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Review

# What do clinicians mean by epidemics' preparedness

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ABSTRACT

*Background:* Infectious disease pandemics and epidemics pose significant global threats, and the risk of emerging infectious diseases has increased because of factors such as international connections, travel, and population density. Despite investments in global health surveillance, much of the world remains unprepared to manage infectious disease threats.
*Objectives:* This review article discusses the general considerations and lessons learned from the COVID-19 pandemic in terms of epidemic preparedness.
*Sources:* Non-systematic search on PubMed, scientific society websites, and scientific newspapers (performed in April 2023).
*Content:* Key factors for preparedness include robust public health infrastructure, adequate allocation of resources, and effective communication between stakeholders. This narrative review emphasizes the need for timely and accurate dissemination of medical knowledge, as well as addressing the challenges of misinformation and infodemics. It also highlights the importance of quick availability of diagnostic tests and vaccines, ensuring equitable access to these technologies. The role of scientific coordination in developing treatment strategies and the safety and mental well-being of healthcare workers are discussed. Lastly, it should be emphasized the need for medical training, multidisciplinary teams, new technologies and artificial intelligence, and the active role of infectious disease physicians in epidemic preparedness efforts.
*Implications:* From clinicians' perspective, healthcare authorities play a crucial role in epidemic preparedness even by providing resource management plans, ensuring availability of essential supplies and training, facilitating communication, and improving safe infection management. **Michele Bartoletti, Clin Microbiol Infect 2024;30:586**


## Epidemic preparedness: general considerations

Infectious disease (ID) pandemics and epidemics are important and continuous global treats. In the last century, the risk of emerging IDs has increased steadily in parallel with the increase of international connections and travels, over boundary trades, and livestock husbandry. In addition, epidemics and pandemics waves are associated with the increasing human population density and changing interactions between humans and wild animals [1]; in fact, if compared with the beginning of the 20th century, the global population has triple its size, reaching 8 billion of individuals in 2022 [2].

Despite significant investments in global health surveillance and capacity building, large parts of the world are unprepared to manage ID threats. Epidemic preparedness reflects the capacity of institutions—public health authorities, health systems, and emergency response bodies—to detect, report, and respond to outbreaks to minimize possible health and economic impact [3].

First of all, key factors for epidemic preparedness include the ability of public health infrastructure to guarantee surveillance and effective tracing in case of ongoing infectious processes. Second, investments in public health systems should guarantee the adequate resource for any potential health crisis [4]. Finally, ensure the communication between stakeholders is essential to obtain

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adequate risk management and diffusion of updated medical knowledge.

Because of the importance and complexity of this topic, most of available guidance and documents were developed and focus on epidemic preparedness from a national and international level. In this narrative review, some perspectives of clinicians that were on the frontline during the last COVID-19 pandemic are reported and discussed in the view of potential future epidemics.

## Epidemic preparedness: lessons learned from the past

The current COVID-19 pandemic is an important stress test for many healthcare systems and their preparedness for epidemics. However, as discussed in the following paragraphs, the lesson learned from COVID-19 may be useful to provide better response to next possible pandemics (Table 1).

## Clinician perspectives

Several pitfalls emerged in most pandemic epicentres since the initial phases of the COVID-19 pandemic: alarming reports from frontline clinicians described extreme shortages of drugs, ventilators, and intensive care unit beds. In fact, in a qualitative study based on interviews to groups of clinicians between April and May 2020, the most important themes emerged regarding the management of resource limitations were (a) planning for crisis capacity, (b) adapting to resource limitation, and (c) barriers to care delivery [5].

Accordingly, to manage these weaknesses of the healthcare systems, the pre-establishment of algorithms and institutional protocols, clearly describing allocations of resource, could be ensuring for physicians and may provide the best quality of care to all patients. The development of these guidelines should involve team leaders and expert of triage (e.g. intensivist and emergency department doctors) along with doctors involved directly in patients care (e.g. ID and pulmonology) [5].

Another important factor was the correct dissemination of knowledge. During the recent pandemic, we learnt that novel scientific findings from clinical studies may be available in very fast manner. For instance, pre-print articles and press release became rapidly and widely available without proper description of data [6,7]; in this scenario, to distinguish between good-versus bad-quality data could be very difficult, and misleading information from studies with methodological flaws may not be rejected.

Along with this challenge, also the phenomenon of infodemic should be considered [8]: on the one hand, it contributes to misleading information; on the other hand, it leads to mistrust in doctors, healthcare workers (HCWs), health authorities, and destabilizes the public health response. The misuse of hydroxychloroquine, azithromycin, and ivermectin are only some examples of drugs that were widely used (and in some cases still used) but no longer recommended by nearly all guidelines [9–11]. Sadly, the current COVID-19 pandemic also demonstrated the unpreparedness of collectivity to understand the scientific debate, based on data and opinion exchange: the unfiltered information often resulted in either incorrect or malevolent misinterpretations when exposed to public scrutiny.

## Diagnostics and vaccines availability

As demonstrated by several pandemics, especially those caused by viral infections, such as Influenza or COVID-19, key factors for outbreaