care Medicine (SCCM) – Society of Hospital Medicine (SHM) – Society of Infectious Disease Pharmacists (SIDP)	14
Total # of interviews	41

Landscape assessment

The landscape assessment identified existing supports, programs, and initiatives that disseminate education, build capacity, facilitate collaborations with local public health officials, and otherwise meet needs discussed throughout this report at the hospital and health care organization level. Sources of information for the landscape assessment included online searches, key informants, and the PPNA Advisory Group.

PPNA Advisory Group meetings

Prior to finalizing this report, we met three times with the PPNA Advisory Group, which consists of ID experts with a range of backgrounds, including public health. The group provided expert insights during planning, at the point of preliminary findings, and in reviewing the draft report.

II. Roles of ID Experts

A. Actual roles

In this section, we discuss the roles and responsibilities that ID experts fulfilled before and during the COVID-19 pandemic.[2] We have included their pre-pandemic roles and responsibilities to provide a background on the experiences and skills that led to and equipped ID experts to take on their pandemic roles and to contextualize their workload during the pandemic, as many ID experts continued to fulfill their pre-pandemic roles and responsibilities while also taking on new roles and responsibilities. Where we include citations, the role was discussed in the literature review and key informant interviews; otherwise, the role was mentioned by at least four key informants.

Pre-pandemic

Day-to-day responsibilities

In their day-to-day roles within their health care settings both pre-pandemic and at present, ID physicians are typically responsible for diagnosing and treating infectious diseases, as well as providing consultations to other health care professionals that have patients with complicated infections (Hussaini 2020; Livorsi et al. 2022). ID physicians, in partnership with other ID-trained health care professionals such as ID pharmacists, are also typically responsible for leading antimicrobial stewardship programs, which work to prevent the overuse and misuse of the antimicrobial agents that drive antimicrobial resistance (AMR) (Heil et al. 2016; Livorsi et al. 2022; McQuillen and MacIntyre 2017).

Other responsibilities, depending on the individual, include conducting research in infectious diseases and microbiology; overseeing infection prevention; teaching and training new ID physicians, resident physicians, and other health care professional trainees; and advocating for policies that support efforts to monitor, prevent, and treat infectious diseases (Brito et al. 2021; Hussaini 2020; Ostrowsky et al. 2018). ID physicians and other ID-trained health care professionals also work within and with state and local public health departments to support public health efforts. They may serve as liaisons between health care settings and public health departments, identifying infectious disease outbreaks and recommending treatment guidelines for local patient populations (Ostrowsky et al. 2018).

[2] We included a role or responsibility in the report if four or more key informants and PPNA Advisory Group members mentioned it. Please note that the inclusion of a role or responsibility does not mean that all ID experts fulfilled the role or responsibility, nor that each ID expert fulfilled all roles or responsibilities listed.

Exhibit II.1. Emergency preparedness plan requirements

State, tribal, and local health care organizations must ensure that their preparedness plans are consistent with the National Incident Management System to receive federal preparedness assistance, such as funding from the Hospital Preparedness Program (HPP); this includes adopting and implementing an emergency operations plan and the Hospital Incident Command System or an equivalent system (Assistant Secretary for Preparedness & Response 2015).[3] There are HPP funding recipients in all 50 states and the District of Columbia, with 325 health care coalitions—regional coalitions of health care and response organizations, such as acute care hospitals and public health agencies—across the country (Administration for Strategic Preparedness & Response n.d.). The requirements to receive federal preparedness assistance align with the regulations from the Centers for Medicare & Medicaid Services (CMS), published in the Emergency Preparedness Requirements for Medicare and Medicaid Participating Providers and Suppliers Final Rule and The Joint Commission emergency requirements (Banach et al. 2017; Centers for Medicare & Medicaid Services n.d.).The CMS regulations require providers to comply with emergency preparedness regulations to participate in the Medicare or Medicaid program (Centers for Medicare & Medicaid Services n.d.). However, these requirements do not specify an explicit role for ID experts in preparedness activities.

Roles and responsibilities related to preparedness

Pandemic preparedness efforts leading up to the pandemic varied across health care organizations in the type and extent of activities performed and in the level of ID expert involvement. Some ID experts shared that they were unaware of any formal pandemic preparedness activities at their organization, including a lack of dedicated resources and inactivity in reviewing or exercising pandemic response plans. Others shared that there were preparedness activities and that they were involved, including helping to develop pandemic response plans and participating in or leading pandemic preparedness-related efforts, such as drills or exercises. In some health care organizations, there were pandemic preparedness activities, but there was little or no direct ID expert involvement; in some instances, other departments may be leading preparedness activities or organization leadership knew which ID experts to tap for the Hospital Incident Command System (HICS) if activated in an outbreak or pandemic, but that was the extent of ID involvement.

Although ID experts often shared that they did not receive formal pandemic preparedness training through their fellowships or health care organizations, many felt that their real-world experiences from roles in previous outbreaks (for example, Ebola, H1N1, SARS-CoV-1) provided them with the knowledge and skills that helped them fulfill their roles during the COVID-19 pandemic. Specifically, ID experts recalled their roles in performing exercises or drills and implementing response structures (for example, HICS) and processes in past pandemics and outbreaks. Some shared that preparedness-related materials such as guidelines, plans, and playbooks were developed during those previous pandemics and outbreaks but then remained untouched until COVID-19.

> **"I would say there was no formal pandemic preparedness in my institution before COVID-19. However, we did have experience with the threat of Ebola. We did have experience when SARS happened … But there was no specific investment of resources that I'm aware of. Certainly not in my division for something that we now know as pandemic preparedness."**
>
> **– ID physician**

[3] For a compilation of federal legal authorities on public health emergencies, see www.cdc.gov/phlp/docs/ph-emergencies.pdf.

Some ID experts also shared that their day-to-day responsibilities, although not explicitly linked to pandemic preparedness, were helpful in preparing them for their COVID-19 pandemic roles and responsibilities. These responsibilities included leading infection prevention and control programs or efforts, identifying and monitoring outbreaks, leading antimicrobial stewardship programs or efforts, and conducting research.

During the COVID-19 pandemic

Many ID experts continued to fulfill the same roles and responsibilities on a larger scale while taking on new, integral roles and responsibilities within their health care organizations and, in many cases, within the public health response and community response to the COVID-19 pandemic. Some of the roles and responsibilities were expected by ID experts, such as providing expertise in how to care for patients and developing protocols for diagnosis and treatment. However, other roles felt unplanned, and few ID experts predicted the extended length and magnitude of these roles and responsibilities. Many ID experts shared that their roles from the height of the pandemic lasted a long time, from eighteen months to two years. Some respondents stated that pandemic-related work has only slowed recently, nearly three years after the pandemic onset. During this time, ID experts reported working long hours every day, including weekends, and their workload was exacerbated by the dearth of ID experts across the country.[4]

Within their health care settings

Many ID experts shared that they took on **leadership or advising roles** at their organizations, particularly within the HICS (Exhibit II.2), which included:

- Helping their organizations **develop standard operating procedures and policies**, especially at the beginning of the pandemic, to allow their health care organizations to safely continue cancer care, surgical services, and other core hospital functions (Griffin et al. 2020; IDSA and Johns Hopkins Center for Health Security 2022). These procedures and policies included guidelines and instructions on screening, masking, and vaccinations. ID experts also interpreted and incorporated federal, state, local, and professional society COVID-19 guidance into operating procedures and policies for their organizations (IDSA and Johns Hopkins Center for Health Security 2022).

> **"… the division chiefs for infectious diseases were the incident command leaders for the COVID-19 pandemic … We sat at the table and coordinated all of the hospital administrators and the other key leadership positions for the COVID-19 pandemic, really driving the building of standard operating procedures and protocols in real time."**
>
> **– ID physician**

[4] Approximately 80 percent of U.S. counties have no ID physicians, and more than 60 percent of all Americans live in the 90 percent of counties with below-average or no ID physician access, an issue that disproportionately impacts rural communities (IDSA and John Hopkins Center for Health Security 2022; Walensky et al. 2020).

- Helping **coordinate logistics**, such as supply chain and staffing, while managing shortages for essential supplies, such as personal protective equipment (PPE) and ventilators; medications; and vaccines. During these shortages, some ID experts recalled helping to decide how to **ethically distribute limited supplies and treatment**.[5]
- Providing **consultations and support to other health care settings** without access to ID expertise, such as congregate care settings (for example, nursing homes and long-term care facilities), community-based primary care practices, and federally qualified health care centers (FQHCs). This included acting as incident commander for those settings, investigating outbreaks, leading communication between those settings and their organization, and helping develop policies and guidelines for transfers between health care settings, isolation, and testing.
- Leading **cross-department task forces or committees to coordinate pandemic response efforts across departments**, including the emergency department, intensive care unit, and nursing. These task forces or committees would meet frequently, especially during the beginning of the pandemic, to discuss the number of admissions, department needs, changing guidance, new protocols, and more. Some key informants shared that they still meet in these groups, although less frequently, to continue responding to COVID-19, or that they have maintained the new cross-department relationships to respond to new outbreaks, such as mpox.

In addition to leadership and advising roles within their health care organizations, ID experts fulfilled **clinical care and research roles** with responsibilities that included:

> **"… supply constraints, whether it's medications, vaccines, whatever it is … How do we make sure we're deploying this…we even incorporated our ethics team because ethical framework is so critical … having that equity lens on it."**
>
> **– ID physician**

Exhibit II.2. A closer look at the Hospital Incident Command System

What is it?

The Hospital Incident Command System (HICS) is a standardized approach for hospitals that adapts the principles from the Incident Command System (ICS) component of the National Incident Management System for a health care setting. The HICS provides an organizational structure for incident management, guidelines, and tools, including an incident planning guide and incident response guide, to prepare hospitals for emergencies such as pandemics (California Emergency Medical Services Authority 2014; IDSA 2016). The HICS structure allows for the rapid iteration of multifaceted response elements within a hospital and facilitates communication in an efficient and organized manner (Banach et al. 2017).

What roles did ID experts fulfill within the HICS?

During the COVID-19 pandemic, key informants explained that ID experts were often tapped by health care leaders for one of two positions in organization-level and system-level HICSs:

- **Incident commander**
  Some ID physicians were incident commanders and responsible for coordinating department leaders, developing standard operating procedures, and coordinating logistics (for example, supply chain and staffing)
- **Medical-technical specialist/subject matter experts/advisors**
  In this role, ID experts provided subject matter expertise to the incident commander and advised them in decision making.

[5] This work is known as "allocation of scarce resources," and a systematic review found that, in 2020, nearly 20 states provided no explicit guidance for health care entities or workers functioning during times of pandemic or crisis on how to allocate scarce resources (Emanuel et al. 2020; Romney et al. 2020).

- Providing **direct patient care** through clinical consultations with patients with suspected or confirmed COVID-19, including diagnosing and treating patients (IDSA and Johns Hopkins Center for Health Security 2022).
- Helping **develop** isolation, testing, treatment, clinical management, testing, and vaccination **protocols and guidance**. This included keeping protocols and guidance updated and aligned with new data and information.

> **"Leadership role? Yeah, pretty much … But there was work 24/7 … because I was also doing the patient role, not just the administrative role. I was also taking care of patients."**
>
> **– ID physician**

- Designing, leading, and enrolling patients in **clinical trials** for COVID-19 therapeutics (IDSA and Johns Hopkins Center for Health Security 2022).
- **Reviewing the latest research and literature** on COVID-19-related topics, including therapeutics and clinical symptoms, to help them perform other responsibilities, such as developing treatment protocols.

In areas with few ID experts, such as rural communities, an ID expert may fulfill more of a **consultative role** than provide direct patient care so that they may serve and provide their expertise to multiple health care organizations.

Within the public health response

Aside from their roles and responsibilities within their health care organizations, ID experts also contributed to the public health response at the local, state, and national levels by collaborating with public health departments, taking on national-level roles, and supporting their local communities.[6] These **public health and community-based roles and responsibilities** included working with and supporting their local and state public health departments in their response efforts, such as:

> **"[ID experts] are always … the first one that people go to with questions from the community … they're the most important force multipliers we have in terms of getting our messaging out, our guidance, messaging. They're really the ones that we can rely on to communicate effectively what we're recommending."**
>
> **– Public health official (ID physician)**

- **Identifying and reaching medically vulnerable and underserved populations**, such as the elderly population, undocumented immigrants, migrant farm workers, and residents of congregate care settings.
- **Developing COVID-19 guidance and recommendations** for the population, such as mask mandates, travel guidance, and testing guidance.
- **Communicating with the public** to educate and update them with information about the virus, including amplifying the latest guidance available from public health departments and countering rampant misinformation. ID experts often participated in town halls, media conferences, and news interviews, while also disseminating information informally to the community and answering their questions. This responsibility was especially important once segments of the public began to lose trust

[6] Although some ID experts work primarily in public health, this section focuses on the roles and responsibilities of ID experts who primarily work in health care settings but also contributed to the public health response.

in public health departments, while ID experts remained, for the most part, trusted members of the community.

- **Supporting vaccination and testing efforts**, including helping to set up mass vaccination and testing sites and ensuring measures for infection control were in place at those sites.
- **Conducting surveillance and investigating cases and outbreaks** in health care organizations and the community.
- In many regions, ID experts and public health officials shared that they met at a regular cadence during the height of the pandemic to exchange information and conduct these collaborative efforts. In some regions, preexisting relationships between the public health departments and ID experts helped facilitate contact and continued communication. For more information about the flow of information between health care settings and public health departments, see Chapter IV.

> **"In many of our regions, we took the lead on community vaccination sites in collaboration with public health when the vaccination rollout started … we did a lot of that … and collaborated with public health on testing sites, because their resources were very slim and not prepared."**
>
> **– Health leader (ID physician)**

- **Joining task forces, committees, and workgroups** outside of their health care organizations to advise and work with different entities, including (1) local, state, and federal governments (for example, public health departments, governor's advisory committees, White House task force); (2) federal agencies (for example, CDC, NIH); and (3) professional organizations (for example, IDSA, SIDP).
- **Providing guidance to community institutions**, such as schools and businesses, so they could operate safely during the pandemic and minimize outbreaks.

Differences between ID expert types

Although the work of the four types of ID experts discussed in this report often overlapped in the COVID-19 pandemic response, there were some differences in the roles and responsibilities they tended to take on (see Exhibit II.3).[7] Health care epidemiologists focused more on infection prevention and control efforts, including investigating outbreaks, predicting infection spread, and conducting contact tracing because of their knowledge of transmission in different settings. ID pharmacists played a large role in therapeutic management and the vaccine rollout, including setting up monoclonal antibody programs and vaccine clinics and developing vaccine protocols. ID physicians generally have a broader skill set, touching upon all the roles and responsibilities discussed in the report, although they were particularly relied upon for leadership roles and diagnosis and clinical management of the disease.

[7] There was an overlap between ID physicians and health care epidemiologists in the roles and responsibilities they fulfilled during the COVID-19 pandemic, as some ID physicians are also health care epidemiologists. One key informant noted that there is currently no standardized training or accreditation for health care epidemiologists, making it difficult to separate their unique roles and responsibilities from other ID experts.

Exhibit II.2. Common responsibilities among different types of ID experts

Type of ID expert	Common responsibilities
ID physicians	• Diagnosing and managing infectious disease directly and consulting on other clinicians' patients, as needed* • Holding leadership or subject matter expert roles within the Hospital Incident Command System • Leading cross-department task forces or committees to coordinate pandemic response efforts across departments • Guiding operating policies and procedures • Guiding ethical allocation of scarce resources • Leading antibiotic stewardship programs* • Overseeing infection prevention and control* • Conducting research* * Indicates pre-pandemic role as well
Health care epidemiologists	• Infection prevention and control • Investigating cases and outbreaks • Contact tracing • Forecasting infection spread and predicting patient volume • Interpreting public health guidance
ID pharmacists	• Keeping up to date on rapidly emerging new research and sharing key takeaways with others • Developing treatment guidelines • Therapeutic management • Overseeing the drug supply chain and managing drug shortages • Developing protocols for vaccines and helping manage vaccine clinics Leading and supporting clinical trials
Clinical microbiologists	• Develop and run COVID-19 tests • Contribute to diagnostic stewardship efforts, including deciding how tests would be used, how frequently tests would be administered, and who would get tests • Obtain samples of the virus to help develop tests and work with state and federal regulators, such as the U.S. Food and Drug Administration • Manage the supply chain for testing and laboratory supplies, including dealing with shortages • Educated the public and medical staff about diagnostic testing

Note: These are the responsibilities that ID experts tended to take on according to the key informants, but it does not mean ID experts did not take on responsibilities not included in their row.

Post-pandemic

Many of the roles and responsibilities from the height of the pandemic have now concluded for ID experts. At the time of our interviews in summer 2023, there continued to be great variation in the pandemic preparedness activities and level of ID involvement across health care organizations. Many key informants shared that there are more preparedness activities at their organizations now than pre-pandemic and that they play a role in these activities, which include: (1) trainings on emergency preparedness and public health and cross-training other health care professionals in infectious diseases and infection control, (2) helping labs to improve their ability to rapidly develop diagnostic tests and ramp up testing capacity in future pandemics, (3) creating a dedicated position for pandemic preparedness, (4) improving research capabilities (for example, accelerating the processes of clinical trials and vaccine development), (5) and paying closer attention to the supply chain and maintaining a larger stockpile of PPE.[8]

> **"There's no perfect way … to prepare for a pandemic, because you just don't quite know what the nature of that pandemic is going to be, but there are … certain things that we know we may need to drum up … there is now institutional memory as well as processes that are now in place that are structured so that they can be expanded rapidly … the ability for us to get together a large multidisciplinary representation to respond…something that maybe took weeks to months to do for COVID happened in days for mpox."**
>
> **– ID physician**

Others shared that they were not aware of any formal pandemic preparedness activities at their organizations at this time. In organizations without preparedness activities, a few key informants cited burnout among ID experts, other health care professionals, and public health officials as a limiting factor.

Many key informants hoped that the lessons learned from the COVID-19 pandemic would be formally institutionalized or documented through a framework, pandemic playbook, or after-action report, although only a few reported that this had occurred at their organization to date. Some key informants worried that without formal documentation, the knowledge gained from the pandemic may be lost when ID experts retire. But many key informants also expressed optimism for the future, sharing how their experiences and remnants of the pandemic, such as multidisciplinary workgroups that formed during the pandemic within their organizations, have helped them in responding more quickly and effectively to more recent outbreaks, such as mpox.

B. Ideal roles

In this section, we discuss the roles that ID experts *should* play in future pandemics, including roles that they already played before and during the COVID-19 pandemic. These roles were identified and recommended by members of our PPNA Advisory Group and key informants, including ID experts, health care leaders, public health officials, and representatives from national stakeholder organizations.

[8] Before the pandemic, hospitals generally employed a "just-in-time" approach to the supply chain, housing few supplies on site but having them delivered as they are used. This approach led to shortages of PPE and other medical supplies and devices during the pandemic (Croke 2020; Herstein et al. 2021).

Pandemic preparedness

> **"I think when the pandemic happened, people were tapped but they hadn't necessarily been part of the preparedness team."**
>
> **– Public health official (ID physician)**

Key informants and members of our advisory group strongly recommended that ID experts play a much larger role in pandemic preparedness activities in their health care organizations and public health departments than they did in pre-pandemic times, with direct involvement in planning and preparation rather than being pulled in once an outbreak or pandemic occurs. Some suggested creating an explicit pandemic preparedness role for ID experts in health care organizations that includes protected time, support from health care administration, and compensation. The ideal roles and responsibilities for ID experts in pandemic preparedness include:

- **Helping develop pandemic response plans or reviewing existing pandemic response plans more frequently** at their health care organizations and public health departments and updating them as needed.
- Helping health care organizations **build and maintain the capacity to implement pandemic response plans or measures** by ensuring that essential supplies, such as PPE, are stockpiled, the appropriate infrastructure is in place and available (for example, bed capacity and isolation rooms), and there are plans for staffing.
- **Working more closely with public health departments** in preparedness efforts, including helping to maintain relationships formed during the COVID-19 pandemic or reaching out to create new ones where they did not previously exist. One public health official also suggested that ID experts become more involved in the Hospital Preparedness Program (HPP), which brings together health care organizations and public health departments through the formation of coalitions.

Pandemic response

> **"I think they need a seat at the table and the highest table … whatever an organization's … central body that is overseeing directing that response … you need to have an ID physician and ID pharmacist at that table at all times… And that's just because we're the clinical experts in this space."**
>
> **– ID pharmacist**

Many key informants and PPNA Advisory Group members recommended that ID experts **fulfill similar roles and responsibilities** in responding to future pandemics to what they did during the COVID-19 pandemic. They also highlighted areas that needed more ID expert involvement in future pandemics. The key informants and advisory group members recommended that ID experts play the following roles and responsibilities in responding to a pandemic:

- **Leading response efforts** at their health care organizations, including leading the HICS, leading infection prevention and control programs and efforts, coordinating across departments, and more. Many suggested creating a designated leadership role for ID experts to ensure they have a seat at the leadership table of their organizations, protected time, and compensation.
- **Playing a consultative role and providing guidance and advice in areas or health care settings where ID expertise is limited** (for example, rural communities, congregate care settings, correctional facilities, community-based primary care practices, FQHCs, and safety-net hospitals). Although many ID

experts did this in the COVID-19 pandemic, some key informants shared that more support was needed in these areas and health care settings, as many of these communities and facilities reported having no access to ID experts during the COVID-19 pandemic.

- **Collaborating with public health departments** in their response efforts, including having a formal role in communication with the public.
- **Providing clinical care and developing guidance for other health care professionals** for diagnosis, clinical management, and therapeutics.

III. Existing and Needed Supports for Pandemic Roles

A. Supports received during the pandemic by ID experts

Overview of supports

Many configurations of networks worked hard to support ID experts during the pandemic. Examples included recurring calls among ID physicians and epidemiologists in a state, a statewide collaborative, normally competing health systems working together to serve their community, networks with peers in the same system, and cross-disciplinary networks extending outside their system that were built by individual leaders.

In addition, national stakeholder organizations—including specialty societies and other health care membership organizations, such as the National Association of Community Health Centers (NACHC), and the CDC—offered support both to ID experts and to organizations lacking local ID expertise. Many different modes of dissemination and methods for peer sharing were used, including web-based synchronous and asynchronous methods.

ID experts also drew heavily on internal supports to fulfill their pandemic roles, particularly their professional training and personal and professional experience.

Supports for ID experts' roles during the pandemic are discussed in more detail below by level—internal/personal, local or within system, state, national, and cross-cutting.

Internal/personal supports: ID experts drew on their professional and lived experience and prior education and training to assume pandemic leadership roles. The ID experts we interviewed—who were most often participating in leadership-level roles within their health care organizations—drew primarily on their past professional and lived experience and prior education and training to play these critical roles during the COVID-19 pandemic. While their most relevant past professional experience was often related to Ebola, H1N1, or SARS-CoV-1, some also explained that they drew on past experience reaching historically marginalized populations, past military experience treating small outbreaks of malaria or viral hemorrhagic fevers that are more common overseas, or caring for patients with HIV/AIDS in the early days of the AIDS epidemic.

The educational backgrounds of the key informants—which are likely more advanced on average than most ID experts—were also important to their ability to play these roles, even though these individuals completed their education in most cases many years prior. Examples are listed in Exhibit III.1.

Local or within-system supports: Some examples were cited of supportive local or within-system organizational relationships. Some key informants who were leaders within their own facility discussed the importance of being able to share ideas and concerns with ID colleagues in other facilities within their system or even working with a normally competing hospital organization in their area to develop response plans for the pandemic to serve the entire community. Relationships with local public health departments were most often discussed as an area of need for the future; however, we found several examples of supportive relationships between public health departments and hospitals. In one case public health officials attended some of the hospital's meetings, bringing important information; in another, the hospital had participated in tabletop exercises with the local public health department (pre-pandemic) and reported that the resulting relationship as well as the exercises themselves had contributed to their ability to respond.

Exhibit III.1. Examples of education and training that supported ID experts

Physicians

- Fellowship training with time spent in long-term care settings led to work with these settings during the pandemic
- Fellowship training topics included infection prevention and bioterrorism agents; these were helpful in thinking about responding to people's fear
- Completion of the joint ID and EIS (CDC Epidemic Intelligence Service) fellowship for ID physicians provided public health knowledge
- SHEA/CDC training in topics ranging from infection control to isolation guidelines helped; it was provided through SHEA conference offerings and taken throughout their career

Pharmacists

- Advanced residency training in infectious diseases was key
- Required educational background: Evaluating the literature, understanding different treatments, and synthesizing that data to make a recommendation is inherent to pharmacist training

Microbiologists

- Ph.D. focused on viral discovery
- MD (lab director)
- Fellowship in medical and public health microbiology

Any ID expert

- Programs on dealing with anti-vaxxers, provided by the National Foundation for Infectious Diseases

State-level supports: Some examples were cited of supportive state activities. One leader whose system operates in multiple states reported that, unlike other states in which they operated, Minnesota had high-quality, recurrent infectious disease calls that they joined, where many ID doctors and epidemiologists were sharing information, enabling this leader to spread some of the learnings from those events across system hospitals in other states. Another key informant noted that Minnesota's email alerts were helpful. More broadly, CSTE held weekly state-level epidemiology meetings.

National-level stakeholder supports from specialty societies, other health care membership organizations, and the CDC and NIH were very helpful. One-way, just-in-time information sharing that key informants cited as supportive included keeping their websites up to date as guidance rapidly changed (for example, CDC, IDSA, and NIH) and sending alerts or email updates (for example, CDC, IDSA,

and SHEA). Key informants used interactive platforms to learn rapidly from peers, including discussion boards and listservs (for example, NRHA and AHA) and the Emerging Infections Network (IDSA). Many key informants reported that Saturday clinician calls led by the IDSA and CDC were very helpful, including interactive chats. Key informants also described other supports that national stakeholders had provided to their members, including webinars (NACHC), pandemic toolkits (SIDP, NACHHO), a field guide (ACEP), a clinician call center (IDSA), and a vaccination program playbook that the Indian Health Service adapted from the CDC's COVID-19 Vaccination Program Interim Playbook to be culturally responsive for American Indian/Alaska Native communities (IHS).

> **"It wasn't sponsored by anybody, but we had email chains, we had phone calls, we basically did a ton of sharing about implementation issues in our institutions through organic networking … having that peer group to be able to work with and talk through gave us some confidence when there was a huge degree of uncertainty."**
>
> **– ID physician**

Cross-cutting supports involved connecting regardless of geographic location. For some of the supportive peer sharing, geographic boundaries were irrelevant. The quote on the left indicates email chains and phone calls were often used. Another key informant commented that "Twitter (now X) became the town hall for ID physicians to share information," and "we had WhatsApp groups, Facebook groups, everybody had their way of getting in information sharing with peers." A third explained that an antimicrobial stewardship collaborative specific to pediatric patients was very active from the beginning of the pandemic as a sounding board and information-sharing vehicle for pediatric ID physicians.

B. Key informant suggestions: Training needed but not received during the COVID-19 pandemic

After the key informants described the supports they had received during the pandemic, they explained the important opportunities to improve training and other kinds of supports to be better prepared for the next pandemic. Many reported that both training and other types of support are needed. This section focuses on the training needs they identified, and Section C focuses on the other types of needed support.

Key informants commonly identified needing additional communications training, pandemic response/incident command training, and leadership training. However, the additional training needs that surfaced less frequently in the discussions are also important to consider and are listed below. While many key informants did not elaborate on the ideal features of training for the topics they recommended, a few added suggestions are described at the end of this section.

Topics of needed training

Communications training was the most frequently mentioned type of training needed, and key informants identified several different aspects to be addressed:

- **Media** training: For example, one key informant recounted the frustrating experience of providing a very long and detailed interview with a reporter who only used one line from their discussion. (Microbiologist, lab director)
- **Town hall** training: For example, one key informant reported losing much sleep while strategizing how to do a town hall. (ID physician)

> **"Communication is so important in a pandemic situation. Everybody is so scared. So … I wish I had more training in that."**
>
> **– ID physician**

> **"We need the expertise in clear and effective health messaging that builds trust within communities."**
>
> **– Public health official**

- **Influencing those with negative attitudes toward the health system**: This training could teach "how to talk to people and how to provide information that people will accept," noted one key informant. (Microbiologist, lab director)
- **Help in dealing with political backlash**: "None of us had the training to handle the political pushback that many of us experienced." (National stakeholder organization)

Pandemic response training, or incident command training, was also commonly mentioned as needed. One health leader noted that early in the pandemic "everybody was trying to go their own way" rather than working together smoothly, and that more training in "the FEMA methodology" and incident command would help. Another key informant expressed the need for all health care professionals involved in a pandemic to understand the different roles people play, the resources they can lean on, and the people they can call when challenges arise.

> **"CDC training which I have was good but, not really enough…. What was missing was formal training in crisis management and incident command."**
>
> **– ID physician**

Leadership training was the third common type of recommended training. A health leader who was especially passionate on this topic had observed that ID physicians often do not have a voice at the higher levels of their organizations. To have that voice, they need to develop skills in communication and physician leadership and then push harder to be at "the table." Another key informant mentioned that some national stakeholder organizations (including ASTHO) have begun offering trauma-informed leadership training, and they had found it useful in their own experience and thought it should be explored for wider use.[9] Others were less specific, but as one noted, leadership training helps with understanding how people think, how humans respond to different humans, what drives different people, and how they want to be communicated with—all valuable understandings for leading a pandemic response.

While the following training topics were identified by fewer than four key informants, often one or more of the key informants was passionate about the need for these training topics to be covered:

[9] A trauma-informed leader enhances psychological safety so employees can thrive and function as part of an effective team. "Trauma-informed practices are based on the basic human need for connection—people are hard-wired to connect and feel calm and stable when safe connections are available" (Lee-Baggley 2022; Koloroutis and Pole 2021).

- **Public health:** One ID physician suggested a need to formalize public health training within fellowship training for infectious diseases, specifically to focus on the things ID physicians need to know in a pandemic that they do not need to think about frequently, such as "how lab tests work, how the drugs work, what's different in children vs. adults?" An ID expert who was also a public health official commented that they did not know anything about the public health world and infrastructure before they took a public health role. Another thought public health training should be more widespread and would help "not only coordinate your own internal response but understand how you're communicating with all the resources external to your organization."
- **Updating epidemiologists**: Since methods have advanced in the last decade, one public health key informant suggested that many practicing epidemiologists should take updated training on causal inference to ensure that observational studies are well structured. Another key informant explained that people who practice epidemiology have various levels of training and that implementing a standardized exam with certification for epidemiology would bring better overall trust that epidemiologists meet a professional standard. An ID physician also suggested that additional epidemiologists with modeling and forecasting training—a skill that some but not all epidemiologists possess—would be beneficial to be better prepared for the next pandemic.
- **Implementation science training, or human factors engineering:** While one key informant was unsure how to label the training they thought would be helpful, the concept was that ID experts should be given principles and a framework so that they would have enough knowledge about how systems work (in their own context) to be able to make it work effectively and to collaboratively redesign workflow where necessary with the front-line staff, rather than adding to their work.
- **Rural health:** Much of the information passed to hospitals on pandemic response was not specific to rural communities with scarce resources. One key informant noted that "it was a huge surprise to the nation that Critical Access Hospitals … didn't have ICU units" and might have few or no ventilators. Educating ID experts (and others involved in shaping and leading pandemic response) on key rural health circumstances would help to plan appropriate recommendations for rural settings in a future pandemic.
- **Supply chain issues:** A major hurdle in the pandemic was "how to get stuff." ID physicians and laboratory professionals are not currently trained in how to get materials or how to overcome shipment crises.
- **Pathogenesis:** An ID physician leader found that there was not enough understanding even among ID physicians about the basic mechanisms of infectious disease pathogenesis and seeing the parallels between COVID and other infectious diseases. For example, it was, but should not have been, a "news flash" that asymptomatic people could transmit the virus, or that a vaccine would not completely prevent transmission.
- **How to address a new disease**: The process to address a new disease is different and presents challenges relative to addressing a more familiar disease.
- **Digital training**: Increasing digital training (such as informatics and artificial intelligence) could ultimately greatly increase the capacity of ID physicians to see more patients per physician, creating

additional access to ID expertise. This key informant has seen promising progress on these fronts within their organization.

Suggested features of needed training

> **"…consider how to formalize that as part of … fellowship training in infectious diseases. What are the different things that you need to do in the more acute pandemic setting that are not necessarily a day-to-day role?"**
>
> **– ID physician**

Many key informants suggested enhancing **fellowships** to better prepare the next generation of ID experts for future pandemics. To better prepare those already in the field, some suggested an **online curriculum** be developed, with one further suggesting realistically it could be two to four hours in length and be similar in type to one already developed for antibiotic stewardship. Other key informants suggested that the annual IDWeek event is a good vehicle for offering training, with one even suggesting that there be an organized sequence of pandemic preparedness and response training within IDWeek over a five-year period. One key informant expressed that the training should not just be didactic, it should also **include tabletop exercises**. Another focused on training specific to epidemiologists and suggested that developing a certification for epidemiology would help to ensure a minimum standard set of competencies within the field.

C. Key Informant suggestions: Supports other than training were needed during the pandemic but not received

Three types of supports other than training were commonly cited as important: supports to better utilize ID expertise, the need for increased capacity (of ID experts and related professionals, public health officials, and staff and equipment more generally), and the need for a playbook to guide response. Supporting a quick start to research, peer-sharing support, and other ideas were also suggested and are included below.

Supports to better use ID expertise

Key informants commonly suggested that an important support to better use existing ID expertise would be **to improve ID experts' connections to their surrounding community**. For example, the only ID physician covering multiple small hospitals explained that beyond serving those hospitals, they were called by others in the surrounding communities where there were no ID physicians at all. A key informant with a broad perspective noted that there are many very small rural facilities with emergency departments but no ID physician in their state and commented that ID experts are typically not connected in any way, although their help is needed. Others commented on the gap in ID expertise for congregate settings, such as homeless shelters, or that there needed to be more collaboration between hospital clinics and public health departments.

Some suggested that **user-friendly resources designed for community ID physicians** could improve their effectiveness in a pandemic and better utilize their expertise. A public health key informant commented that the community-practicing ID physicians have even more limited time than others to read scientific literature, so guidance resources for them should be rapidly digestible, allowing them to stay up to date quickly. Another key informant from a community setting was involved in national-level

pandemic-related efforts and was always receiving cutting-edge information, while others did not benefit from such connections.

> **"The best way to do that [integrate ID experts with emergency preparedness] would be to have those conversations regularly and to have it be practiced … but that isn't always happening."**
>
> **– National stakeholder organization key informant**

Better including ID experts in preparedness and response efforts would also improve the utilization of ID expertise. A national stakeholder key informant explained that it varies across the country in how well communicable disease/ID experts work with emergency preparedness, but often emergency preparedness does not include this component well. A public health key informant reported that state public health departments lack recognition of ID physicians as a resource for state-level public health response and suggested this could be addressed by strengthening IDSA's educational efforts on this topic.

> **"… more trained ID physicians would really help … communities that had ID physicians were more resilient than ones that weren't. For future preparedness that's a big, big problematic thing."**
>
> **– ID physician (rural community)**

Supports to increase capacity

Key informants commonly mentioned the need to increase ID experts' and related public health and health care professionals' capacity to improve preparedness and response for the next pandemic. The lack of enough capacity in some places contributed to ID experts' extreme work schedules and their need to play multiple roles. There are several reasons for the **historically low number of ID physicians,** and the fact that nearly 80 percent of counties have no ID physician at all, including (1) low compensation compared to other specialties, driven in part by a billing system that is skewed toward procedure-based specialties and fails to account for administrative roles, such as leading antibiotic stewardship programs; (2) the high cost of medical school that can lead to substantial educational debt; and (3) immigration policies that affect noncitizen physicians, who form one-third of the ID workforce (Hussaini 2020; IDSA and Johns Hopkins Center for Health Security 2022). One key informant was hopeful that passage of the PREVENT Pandemics Act by Congress might help at least repay loan payments for some.

In addition to ID physicians, one key informant stressed the need for additional **ID pharmacists**, noting that there are too few programs and not nearly enough residency slots for pharmacists who want an ID residency, so most must learn on the job instead. While the number of epidemiologists has substantially increased since 2017, a key informant with a broad view of the field agreed with the CDC that there remains a need for additional **epidemiologists** (Arrazola and Auer 2022).

> **"There just aren't enough people. These ID docs and the ID professionals, they are overwhelmed during a pandemic response, and they need to have help."**
>
> **– Public health official**

> **"… the public health infrastructure was shown to be inadequate … we're seeing the resources being pulled back out again … we need to build the workforce…we need to build the public health infrastructure."**
>
> **– ID physician (community setting)**

Some key informants highlighted the need for stronger **public health** capacity, noting wide variations across states. One health leader described how in their state, when budget cuts are needed, "we all know they're the ones that get sacrificed at the altar." As a result, according to this leader, the public health department was not able to provide much support in the response until many months into the pandemic, necessitating the local health systems to operationalize the early response for their entire service area on their own. A public health key informant cited underpayment of public health professionals as a reason why so many left their jobs at the end of the pandemic, on top of the pandemic-related stress and burnout, commenting, "We need a culturally diverse public health workforce that's well equipped to perform the broad range of needed public health skills, and sustained by livable wages."

In addition, some key informants discussed the need to **increase staff and equipment capacity** to allow for flexibility to respond in the event of another pandemic. One explained that while such efforts were largely led by infectious disease specialists, the workforce that is needed is far broader. For example, initial therapies required infusions at the medical center, requiring the people to create and run systems to do that, ranging from people who could receive referrals and schedule patients to nurses and others to staff the infusion centers: "And I don't know what the answer is, to fix things like our shortage of nurses, or just general health care staffing crisis." Another, a microbiologist lab director, commented that it is very important to build in flexibility—"having some stock, being a little overstaffed, having a little bit of extra equipment in case something comes up."

> **"I basically need to know when I need to get that piece of knowledge out and dust it off and relearn it so I can be ready. Where is it? How do I get to it? And hopefully it's quick and easy to navigate through it."**
>
> **– Health leader (ID physician)**

Support in the form of a locally-defined playbook—Drawing on lessons learned

Key informants commonly pointed to the need to preserve learning from the pandemic in a form that would outlast the tenure of those who worked through COVID-19, so as not to repeat mistakes. One expressed that between pandemics even those who lived through it do not have the attention span or memory to retain information on how to respond, so a playbook should enable organizations to be ready to roll out a response; it should cover multiple levels: physicians, patients, employees, and community. Another expressed the need for a structured framework and plan, which could take the form of a playbook. Another clarified that lessons need to be documented at a high level—with IDSA, state health departments, and the CDC involved—and also within each organization, given their own context.

Other supports

Individual key informants recommended other supports as well, including direct supports to ID professionals at work and other national-level recommendations, as shown in Exhibit III.2.

Exhibit III.2. Less commonly mentioned suggestions for additional support to ID experts

Recommendation	Type of key informant recommending this	Rationale offered by the key informants
Direct supports to ID experts as they work		
Support to begin research quickly	ID physicians, including those focused on pediatrics and long-term care	The field did not contribute enough knowledge about pathenogenesis early on because it was too difficult to get research studies started; a template could be developed for research questions to speed the process. Pediatric and long-term care research findings were very slow in coming. Research networks are needed to generate knowledge more quickly; fortunately, this is underway and just needs to continue.
Peer-sharing mechanisms	ID physician, public health officials	Peer sharing that occurred over social media was necessary but very broad-based and unstructured; the IDSA's Emerging Infections Network is a good model for people to use from anywhere with perhaps a little more structure. While the key informants had a sufficient informal network within their system, they were concerned that ID experts in community hospital settings or other settings where people may feel more isolated would not have access to an informal network and would need peer-sharing support.
Mental health support	National stakeholder organization	Magnitude of need for mental health support is much greater than anticipated, and they are seeing it even now, post-pandemic.
Other national-level recommendations		
A national dashboard to identify available beds and equipment	National stakeholder organization	There is a need for a national health information technology solution that would identify nearby beds or key equipment; local solutions have been designed in many places but are not consistently available across jurisdictions, particularly in small, rural communities.
Need to include ID experts in the national rural health plan	National stakeholder organization	ID experts should be included in developing the national rural health plan underway within the CDC Office of Rural Health.
A central group tasked with "making sense" out of early studies	National stakeholder organization	National stakeholder organizations including CDC, IDSA, and other relevant specialty societies should be prepared to rapidly make sense of early studies that come out; although they did so later, this was a gap in the early months of the pandemic.
More conservative early guidance on masking among health care professionals	National stakeholder organization	The switch from early guidance that surgical masks were protective enough to guidance that N-95 masks were needed caused great disruption, including health professionals quitting. Key informants advised that next time, if there is even small uncertainty, to begin with the more protective policy and allow the less protective one if the more protective one is unavailable.

Source: Key informant interviews conducted by Mathematica for IDSA, summer 2023.

D. Key informant suggestions: Supports needed to avoid burnout

> **"I felt like we got done with the marathon and somebody gave me a little tiny cup of water to take a drink and then they were like, okay, run your next marathon because we've ignored all this other stuff for a year and a half."**
>
> **– Health leader (ID physician)**

Key informants most often attributed the serious burnout among the profession to an inadequate supply of ID experts and suggested that finding ways to increase the supply—for example, by increasing compensation to help retain and attract ID physicians to the profession—would be key to preventing burnout in a future pandemic. Beyond the supply, some key informants explained ID experts are motivated by a sense of mission and feeling that they are making an impact together with the public and policymakers. When that feeling changed as the pandemic became more political, one explained that it contributed to stress and burnout. Other suggestions included:

- Minimizing administrative responsibilities (such as reporting and electronic medical record keeping).
- Setting up coordinated phone-based triage by other health care professionals—including primary care physicians, nurses, interns, and residents—to keep ID physicians' focus on cases that needed their expertise.
- Respite care since clinicians cannot sustain extremely heavy loads for extended periods.
- Mental health support—letting people know what they might experience and what supports will be there for them.

E. Key informant suggestions: Supports needed to avoid rising antimicrobial-resistant infections

Key informants explained that AMR infections had increased during the pandemic because the focus on antibiotic stewardship and infection control was lost in the chaos of the pandemic. While each had a slightly different suggestion about what steps could be taken to prevent this in the future, together their ideas comprise a set of potential actions that could help.

Having a more robust antimicrobial stewardship program in place at all times would provide more bandwidth to help during a pandemic; one key informant recommended that CMS and the Joint Commission require a specific percent full-time equivalent devoted to this to help increase its priority. Health care organizations could include stewardship in their emergency planning exercises and could ensure their information systems will detect a problem rapidly if it occurs. One key informant explained that their hospital had detected the problem and set up a second stewardship panel to address the problem among patients with COVID-19. Other key informants focused on reducing the demand for antibiotics when they are not really needed, suggesting improved education to community providers about handling viruses versus bacteria, and improving trust in the relationship between patients and the medical system, as this could lead to less patient demand for antibiotics when they are unnecessary.

F. PPNA Advisory Group insights on training and supports needed

After hearing the results of the key informant interviews, the PPNA Advisory Group identified three major issues to be addressed and two additional types of supports, described next.

Issue 1: Bridging the gap between the public health and the ID expert community. Additional training should include core public health knowledge, training on how to engage with public health departments, and training for ID experts to learn how to advocate for themselves to get a seat at the table for health care coalitions or other structures involving public health. In addition, there should be additional training and support for network building to maintain or build new relationships between public health departments and their organizations. Also, each health care organization should have its own HICS that feeds into a network structure and ultimately into a coalition that is led by public health officials.

> **"The role for ID experts should be built into the incident command structure. It's not just the response, we need a role in preparedness. That includes getting a seat at the table, getting yourself built into the HICS—this should all happen beforehand."**
>
> **– Advisory group member**

Issue 2: Getting ID experts a seat at the table in hospital incident command training and overall preparedness and response work. Hospital incident command training would empower the ID community to become more actively involved in their HICS at the preparedness stage rather than just being tapped to respond to an outbreak or response. Leadership training could assist ID experts in navigating within their organizations—including communicating with people in "C-suite" positions—in ways that will lead to greater participation in high-level decision making for preparedness and response.

Issue 3: Supporting ID experts with the skills building and education needed to optimize their role in preparation for and during pandemics. Creating a pandemic preparedness curriculum would directly address the needs that the key informants described for practicing ID experts; this could vary in level of intensity depending on the person's role. ID professionals who need to increase their general knowledge about pandemic preparedness may receive more infrequent trainings through events, such as IDWeek, or webinars. Others who do or might hold a leadership role at their organization during a pandemic may require more intense training, including case studies and lectures from subject matter experts. Priority topics for a training curriculum include:

- **Communication training**, including visual data communication and improving storytelling skills to communicate disease risks more effectively to patients and the public, as well as media training.
- **Training and support for ethical allocation of scarce resources during a pandemic**—how to ensure a plan is in place for allocating resources appropriately if scarce during an emergency, including equity as a component and using race-conscious approaches when disparities are identified. Supporting the advisor's point in an earlier interview, one key informant explained that if medical outcomes are the only consideration, it would be better to give scarce treatments to those who present to the hospital earlier in the course of disease, but that that discriminates against those who have less means to get to the

> **"The clinics that are on the front lines, especially dealing with the underserved, uninsured, underinsured, our Black and Brown and Hispanic populations…most of my communication was: How do we get staff to buy into the…vaccines that were being rolled out? And how do we get our patients to…embrace it? And how do we build those relationships?"**
>
> **– ID physician (community health center)**

hospital early (for example, they can't miss work, or lack transportation). In his case they did make sure to incorporate those considerations.

- **Training on how to best support colleagues in under-resourced areas** (for example, critical access hospitals, rural health settings, community health centers, clinics, zip codes with high historically marginalized populations) with little or no access to ID expertise.
- **Data collection and interpretation training and support**, including (1) assistance in identifying data resources and building data collection systems; (2) assistance in generating reports and data dashboards; and (3) learning how to conduct equity-focused epidemiologic analyses, including the essential data that should be collected and how to interpret and act on data findings.

In planning for the deployment of a curriculum, PPNA Advisory Group members emphasized that any trainings and resources created need to be ***accessible to all and equitable***, including those working in under-resourced organizations who may not be able to afford to attend events requiring travel or substantial time away. They recommended (1) establishing free or online offerings, (2) providing shorter trainings at a recurring cadence to establish consistency without overloading the trainees, and (3) offering rapidly digestible resources for physicians working outside of academic medical settings. Existing platforms or forums, such as the Real Time Learning Network, IDWeek, and IDSA weekly clinician calls could be adapted and used to facilitate trainings and education.

In addition, the PPNA Advisory Group supported embedding preparedness training within fellowships. IDSA could facilitate more consistent preparedness training by working with training directors to ***enhance fellowships*** by consistently including pandemic preparedness components. Fellowships could also include rotations in other congregate settings to better understand the transmission of diseases in those settings so that ID experts are better equipped to support these settings in future pandemics.

Additional support 1: Sharing best practices and ideas among peers. Peer sharing can be supported informally and formally through networks such as the University of New Mexico's Project ECHO, THE Administration for Preparedness & Response (ASPR) Technical Resources, Assistance Center, and Information Exchange (TRACIE), and IDSA's Emerging Infections Network. Although key informants reported peer sharing during the COVID-19 pandemic, PPNA Advisory Group members recommended that peer sharing occur in nonpandemic times as well to support preparedness and information exchange in advance of an outbreak or pandemic. This will also help facilitate communication and knowledge exchange for community-based clinicians and ID experts in under-resourced settings.

Additional support 2: Development of a playbook. PPNA Advisory Group members agreed with key informants that some form of a playbook is needed to prepare ID experts and their health care organizations for pandemics, thereby preserving institutional knowledge and lessons learned from the COVID-19 pandemic. The playbook could be tailored to different regions and based on available resources, although it would ultimately need to be adapted locally and incorporate insights from local after-action reports. They suggested that this could be a collaborative effort between different kinds of ID experts, with a role for national stakeholder organizations (for example, IDSA, SHEA, ASTHO, and CSTE).

Reducing burnout

PPNA Advisory Group members provided the following suggestions to help reduce burnout among ID experts:

- Aligning with key informant suggestions, members of the group suggested building in **shared responsibility** within an organization so that other health care professionals or ID experts can help take over responsibilities when ID experts need breaks. For example, Emory University used a call system so that ID experts could take turns responding. In smaller hospitals or areas with few ID experts, coverage may need to be shared on a regional or state level.

> **"You did what's needed but … it was never told to you it's a role. But you need a role to prepare for the next time."**
>
> **– Advisory group member**

- Group members also suggested **identifying and defining the role** ID experts will fulfill during a pandemic may also help reduce burnout. Defining the role's responsibilities explicitly, using documentation of lessons learned from the COVID-19 pandemic for guidance, will help ID experts prepare accordingly and may reduce the number of ad hoc tasks ID experts take on during an outbreak or pandemic.

Considerations for evaluation of preparedness at health care organizations

> **"There's so many differences between state, city, county leadership and organizations that we need that national presence from IDSA to advocate for this. There needs to be leadership, accountability, and visibility."**
>
> **– Advisory group member**

We asked the PPNA Advisory Group what needs to be considered in developing a program that will evaluate preparedness at health care organizations, such as a CoE Program. They emphasized that such a program would need to secure **leadership support and buy-in** at all levels, including endorsement from local and state leadership, and championship and advocacy by national stakeholder organizations such as IDSA. Leadership, accountability, and visibility are all needed for such a program. They advised planning such a program in partnership with key players, including federal agencies (ASPR, CMS, and FEMA) and national stakeholder organizations (including but not limited to SHEA, CSTE, and APHA). The approach should build on the existing HPP and could include supporting regional directors in organizing pandemic preparedness systems in their region. Engaging with CMS about their emergency preparedness rules may be an opportunity to encourage organizations to participate in such a program.

IV. Experience with the Flow of Information Between Health Care Organizations and Public Health Departments During COVID-19

A. Experience with information and guidance flow from public health to health care organizations

Lack of a unified voice transmitting information to health care organizations was an issue for many key informants. Key informants often cited the lack of a unified voice as a challenge in understanding pandemic-related guidance and information from local, state, and national public health sources, including the CMS and CDC. Some national stakeholder key respondents with broad perspectives helped explain this. One noted that health care organizations often took guidance directly from the CDC but state guidance was often "a notch different." Another explained that states add customization to CDC alerts, and then local public health departments often add on as well. This challenged ID experts in their communication and organizational policies and procedures roles, as described in Chapter I.

> **"So, you have this terrible situation where the message you may be getting from a local health department is different than the State's, is different than the CDC's."**
>
> **– National stakeholder organization key informant**

Collaborative relationships with public health officials or frequent participation in interactive convenings helped avoid information flow problems for many key informants. When key informants reported that the flow of information and guidance from public health departments to their organization had *not* been a problem, it was often either because they had strong relationships with public health officials or they had participated in frequent (often weekly) interactive convenings with state or national-level policymakers. The good relationship with public health departments varied from one where a public health professional regularly attended their organization-level meetings, to the ability to get a quick email response from the state health department when necessary to clarify guidance, to the ability to call a responsive state health department staff member on the phone to discuss a point of confusion.

Many key informants reported that various regional, state, or national-level convenings had helped prevent problems in communication flow with public health departments, offering a means to feed information and questions to policymakers as well as to receive guidance and information. These convenings variously included:

- State health webinars with chat enabled, weekly calls with officials from the state departments of health that included question-and-answer time.
- Weekly calls between the state public health departments and ID physicians.
- Regional weekly meetings between public health directors and hospital leaders.
- Biweekly or monthly CDC calls with lab professionals and physicians.

> **"It's not enough just to post information on a website … how people interpret [the information] impacts the way hospitals and clinics operate … it's really important to get people together and be able to talk through things to create that clarity."**
>
> **– Microbiologist (lab director)**

Other shortcomings in information flow from public health departments to health care organizations varied by key informant

Other shortcomings in information flow from public health departments to health care organizations cited by one or more key informants included the following:

- **Rapid changes to guidance were necessary but created challenges.** One national stakeholder organization noted it was a "constant battle to figure out what guidance facilities were actually following, and lots of alignment issues and confusion." A health leader noted that when guidance changed, as it frequently did, the key state website they followed updated their web page but did not highlight what had changed, making it difficult to discern the actionable information. Another expressed that the lack of any "heads up" from the CDC to state health departments when changes were being made left them scrambling.
- **Some state or local health departments were unable to be responsive.** One national stakeholder organization key informant observed that states with traditionally more funding for public health agencies did better with information flow, and because of these historical funding differences the quality of information flow varied a lot from state to state. A health leader and ID physician provided an example of this variation, reporting that their state department of health had not been able to respond effectively early in the pandemic due to historical underfunding.
- **Difficulty reaching all the relevant practicing ID physicians.** A public health key informant reported a challenge reaching ID physicians who practice in the community who are less tuned in to changes in guidance and public health issues. Also, a health leader reported great difficulty in reaching all the relevant providers, saying they tried faxing information as the most likely way to get information in front of community providers but did not know how many had really been reached. An ID physician suggested that while their state epidemiological dashboard is helpful to providers, an email or text list of contacts should be generated and used as well to provide information.

> **"…it's really difficult to try to reach the people who want the information…It's really very labor intensive trying to do this…I'd email the Chief Medical Officer. I'd email the medical society and send it to our FAX.PLUS people, but it all depended on me. If I wasn't there, it didn't go to all these people…it's not very automated."**
>
> **– Health leader**

- **Information on the supply of treatments was inadequate.** An ID physician noted that the information they would get on the supply of treatments was often inaccurate, in both directions: sometimes they would expect a supply to arrive based on the information provided but it did not arrive, and other times they would not be expecting any and more supply arrived. They noted that this inaccuracy further worsens the difficult choices they must make when allocating scarce medication among the patients who need it.

B. Experience with information flow from health care organizations to public health departments

> **"… that relationship [with the city health department] being in place before the pandemic, I think, made that process of communication very easy for us … the city people are very accessible, they are responsive … to our observations."**
>
> **– ID physician**

We asked whether it was a smooth process to provide important information **from** the key informant's organization **to** public health departments on organizational needs and observations, and whether there were any major shortcomings in that process that should be prioritized for the future. Many key informants commented that **the same two-way communication channels and strong relationships with public health agencies that had promoted effective communication *from* public health departments also allowed them to provide important information *to* public health departments.** Some key informants noted that they were not the ones responsible for reporting data, so they did not answer the question as it pertains to reporting data on COVID-19, focusing instead on organizational needs and observations not involving data.

Some key informants who were comfortable commenting on data reporting explained that **variation in data reporting requirements by jurisdiction and over time presented a challenge**. For example, a health leader said reporting was "incredibly resource intensive and difficult" because the CMS had definitions of how to report things, then states modified or added to that, and the organization then had to report in multiple ways. An ID physician similarly noted that reporting was very difficult because of the detailed level of the requests and constant changes to the requirements, and that the very busy people responsible for this were taking time from other very important work. A national stakeholder organization key informant expressed that the data to be reported to public health agencies need to be harmonized, especially around race and ethnicity: "Many of the public health organizations aren't even aware of the existence of ONC and USCDI and the OMB rule on race and ethnicity…what those requirements say is the EHR must be able to get the data out in this format. So, wouldn't you want to ask for the data that you're asking for in the format in which it's already available?"

Other issues in reporting data or key information to public health agencies raised by at least one key informant included:

- Data transfer issues: Some state health data systems are antiquated, creating difficulty in data transfer (national stakeholder organization); manual uploads were needed from provider organizations to get the data on COVID-19 prevalence in the state (national stakeholder organization).
- Data reporting was not as quick, efficient, or thorough as it should have been because people were overwhelmed with other priorities (public health).
- There were "a lot of issues with reporting data" among their members (national stakeholder organization), in part because COVID-19 data reporting was different from reporting for other communicable diseases.
- There was no channel for this key informant to report that even though they were receiving monoclonal antibodies, they could not use them without having additional support necessary to administer them (national stakeholder organization).

C. Key informants' suggestions to improve information flow

Key informants' suggestions to improve information flow were focused on **developing effective messages** and **reaching people more effectively** with the messages. Each key informant brought a different idea to these general themes.

Developing effective messages

Some key informants focused on who should be involved in developing effective messages:

/ Keep involving the national-level membership organizations.

/ Strengthen ID expert involvement with state public health departments.

/ Ensure scientists with a rural perspective are involved in message development to ensure the messaging considers rural organizations.

Others focused on the process for ensuring the messages are effective prior to dissemination:

/ The CDC and IDSA should run messages by those "in the trenches" to make sure messages are clear before widespread dissemination.

/ Tell people up front that things may change as more is learned.

/ Presenting information in a very clear, concise, understandable way is critical.

Reaching people more effectively with key messages

To reach people better with key messages, some key informants said to:

/ Support frequent state-level (or city-level for large cities) status updates by web platform or phone.

   a. Create these points of contact and mechanism outside of a pandemic environment, so it is ready.

/ Create a provider email or text list that can be used by public health officials to push out information and maintain an updated website.

/ Think through a different strategy for communicating with providers that avoids the problem of the old "telephone" game where the message is passed down through many layers and garbled by the end.

D. PPNA Advisory Group insights on the flow of information

Due to time constraints, the PPNA Advisory Group did not have the opportunity to fully discuss the findings from the key informant interviews related to the flow of information between health care organizations and public health departments during COVID-19. However, when discussing needed training (Section III.F.), they indicated that an important topic is **how to conduct equity analyses, including what essential data should be collected and how to interpret and act on data findings.** The members of the advisory group also suggested that ID experts receive **public health training**, including training on how to engage with public health departments, which may help facilitate the flow of information in future outbreaks or pandemics.

V. Strategies to Meet Identified Needs

Note: The strategies below were developed with input from all project participants, including key informants, PPNA Advisory Group members, IDSA staff, and Mathematica researchers. Preexisting initiatives or supports identified by the project team's landscape assessment are listed where relevant, and explained further in Appendix B.

1. **Support more effective inclusion of ID experts in pandemic preparedness and response by**
    a. **Modifying relevant CMS Conditions of Participation or interpretive guidance and/or HPP guidance:** Work with ASPR and CMS to review existing preparedness requirements and incorporate ID experts within preparedness and response. To support effective modification of guidance, define a blueprint for where and when ID experts should be included in preparedness and response structures, exercises, and response. Include how rural and congregate care facilities will be linked to ID expertise. *Primary target audience:* ID experts, Health Care Coalition leaders and participants

Landscape assessment: Appendix B, Table B.1: CMS Conditions of Participation and interpretive guidance on emergency preparedness require a plan for emerging infectious disease threats which per the guidance promotes consideration of including "infection prevention personnel" because they "would likely be coordinating activities…during a potential surge of patients." This could be modified, for example to add ID expertise where available, to recognize the important role beyond coordination of setting policy and operating procedures, and to broaden from a potential surge of patients to an infectious disease outbreak. Our understanding is that the health care coalitions in the HPP vary across the country in who is included in their activities and that HPP guidance does not currently outline how ID experts should be included, and could be strengthened with respect to inclusion of rural and congregate care facilities.

    b. **Promoting better linkage between ID experts and public health departments:**
        1. Work with state and large city public health departments to better communicate with ID experts in their jurisdiction and encourage them to plan for large-scale frequent calls (for example, weekly) in a pandemic, to include question-and-answer time.
        2. Work with national public health stakeholder organizations to better bridge *all* public health departments' work with ID experts.

    Primary target audience: Public health experts and ID experts

Landscape assessment: We did not identify any formal initiatives related to these needs; however, the key informants provided local examples of strong linkages to public health departments, as described in previous sections of this report. Our understanding is that the health care coalitions in the HPP vary across the country in who is included in their activities and that there is room for greater consistency in including ID experts.

2. **Prepare ID experts for effective pandemic preparedness and response by**
    a. **Enhancing ID physician fellowships:** Work with the American College of Graduate Medical Education to enhance fellowship training for ID physicians to include and strengthen preparedness aspects, including communication and leadership training. *Primary target audience:* ID physicians

1. Include rotation in congregate care settings, such as nursing homes, correctional facilities, and other under-resourced settings.

Landscape assessment, Appendix B, Table B.2: The joint infectious diseases and the CDC Epidemic Intelligence Service fellowship pilot program is a four-year program that aims to develop future public health leaders. The Leaders in Epidemiology, Antimicrobial Stewardship and Public Health Fellowship trains ID physicians for clinical or academic careers with public health departments, but recruitment is on hold due to funding constraints. The program requirements for graduate medical education in allergy and immunology may be changing to include public health content.

b. **Developing a pandemic preparedness curriculum** for ID physicians, with a more extensive version for ID experts who are leaders. *Primary target audience:* ID physicians and other healthcare professionals
    1. To guide curriculum development, identify two roles for ID experts, to be operationalized locally: a role with defined responsibilities during a pandemic that ID experts should be prepared to play, and an optional leadership-level role to prepare ID expert leaders to hold a seat at the highest tables for pandemic preparedness and response activity.
    2. Develop an online curriculum that is free and designed for community ID physicians who are pressed for time, to include CME credit.
    3. Leverage other in-person and virtual opportunities, such as IDWeek and small group training.
    4. Include communication training (multiple aspects), public health core knowledge, HICS, network building to include public health agencies, sharing expertise with under-resourced organizations, ethical allocation of scarce resources including equity as a component and using race-conscious approaches when disparities are identified, equity data analysis, and follow-up.

Landscape assessment, Appendix B, Tables B.3 and B.4. In Appendix G, the "ID-Focused Hospital Efficiency Improvement Program" articulates 14 specific responsibilities an ID physician leader could take on, although it is a pre-pandemic era list. Table B.4 in Appendix B identifies numerous existing training resources, including, for example, the SHEA/CDC Outbreak Response Training Program for hospital epidemiologists to support effective leadership for outbreaks and public health emergencies, National Emerging Special Pathogens Training and Education Center (NETEC) courses including ones on HICS, a topical collection of resources on disasters and health care disparity from ASPR TRACIE, a rural emergency preparedness and response toolkit from the Office of Rural Health Policy, and several more.

c. **Guiding development of a local pandemic playbook:** Partner with other national stakeholder organizations to outline and guide health care organizations to develop a local pandemic playbook that includes:
    1. Defining the role of ID physicians, ID pharmacists, epidemiologists, microbiologist/lab directors, ED physicians, and others for pandemic response, and include the roles ID experts actually played in the COVID-19 pandemic.
    2. Planning how to maintain usual standards for infection control and antibiotic stewardship during a pandemic.

3. Planning how to share ID expertise with congregate settings and under-resourced providers in the area, such as small rural hospitals, community health centers, and community-based primary care practices.
4. Planning how to work with public health and other organizations to get messages and points of access for testing, vaccination, and treatment quickly into community settings in zip codes with high historically marginalized populations.
5. Planning how to address expanded capacity needs in a pandemic (ID expertise, other clinicians including nurses, public health officials, labs, equipment, and PPE).
6. Identifying what external resources and networks will be utilized (who to call or where to turn for what).
7. Planning for respite care and mental health supports.

Primary target audience: ID physicians and other healthcare professionals

Landscape assessment (Appendix B, Table B.5): Examples of playbooks include the AHA's "CLEAR Field Guide for Emergency Preparedness," and the CDC's "COVID-19 Vaccination Program Interim Playbook for Jurisdiction Operations." Resources that could be used in developing playbook content could include models for reaching rural or under-resourced health care organizations (Project ECHO, Center for Stewardship in Medicine), ways to strengthen health care coalitions with additional ID expertise (the Healthcare Coalition Infectious Disease Surge Annex Template and implementation guide), a preparedness exercise planning starter kit from FEMA, a mechanism for facilitating cross-organization resource sharing through Medical Operations Coordination Centers, and others listed in Appendix B, Table B.5.

3. **Promote consistent, effective two-way flow of information between public health and ID experts and their health care organizations** by sustaining and enhancing national-level mechanisms hosted by CDC, IDSA, and many other health professional organizations and health care organization membership organizations that were reported to be well used during the pandemic and remain as mechanisms to be used in the future. *Primary target audience:* Public health experts and ID experts
    a. **Select, refine, and promote one key website as a one-stop-shop for ID experts** to access trainings, engage in sharing with peers, and where anyone can find key contacts for committed, leader-level ID expertise at a regional or sub-state level.

Landscape assessment (Appendix B, Table B.8): Existing national-level mechanisms for information flow include the Real-Time Learning Network and Saturday clinical calls (IDSA), Clinician Outreach and Communication Activity (CDC), and webinar series, email updates, and alerts from many other medical specialty societies and national-level membership organizations. In addition, TRACIE has a website supported by ASPR ("Healthcare emergency preparedness information gateway") that is intended as a one-stop-shop for all involved in emergency preparedness (not focused specifically on ID experts) and provides access to a peer-sharing network, a resource library, and an assistance center that will respond to requests.

4. **Support peer sharing mechanisms:** Support peer-sharing mechanisms for preparedness as well as response, such as Project ECHO, ASPR's TRACIE, and IDSA's Emerging Infections Network. *Primary target audience:* All ID experts

Landscape assessment (Appendix B, Table B.7): organizations. While Twitter (now X) was often used during the pandemic by ID experts, some key informants suggested that peer sharing with a little more structure would be desirable. Three we identified are ASPE TRACIE Information Exchange, IDSA's Emerging Infections Network, and Project ECHO.

5. **Support a rapid start to research in a pandemic by**
    a. **Advancing the skill set for epidemiologists**, by encouraging them to update their methods training. *Primary target audience:* Epidemiologists
    b. **Supporting continuation of research networks for special pathogens**, including long-term care and pediatric research networks formed during the COVID-19 pandemic. *Primary target audience:* Public health and ID experts
    c. **Supporting robust dissemination of tools for quick start to research**, such as a master protocol and other tools being developed by NETEC. *Primary target audience:* ID experts who lead research

Landscape assessment (Appendix B, Table B.6): Under the Special Pathogens Research Network, NETEC (funded by ASPR) works with 13 Regional Emerging Special Pathogen Treatment Centers and others to advance special pathogen readiness. Workgroup activities include creating a master protocol for research that allows rapid modification and review, as well as other relevant supports for a quick start to research. While we have not discovered any national-level efforts to update epidemiological methods expertise, another research-related need identified by key informants, a key informant mentioned a free state-level course on causal inference in California that 500 people had signed up for (not listed in Appendix B, as it was likely a one-time offering). Of course, there would be many university-based offerings for a price.

6. **Expand the supply and capacity of ID experts, reducing risk of burnout and avoiding unintended consequences, by**
    a. **Working to adjust payment to ID physicians** to correct their undervaluation relative to procedural specialties; this will help to better ensure that enough medical trainees are choosing to specialize in infectious disease. *Primary target audience:* ID physicians
    b. **Expanding the availability of ID pharmacy fellowships** to increase ID expert capacity and relieve ID physician workload. *Primary target audience:* ID pharmacists
    c. **Advocating for a full-time equivalent requirement for ID pharmacist staffing**, to enhance antibiotic stewardship capacity and overall ID expertise in a pandemic. *Primary target audience:* ID pharmacists
    d. **Encouraging ID physicians to engage in additional digital/information training**—including artificial intelligence—as a way to see more patients and help with epidemic-level surges. *Primary target audience:* ID physicians

Landscape assessment (Appendix B, Table B.9): The PREVENT Pandemics Act (P.L. 117-328, Division FF, Title II), enacted December 29, 2022, includes a section on recruiting and retaining the public health workforce and provides some loan repayment provisions to help support ID expert capacity.

7. After some of the strategies described above have been implemented, **develop a Centers of Excellence (CoE) program:** Pursue collaboration with federal agencies and other national

stakeholders to develop a CoE Program that would recognize health care organizations that meet the criteria for pandemic preparedness and are committed to serving as an information and assistance resource for surrounding communities. Criteria for designation as well-prepared could include elements related to other recommendations, such as having a playbook or having an ID expert with leader-level training. Partners could include CMS, FEMA, ASPR, APHA, SHEA, and CSTE; this should not duplicate and could potentially be an enhancement to the existing Regional Emerging Special Pathogen Treatment Centers (RESPTCs). *Primary target audience:* ID experts, health care organization leaders

Landscape assessment (Appendix B, Table B.10): The Antimicrobial Stewardship CoE Program is an existing CoE Program that IDSA operates; it relates to, but is not the same as, a potential the Pandemic Preparedness CoE Program. The 13 (originally 10) RESPTCs funded under the HPP provide relevant preparedness training for health care organizations in their area and have invested in high levels of readiness to treat special pathogens (Grein et al. 2022).

8. **Plan and develop additional strategies, programs, policies, and other initiatives that will enhance the effectiveness of ID experts in a pandemic**, such as the following:
    a. Federal, state, and local governments should plan for more effective communication with the public; provide adequate funding to public health departments; and clearly highlight changes in guidance during a pandemic.
    b. Collaboration should be strengthened across local and state public health officials, CMS, and CDC, so that messaging to health care organizations and clinicians is consistent, as well as CMS and state reporting requirements.
    c. The federal government should work with the private sector to develop systems solutions, such as a national dashboard for finding beds and key equipment, systems to accurately notify when scarce treatments will become locally available, and a flag in the electronic health record noting an outbreak in the area.
    d. Federal and state governments should develop programs or initiatives to support linkages (for example, telemedicine) between facilities with and without enough ID experts.

    Primary target audience: Federal, state, and local government officials (as specified)

Landscape assessment: The IDSA's current advocacy priorities related to pandemic preparedness are provided in Appendix B, Section F.

While the team proposed the organization of the strategies as shown above for the simplest presentation, we also note that several of the strategies together are aimed at **supporting sharing ID expertise with congregate care settings and rural and under-resourced organizations**, an important objective discussed in PPNA Advisory Group meetings. To assist individuals particularly interested in pursuing this set of strategies, the list of related strategies includes:

/ Develop fellowships and training curricula that include rotations in these settings and a module on how to share expertise with these settings (strategies 2.a.1 and 2.b.4).

/ Plan for how ID experts will share expertise with these settings within a local playbook (strategy 2.c.3).

- Plan for how ID will work with public health and other organizations to get messages and points of access for testing, vaccination, and treatment quickly into community settings in zip codes with high historically marginalized populations (strategy 2.c.4).
- Develop programs or initiatives to support linkages (for example, telemedicine) between facilities with and without enough ID experts (strategy 8d).
- Health Care Coalitions within the Hospital Preparedness Program should include rural and congregate care facilities, so that support for them in a pandemic is well organized (within strategy 1a).

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Appendix A: Methods

I. Literature Review

We used the search terms in Table A.1. to help us identify journal articles and gray literature relevant to this topic. We restricted the search to articles about the U.S. and only included articles published between 2002 and April 2023. We used the following search engines in our search:

- / PubMed
- / LitCovid
- / Web of Science
- / Elsevier
- / Google Scholar
- / MedRxiv[10]
- / Nexis Newsdesk[11]

Table A.1. Search terms used in literature review

Key topic	Related search terms
ID Experts	Physician, specialist, clinician, consultant, resident, provider, fellow, public health, healthcare epidemiologist, pharmacist
Pandemic Preparedness	Role, preparedness, planning, training, responsibilities, support, program, infectious diseases, communicable diseases, pandemic, epidemic, emergency, model, gaps, needs
Healthcare Setting	Hospital, health system, congregate care setting, nursing home, federally qualified health center, correctional facility, assisted living, rural

Note: We used different combinations of these search terms in all the search engines to help ensure that we did not exclude any potentially relevant literature.

We reviewed the titles and abstracts of over 450 journal articles to determine eligibility for inclusion in our literature review based on the following two criteria: (1) the article must relate to the role of the ID expert, or (2) the findings must be grounded within the topic of pandemic or emergency preparedness. We also reviewed gray literature from Nexis Newsdesk and a Google search using the same inclusion criteria for journal articles. We found only three journal articles that specifically discussed the role of the ID expert in preparedness or response to infectious disease outbreaks or pandemics; these are used and cited in the text below (Herstein et al., 2021; Nematollahi et al., 2021; Norrby, 2005). After working with IDSA to refine our search and outline the desired literature review deliverable, we incorporated content from 40 relevant journal articles and gray literature in total (listed in the Reference section below).

[10] The MedRexiv database includes preprints, defined as preliminary reports of work not certified by peer review.

[11] The Nexis Newsdesk database includes media mentions, such as news releases.

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II. Key Informant Interviews

Background

The key informant interviews within the PPNA project followed and built upon the targeted literature review.

The targeted literature review pointed to the following key findings:[12]

- During the COVID-19 pandemic, ID experts serving in healthcare settings led pandemic response efforts by fulfilling critical roles beyond their typical responsibilities, including advising healthcare organization leadership and non-ID experts, developing treatment protocols and guidelines, and training staff on PPE use when knowledge of the virus and its transmissibility was uncertain and rapidly evolving.
- The pandemic exposed several gaps within pandemic preparedness infrastructure that ID experts are uniquely positioned to help address.
- Despite the critical roles that ID experts fulfill, low compensation relative to procedural experts and other barriers have led to a slow-growing workforce, an issue that may hinder efforts to improve pandemic preparedness

After the literature review, the key question remained: Given the critical roles ID experts play in pandemic preparedness and response, what is needed to better support them in these efforts?

The key informant interviews were designed to address the following research questions:

1. What roles did ID experts play in pandemic preparedness and response within their health care organizations pre-pandemic, how did that change during the pandemic, and what do their roles look like now?
2. What roles should ID experts play in pandemic preparedness and response within their practice settings/health care organizations?
3. What helped prepare ID experts for unanticipated roles during the pandemic, and what resources or training were needed but not received?
4. How did the two-way flow of information work during the pandemic to support ID experts in their pandemic response roles, and what gaps do ID experts and other stakeholders view as priorities to improve for the future? ("Two-way flow of information" refers to (1) the flow of information from CDC through local government to health care settings, and (2) from health care settings to public health.)
5. What additional resources, training, or other support would improve ID experts' readiness to play essential roles for future outbreaks or pandemics?

Also, diversity, equity, and inclusion principles were integrated into this work in that we ensured that the set of interviews included individuals with a mix of gender identities and racial/ethnic backgrounds.

[12] Phua, S., Felt-Lisk, S., and Chen, A. (2023). Pandemic Preparedness Needs Assessment: Targeted Literature Review. Mathematica.

Types and numbers of key informants

The key informant component of the project included 41 30-minute interviews, allocated among the stakeholder groups best informed to address the research questions (Table A.2). Key informants within health care organizations were asked both about their own specific experience with each topic (see topics section below) and also about their knowledge of their colleagues' experience more broadly.

Table A.2. Number and characteristics of key informants

Type of key informants	Number of key informants (of 41)	Characteristics
ID experts	13	Included 9 ID physicians, 2 of whom were pediatric ID specialists; 3 clinical microbiologists; and one ID pharmacist. Included urban and rural locations, academic medical centers, community hospitals, private practice, underserved communities, and a mix of geographic regions. These ID physicians do not represent the "average," but are leaders in their field, well-suited to help us learn from the best.
Pandemic preparedness and response leaders from hospitals	7	Some were also ID physicians, some were other physician specialties. Many had titles similar to Chief Quality Officer. All had played major roles in shaping their organizations' response to the COVID-19 pandemic. Included those serving health systems with academic medical centers, other tertiary hospitals, community hospitals, and rural hospitals, located in a mix of geographic regions
Leaders in public health departments	7	Four local and three state public health department leaders, with varied geography and populations.
National stakeholder organizations	14	Representatives from the following: ***Health care professional associations:*** American College of Emergency Physicians (ACEP) Council of State and Territorial Epidemiologists (CSTE) National Association of County and City Health Officials (NACCHO) Association of State and Territorial Health Officials (ASTHO) Pediatric Infectious Diseases Society (PIDS) Society of Critical Care Medicine (SCCM) Society of Hospital Medicine (SHM) Society of Infectious Disease Pharmacists (SIDP) The Society for Healthcare Epidemiology of America (SHEA) ***Health care associations for relevant organizations/institutions****:* American Correctional Association (ACA) National Rural Health Association American Hospital Association (AHA) Indian Health Service (IHS) National Association of Community Health Centers (NACHC)

Topics

Four discussion guides were prepared for the key informant interviews, covering different stakeholder types:

6. Physicians and other ID experts,
7. Pandemic preparedness and response leaders from hospitals,
8. Public health departments, and
9. National stakeholder organizations.

The topics overlapped across the different stakeholder groups, in order to capture a more complete view than from any single stakeholder type. The national stakeholder organization guide was tailored to each specific stakeholder organization prior to the interview.

A list of topics to be covered in the interview for each type of key informant is provided in Table A.3.

Recruiting and scheduling

Stakeholders were identified leveraging IDSA's networks of relationships, including those of the PPNA Advisory Group, while ensuring the resulting set of invited respondents provided the diversity described above. We offered a $100 Amazon gift card after completion of the interview, to encourage participation and show respect for the key informants' time.

Once appropriate individuals were identified, an IDSA staff member sent brief background about the study, invited them to participate, and introduced the Mathematica staff who followed up to schedule the interview. These invited individuals were assured that their comments would be analyzed and reported together with many other key informants, and no quotes would be shared that could identify them.

As the interview was being scheduled, we sent the key informant a list of topics as an agenda for the meeting. Interviews were conducted on Mathematica's Webex platform and recorded, with the key informant's permission. We reminded the key informant of the scheduled interview two business days prior to the meeting to help avoid no-shows.

Prior to beginning the interviews, on June 27, 2023, we received approval of our plan by the Health Media Lab (HML) IRB.

When requested to participate, most of the contacts agreed to an interview, and participated with a high degree of engagement and thoughtful response.

Documentation, analysis, and reporting

Documentation. Mathematica used a transcription service to transcribe the recorded key informant calls. The transcripts were deidentified before being shared with IDSA and CDC for potential secondary analysis or use in publication.

Table A.3. Research topics covered in the interviews

Research question	Physicians & other ID experts (I)	Pandemic preparedness & response leaders from health care organizations (II)	Public health departments (III)	National stakeholder organizations (to be tailored to each one) (IV)
What roles *did* ID experts play in pandemic preparedness and response within their health care organizations pre-pandemic, how did that change during the pandemic, and what do their roles look like now?	Structure of emergency/ outbreak preparedness and response in the care setting, and planned role of ID expert in it • Pre-pandemic • Height of pandemic • Now Unplanned roles ID experts played Individual, care setting, or community characteristics that affected the roles	Planned and actual role of ID experts in the health care organization's COVID-19: • Preparedness • Response Current role, for future outbreaks Individual, care setting, or community characteristics that affected the roles	Role of ID experts in the community- level response to the pandemic	Typical structure of emergency/ outbreak preparedness and response in health care settings • Pre-pandemic • Now Planned and actual roles of ID experts in response Any supports the organization provided to help its members use ID expert expertise to best advantage in preparedness and response
What roles *should* ID experts play in pandemic preparedness and response within their practice settings/organizations?	Ideal roles in preparedness during non-pandemic times, include how to get ID expertise within Hospital Preparedness Programs (HPP), and leveraging their expertise for the community Ideal roles in response to outbreaks/ pandemics Ideal roles specific to certain types of ID experts, distinct due to: • Training, credentials • Personal characteristics or experience • Care setting or community characteristics	[same as column I] Ideal roles in preparedness during non-pandemic times Ideal roles in response to outbreaks/ pandemics, include how to get ID expertise within HPPs, and leveraging their expertise for the community Ideal roles specific to certain types of ID experts, distinct due to: • Training, credentials • Personal characteristics or experience Care setting or community characteristics	If ID experts played little or no role in the response: • Who used the public health information they pushed out or amplified to shape health care organization response • Ideal role of ID experts, including within HPPs.	Ideal roles of ID experts in health care settings' preparedness and response, including HPPs, and leveraging their expertise for the community Ideal role of this organization in helping their members use ID expert expertise to best advantage in preparedness and response
What helped prepare ID experts for unanticipated roles during the pandemic, and what resources, training, or support were needed but not received?	Training, experience, resources that prepared ID experts for the roles they played during the pandemic Resources, training, or support needed but not received, including emergency management and health communication training	Training and information that were needed but not received, or would have been useful earlier to support ID experts in the roles they played, including emergency management and health communication training	[not a priority topic for these key informants as the other stakeholder groups will be more knowledgeable of this topic]	[same as column II] Training and information that were needed but not received, or that would have been useful earlier to support ID experts in the roles they played, including emergency management and health communication training
How did the flow of information work during the pandemic to support ID experts in their pandemic response roles, and what gaps do ID experts and other stakeholders view as priorities to improve for the future?	Adequacy of flow of information, guidelines and resources through state and local government including health department to health care settings Adequacy of flow from health care settings to public health departments on needs and observations Priorities to improve flow in either direction	[not a priority topic for these key informants as the other stakeholder groups' responses on this topic should be sufficient]	Public health's interactions with ID experts during the pandemic • Information both to and from ID experts	[same as column I] Adequacy of flow of information, guidelines and resources through state and local government including health departments to health care settings Adequacy of flow from the health care settings to public health departments, on needs and observations Priorities to improve flow in either direction
What additional resources, training, or other support would improve ID experts' readiness to play essential roles for future outbreaks or pandemics?	To increase skillful execution of pandemic roles To help avoid burnout To help avoid unintended consequences such as rising AMR infection rates	Suggestions for preparedness information, training, or support to ID experts to better play essential roles in the future	[same as column II] Suggestions for preparedness information, training, or support to ID experts to better play essential roles in the future	[same as columns II and III] Suggestions for preparedness information, training, or support to ID experts to better play essential roles in the future

Analysis. To analyze the full set of qualitative data, Mathematica used NVivo 12 to organize the information by topical codes following the research questions. Coding query results were summarized at the paragraph level and summaries entered into a customized Excel tool and further coded after reviewing the complete summary for each topic for emerging patterns and themes. Throughout the summarizing and coding process, we kept the type of key informant (ID physicians, other ID experts, etc.) together with the information and considered it in the analysis.

Reporting. After completing the interviews, Mathematica prepared a preliminary findings PowerPoint slide deck to share with IDSA and the PPNA Advisory Group. We incorporated the key points of the discussion into a draft report, which was shared with the group before finalizing.

III. Landscape Assessment

The purpose of the landscape assessment was to identify existing pandemic preparedness programs and initiatives that disseminate education, build capacity, facilitate collaborations with local public health officials, and provide clinical support to healthcare workers engaged in pandemic preparedness efforts at the hospital and healthcare organization level.

The landscape assessment used four sources of information: an initial online search, key informant mentions followed by online search, PPNA Advisory group mentions, and the research team's own knowledge.

For the initial online search, we used the following inclusion parameters:

1. The program or initiative must explicitly include pandemic preparedness as a topic, although it may fall within the broader scope of disaster or emergency preparedness.
2. The primary focus of the program or initiative must involve providing resources or support (e.g., technical assistance, training, education, knowledge, etc.) to healthcare workers who will engage or are engaged in pandemic preparedness efforts at the hospital or healthcare organization level.
3. The program or initiative must be federal or national, spanning multiple states.

Because the set of programs and initiatives identified through the initial online search was limited, we expanded the search to solicit ideas from the PPNA Advisory Group members and utilized key informant interview suggestions. As we began preparing preliminary recommendations, we began focusing on identifying existing training and supports of the kinds that we might recommend. The research team members added other relevant initiatives as they could.

The results of the landscape assessment presented in Appendix B thus represent a collection of relevant programs, initiatives, and other existing mechanisms that should be considered as IDSA moves beyond the report phase and considers next steps to address some of the recommendations. They were not identified systematically, and represent examples rather than an inventory of all relevant initiatives: many other potentially helpful mechanisms or curricula undoubtedly exist at state or organizational levels.

Appendix B: Landscape Assessment: Existing Resources Identified for the Pandemic Preparedness Needs Assessment

The PPNA project team has been working to identify existing infrastructure, programs, and supports that should be taken into account in following up on potential recommendations to improve ID experts' and their organizations' preparedness and response prior to the next pandemic. The items identified below come from suggestions from key informants we interviewed, suggestions from PPNA Advisory Group members, and our own exploration of relevant programming and infrastructure.

The list is organized according to the goals and topics that emerged from the key informant interviews and the October PPNA Advisory Group discussion and that were used in preparing draft recommendations. The project team does not endorse any of the specific products or vendors mentioned; our goal was just to surface relevant supports.

Modifying existing regulations and guidance

Table B.1 lists existing regulations and guidance relating to emergency preparedness that could be modified to include specifically requiring the involvement of ID experts.

Table B.1. Existing regulations and guidance

Regulation or guidance	Description	Source
CMS's Emergency Preparedness Requirements for Medicare and Medicaid Participating Providers and Suppliers Final Rule	Emergency preparedness regulations that apply to all 17 provider and supplier types, including developing and maintaining emergency plans.	CMS website
Joint Commission's Emergency Management Standards*	Emergency Management standards apply to all Joint Commission-accredited hospitals and Critical Access Hospitals, including requiring hospitals to have comprehensive emergency management programs, hospital leadership to provide oversight and support of the emergency management program, and hospitals to have a staffing plan.	Joint Commission website
ASPR's Health Care Preparedness and Response Capabilities	The 2017-2022 guidance from ASPR (reaffirmed in the 2019-2023 Hospital Preparedness Program Performance Measures Implementation Guidance) describes what Health Care Coalitions under the HPP should do to effectively prepare for and respond to emergencies.	HHS website

*Other health care accreditation organizations may also have relevant sections within their guidance, we list the Joint Commission as the most frequently used accreditation organization for U.S. hospitals.

Training to support ID experts to be better prepared for the next pandemic

Enhancing fellowship training

The programs in Table B.2 concern including public health in fellowships; we would like to identify but do not know of any examples of requiring pandemic preparedness components within fellowship, or rotation to congregate care settings such as nursing homes, or other under-resourced settings, although that type of enhancement was suggested by key informants.

Table B.2. Fellowship training that includes public health

Program or support	Description	Source
Joint infectious diseases and CDC Epidemic Intelligence Service fellowship (ID/EIS) pilot program	Aims to develop future public health leaders. Combines the two-year ID fellowship and two-year EIS program for a structured four-year training opportunity.	IDSA website
Leaders in Epidemiology, Antimicrobial Stewardship and Public Health (LEAP) Fellowship	Trains ID physicians for clinical or academic careers with public health departments. Joint program offered by IDSA, SHEA, and PIDS and is funded by CDC. **Recruitment is on hold due to funding constraints**.	IDSA website
Changing program requirements for Graduate Medical Education in Allergy and Immunology to include public health	Cited by key informant as an example of what ID or ACGME could decide to do	Key informant (Existing requirements found online allow but do not require public health rotation.)

Pandemic preparedness curriculum, taking into account ID expert roles

We identified several existing, federally-funded sources of training related to pandemic preparedness, that include at least some of the components that key informants and the PPNA Advisory Group identified as important (Table B.4). Note that we provide multiple links below to Administration for Strategic Preparedness and Response (ASPR) Technical Resources, Assistance Center, and Information Exchange (TRACIE) resource collections based on the most relevant topics given our findings, however, the set of ASPR TRACIE resources is broader than just those linked below; the gateway page to all their resources is here.

As noted above, developing a curriculum for practicing ID experts should be guided by a definition of the role they are being prepared to play. Key informants and the PPNA Advisory Group suggest ID experts could take a leadership role in pandemic preparedness and response, while others need not do so, and training could be differentiated depending on which role they play. Consequently, we looked for a starting-point ID leadership role definition, and found this one from IDSA cited in Table B.3.

Table B.3. Potential role definition for ID physician executive leading pandemic preparedness and response

Program or support	Description	Source
"ID-Focused Hospital Efficiency Improvement Program" Appendix G: Specific management services – Bio-security, bio-preparedness, & emerging infectious diseases	Articulates 14 specific responsibilities an ID physician leader could take on. Dated 2016 so would need to be updated, but could serve as a starting point.	ID-Focused Hospital Efficiency Improvement Program (idsociety.org), Appendix G of the document

Table B.4. Existing training related to pandemic preparedness

Topic, and program or support	Description	Source
Leadership: SHEA/CDC Outbreak Response Training Program Joint Commission, Pediatric Infectious Disease Society (PIDS), and the American Academy of Emergency Physicians were partners.	Designed to give US hospital epidemiologists who oversee infection control programs the skills, knowledge, and tools to provide effective leadership during facility-level outbreaks and large-scale public health emergencies. Provides expert-developed guidance and resources, including incident management training, toolkits, and best practice recommendations to strengthen outbreak preparedness and response.	SHEA/CDC Outbreak Response Training Program (ORTP) | LearningCE @ SHEA (shea-online.org)
Communication: Crisis and Emergency Risk Communication (CERC), CDC	Webinars offer responders and public health professionals training and resources to communicate more effectively in an emergency. CERC trainings are based on lessons learned during public health emergencies, evidence-based practices from the fields of risk and crisis communication, and psychology. In-person training, and related manuals and tools are also available.	Webinar Archives | Crisis & Emergency Risk Communication (CERC) (cdc.gov)
Communication: Webinar on Addressing Adult Vaccine Hesitancy in the U.S.	A key informant pointed to the National Foundation for Infectious Diseases (NFID), which they said had developed programs to build skill in communicating with people who have negative attitudes toward the medical system, and referenced the lead speaker in this webinar. We surmise that this could be the webinar they were referencing, but there could be other programming we didn't find.	Key informant Addressing Adult Vaccine Hesitancy in the US – NFID
Communication: Webinar: So Whatcha Sayin'?: Pandemic Lessons on Communication Taison D. Bell, MD, University of Virginia School of Medicine, board-certified in Infectious Diseases and Pulmonary/Critical Care	The speaker has appeared multiple times on national and local TV and has developed a strong Medical Grand Rounds delivered at a number medical schools nationwide. The talk contains both research findings on effects of different communication styles on audience reactions to the information, as well as practical advice for clinicians on communicating with different audiences.	PPNA research team So Whatcha Sayin'?: Pandemic Lessons on Communication | Taison D. Bell, MD - YouTube
Incident management: Topic collection: Incident management, ASPR TRACIE	Links to incident management resources with a healthcare emphasis, though they do not guarantee all linked forms or templates are the most updated versions. Resources specific to multi-agency coordination are included because most	Incident Management | ASPR TRACIE (hhs.gov)

Topic, and program or support	Description	Source
	healthcare coalitions function in a coordination, rather than a command, role.	
Hospital Preparedness Program (HPP): Two-minute overview video and Health Care Coalitions (HCCs) page, ASPR TRACIE	The overview video offers basics about the purpose and structure of the HPP and connection to HCCs. The Health Care Coalitions page could be useful for curriculum development. It provides links to organized sets of resources including webinar/speaker series, ASPR TRACIE-developed tools and templates, topic collections, and state and local plans, tools, and templates.	Home (hhs.gov) Healthcare Coalitions | ASPR TRACIE (hhs.gov)
Pandemic preparedness in rural and congregate settings: ASPR TRACIE technical resources topic collections: Location-specific collections	Links to organized collections of resource links related to preparedness and response for settings including rural disaster health, long-term care facilities, ambulatory care and Federally Qualified Health Centers (FQHCs), alternate care sites (including shelter medical care), dialysis centers, and home care and hospice.	Technical Resources | ASPR TRACIE (hhs.gov)
Pandemic preparedness in rural communities: Rural Emergency Preparedness and Response Toolkit, supported by the federal Office of Rural Health Policy, dated November 2022.	Toolkit includes a component on infectious disease outbreaks, and some of the Case Studies section also includes case studies of how rural communities have prepared for and recovered from infectious disease outbreaks.	Emergency Preparedness and Response for Infectious Disease Outbreaks - RHIhub Toolkit (ruralhealthinfo.org)
Regional pandemic preparedness support: Northwest Healthcare Response Network	A key informant identified this program, sharing that it was helpful integrating the public health and clinical response effectively during the COVID-19 pandemic. This program engages the ID community in preparedness work and provides education to healthcare executives. It also provides plans and tools to help prepare healthcare providers for emergencies.	Key informant What We Do - NWHRN
Various, including HICS, and ethics of allocation with scarcity: National Emerging Special Pathogens Training and Education Center (NETEC, funded by ASPR)	NETEC offers many online courses for continuing education unit credit; includes courses on activating the Hospital Incident Command System (HICS)[a] and using it for recovery, and Ethical Issues in Pandemic Response, Triage, and Beyond, which address some issues raised by key informants.	NETEC
Leadership training: Trauma-informed leadership training	In light of the duration of the pandemic and the resultant stress on providers and their need for mental health support, a key informant's department had been doing trauma-responsive change and management leadership training, which had been helpful. They recommended that trauma-informed leadership training be considered, and mentioned that ASTHO and CSTE (unconfirmed) have been recommending or providing it. Trauma-informed leaders use compassion and understanding to help their people become more resilient, avoiding retriggering traumatic responses in people without sacrificing organizational goals. The key informant did not reference a vendor, but there are likely	Key informant

Topic, and program or support	Description	Source
	multiple sources that could be considered, including this one we found with a Google search.	
Health equity in preparedness and response: Topic collection: Disasters and Healthcare Disparity (ASPR TRACIE)	Includes sections with a large number of resource links on education and training, equity in incident command, guidance and frameworks; plans, tools, and templates, research, lessons learned, and agencies and organizations. The need for health equity training and infrastructure was discussed in the October PPNA Advisory Group meeting.	Disasters and Healthcare Disparity | ASPR TRACIE (hhs.gov)
Health equity assessment: Health Equity Assessment Toolkit (HEAT and HEAT Plus) (online course) (World Health Organization)	Example found by the PPNA project team of a training on assessing health equity and identifying healthcare disparities in a health care setting, using a specific tool. The need for health equity training and infrastructure was discussed in the October PPNA Advisory Group meeting. (Undoubtedly there are other trainings and tools as well.)	Health Equity Assessment Toolkit (HEAT and HEAT Plus) | OpenWHO

[a]There is also a FEMA introductory course on the Incident Command System (free), but the Hospital Incident Command System appears more relevant so we did not list the broader introductory course.

Pandemic preparedness playbook, to structure and ease ID experts' roles in the next pandemic

The PPNA Advisory Group as well as key informants raised the idea of developing a playbook for preparedness, which would ultimately need to be local, but which could potentially be shaped by a national-level outline. Table B.5 provides examples of playbooks and resources with potential content for different components within a pandemic preparedness playbook.

Table B.5. Examples of a "playbook" and programs or infrastructure related to potential components of a playbook outline

Program, infrastructure, or support	Description	Source
High-level playbook: Convening Leaders for Emergency and Response (CLEAR) Field Guide for Emergency Preparedness (American Hospital Association [AHA])	Provides actionable strategies that health care and public health can jointly implement; APHA, ASTHO, NACCHO collaborated.	AHA_ASPR_CLEAR-Field-Guide.pdf
High-level playbook: COVID-19 Vaccination Program Interim Playbook for Jurisdiction Operations (CDC)	A key informant referenced adapting a CDC COVID playbook for their needs, we think it was probably this one as we did not find any others.	Key informant COVID-19 Vaccination Program Interim Operational Guidance Jurisdiction Operations (cdc.gov)
Preparedness exercise planning: Preparedness in a Pandemic Workshop Exercise Starter Kit, FEMA	A playbook could include content on preparedness planning exercises	fema_nep-21-22-operational-coordination-communications-prep-pandemic-2021-esk-fac-guide.docx (live.com)
Models for reaching to rural or under-resourced healthcare organizations: Project ECHO, University of New Mexico Health Sciences	A playbook could include how to extend ID expertise to rural or under-resourced healthcare organizations. Project ECHO was used for this during the COVID-19 pandemic.	Key informant COVID-19 Response | Project ECHO (unm.edu)

Program, infrastructure, or support	Description	Source
Models for reaching to rural or under-resourced healthcare organizations: Center for Stewardship in Medicine, University of Washington	Collaborative that provided programming, tools, and resources to rural health organizations during the pandemic and is continuing. Others may exist as well.	PPNA Advisory Group member Coronavirus Disease 2019 (COVID-19) | Center for Stewardship in Medicine | University of Washington (uwcsim.org)
Potential for including ID experts in national rural health strategic plan: The development of the strategic plan is underway so there may be an opportunity to build in ID expertise.	The new Office of Rural Health established within CDC in 2023 is tasked with developing a strategic plan for rural health at the agency.	Key informant Merkley, Hyde-Smith Announce the Establishment of the CDC Office of Rural Health - Merkley (senate.gov)
Strengthening HCCs with additional ID expertise: Healthcare Coalition Infectious Disease Surge Annex Template Health Care Coalitions (HCCs) page, ASPR's TRACIE (also cited in Table B.3, Existing training related to pandemic preparedness)	The Infectious Disease Surge Annex Template and corresponding implementation guide were developed to assist Health Care Coalitions (HCCs) that receive federal funding to develop a complementary coalition-level infectious disease surge annex to their base medical surge/trauma mass casualty response plan. The HCC page and links could be more broadly useful in strategizing how to incorporate additional ID expertise. It provides links to organized sets of resources including webinar/speaker series, ASPR TRACIE-developed tools and templates, topic collections, and state and local plans, tools, and templates. It also links to a Technical Assistance Center where one-on-one support is available.	Step-by-Step Guide to Implementing the Coalition Infectious Disease Annex TTX Template (hhs.gov) Healthcare Coalitions | ASPR TRACIE (hhs.gov)
Mental health support/resilience resource: Caring for the Health Care Workforce During Crisis, AHA	A playbook might include defining mental health and resiliency supports for the health care workforce. It could reference resources like this learning module, as an example.	Caring for the Health Care Workforce During Crisis: Creating a Resilient Organization | Health Care Workforce | AMA STEPS Forward | AMA Ed Hub (ama-assn.org)
Facilitating cross-organization resource sharing: Medical Operations Coordinating Centers (MOCCs)	A playbook could include how key resources can be found and shared across organizations in a pandemic. MOCCs are coordination elements at the sub-state, regional, state, or federal levels that facilitate patient movement and resource allocation during a major response.	A PPNA Advisory Group Member shared an example. Lessons learned from a review of 10 MOCCs were released by ASPR TRACIE here.

Other supports to ID experts: Rapid start to research and peer sharing mechanisms

Rapid start to research and updating methods expertise of epidemiologists. The one existing federal effort we are aware of to prepare for a more rapid start to research is cited in Table B.6. While we have not discovered any national-level efforts to update epidemiological methods expertise, another research-related need identified by key informants, a key informant mentioned a free state-level course on causal

inference in California which he said 500 people had signed up for (not listed, as it was likely a one-time offering); of course, there would be many university-based offerings for a price.

Table B.6. Rapid start to research

Program or support	Description	Source
Special Pathogens Research Network, NETEC (funded by ASPR)	Under this program, NETEC works closely with 13 Regional Emerging Special Pathogen Treatment Centers and others to advance special pathogen readiness. Workgroup activities include creating a master protocol for research that allows rapid modification and review; operationalizing a central IRB for rapid turnaround of protocols, and implementing a training curriculum for research staff in a biocontainment unit using online content, available for just-in-time training.	About the Special Pathogens Research Network | NETEC

Peer sharing mechanisms. While Twitter (now X) was often used during the pandemic by ID experts, some key informants suggested that peer sharing with a little more structure would be desirable. Table B.7 describes the three other peer sharing mechanisms that have been discovered to date.

Table B.7. Peer sharing mechanisms

Program or support	Description	Source
ASPR TRACIE Information Exchange	Allows those involved in healthcare system preparedness to connect with their peers and participate in near-real time conversations about pending and actual health threats, share plans and other materials, and discuss promising practices and other information in a password-protected environment. Access is restricted to those involved in healthcare system preparedness.	Advisory Group discussion Information Exchange | ASPR TRACIE (hhs.gov)
Emerging Infections Network (EIN), IDSA	The provider-based EIN includes over 2,800 infectious disease specialists, primarily from North America, who exchange information to detect new or unusual clinical events, and gather information about clinical aspects of emerging infectious diseases.	Key informant Advisory Group discussion EIN - Emerging Infections Network (idsociety.org)
Project ECHO, University of New Mexico (also mentioned in Table 4 as a model for reaching rural and under-resourced providers)	A collaborative model, physician experts discuss cases with other physicians over video-conference, sharing, training, advising, supporting. Helps provide expert-level care to patients wherever they live. Project ECHO increases access to specialty treatment in rural and underserved areas for a variety of conditions and was used during the pandemic.	Advisory Group discussion Project ECHO | Agency for Healthcare Research and Quality (ahrq.gov)

Supporting effective two-way flow of information between public health and ID experts and their health care organizations

The supports listed in Table B.8 were well-used during the COVID-19 pandemic, and remain as mechanisms that could be used in the future. Some participants in the project noted that because it is so broad, it is not always easy for ID experts to find things on TRACIE, and the quality of the resources shared there varies.

Table B.8. National-level mechanisms

Program or support	Description	Source
Real-Time Learning Network (RTLN) and Saturday clinician calls, IDSA in collaboration with many other medical specialty societies	Platform for sharing accurate, timely information about COVID-19. Has supported tens of thousands of clinicians who have engaged with the network since its creation in 2020. An editorial team of infectious diseases and public health experts synthesizes clinical guidance, identify emerging scientific consensus and areas of ongoing uncertainty, and tackle misconceptions and disinformation. Frequent clinician calls during the COVID-19 pandemic were cited as very useful by key informants, and a chat function enabled Q&A.	Key informants Advisory Group discussion COVID-19 Real-Time Learning Network (idsociety.org)
Clinician Outreach and Communication Activity (COCA), CDC	A key goal is disseminating evidence-based health information and public health emergency messages to clinicians; the frequent COCA calls held during the pandemic were cited as very helpful by key informants, and a chat function enabled Q&A.	Key informants Home | Clinician Outreach and Communication Activity (COCA) (cdc.gov)
Webinar series', email updates and alerts from many other medical specialty societies and national-level membership organizations	Many other health professional organizations and health care organization membership organizations provided webinars, alerts, resources, and discussion boards during the pandemic (as did many state-level public health departments and policymakers)	Key informants
Technical Resources, Assistance Center, and Information Exchange (TRACIE)	The TRACIE website home page offers access to a resource library, a technical assistance center, and an information exchange.	ASPR TRACIE | Healthcare Emergency Preparedness Information Gateway (hhs.gov)

Support to expand the capacity of ID experts, reducing risk of burnout and avoiding unintended consequences

Table B.9 recognizes one new national-level vehicle to help support ID expert capacity.

Table B.9. Potential support to expand ID expert capacity

Program or support	Description	Source
PREVENT Pandemics Act (P.L. 117-328, Division FF, Title II), enacted December 2022 The act marks the first set of cross-cutting legislative reforms to address pandemic preparedness and response policy after the Coronavirus Disease 2019 (COVID-19) pandemic began.	Includes a section on recruiting and retaining the public health workforce, which includes (1) amending the current loan repayment program for health professionals in a public health agency, including raising the amount per year and adding more degree types who are eligible, and (2) establishing a pilot program known as the Bio-Preparedness Workforce Pilot Program to provide loan repayment for health professionals who have expertise in infectious disease and emergency preparedness and response activities. Applies to individuals who fulfill their service commitment in federal health care facilities, in nonprofit health care facilities located in health professional shortage areas, in entities funded by the Ryan White HIV/AIDS program or the Indian Health Service, or at any other entity determined appropriate by the Secretary.	Key informant PREVENT Pandemics Act (P.L. 117-328, Division FF, Title II) (congress.gov)

Program to encourage better preparedness for pandemics

Table B.10 recognizes an existing Centers of Excellence Program that IDSA runs that relates to, but is not the same as, a potential Pandemic Preparedness Centers of Excellence program, and also recognizes the existance of the RESPTCs, which are tasked with similar roles by ASPR as were discussed for a Center of Excellence program.

Table B.10. Centers of Excellence Program

Program or support	Description	Source
Antimicrobial Stewardship Centers of Excellence	Promotes excellence in antimicrobial use and combating antimicrobial resistance by recognizing hospitals that effectively demonstrate excellence in this work. Program defined core elements (including leadership commitment, accountability, expertise, action, tracking, reporting and education) and an application process to determine if applicant institutions meet the criteria.	Antimicrobial Stewardship Centers of Excellence (idsociety.org)
Regional Emerging Special Pathogen Treatment Centers (RESPTCs)	Thirteen RESPTCs (originally 10, beginning in 2016) have been funded by ASPR to achieve enhanced capability and capacity to care for highly infectious diseases and serve as regional hubs for the National Special Pathogen System. They provide training to healthcare organizations within a large, surrounding area.	ASPR/HHS Regional Treatment Network for Ebola and Other Special Pathogens - November 2017 (phe.gov) ASPR AWARDS $21 MILLION TO HEALTH FACILITIES TO ENHANCE NATION'S PREPAREDNESS FOR SPECIAL PATHOGENS (hhs.gov)

Current 2023 advocacy priorities for IDSA

The IDSA has the following advocacy priorities in place for 2023:

- Ensure pandemic preparedness plans center health equity and focus on the needs of all populations.
  - Advance equitable access to ID prevention, diagnosis and treatment and address factors that produce inequitable health outcomes .
- Build workforce capacity so that an adequate supply of ID clinicians, public health professionals and researchers are available to prepare and respond to pandemics.
  - ID workforce should reflect patients' diverse backgrounds.
- Ensure adequate supply chain that seamlessly facilitates distribution of vaccines, testing supplies, therapeutics and other essential medical supplies to all communities, including marginalized populations and geographically remote areas
- Support biomedical research infrastructure that ensures clinical trials involve clinicians, researchers and community members representing the population being studied or who have lived experience of the health issue.
  - Front-line ID physicians and other community clinicians should participate in trial planning.
  - Support novel strategies to make clinical trial participation more accessible for patients.
- Provide consistent, scientific guidance highlighting that the guidance is based on what is currently known and the expectation that it may change as more data becomes available to rebuild trust with the public and policymakers.
  - Leverage non-government messengers, including ID clinicians and community leaders from disproportionately impacted populations, in communicating to clinicians, public health professionals and the public.
- Strengthen public health infrastructure and facilitate data sharing among federal, state and local governments.
  - Support public health agencies with resources to automate their data monitoring and reporting systems and better access to patient-level data and demographic info to ensure equitable response and planning.
  - Use data regarding, and input from, historically marginalized populations in developing guidance and make additional recommendations for these populations where appropriate.
- Enact legislation and fund programs to address challenges related to antimicrobial resistance
  - The growing crisis of antimicrobial resistance and our insufficient antimicrobial arsenal undermine U.S. public health preparedness and significantly hamper our nation's ability to respond to a wide range of threats, including pandemics, outbreaks, natural disasters and bioterror attacks.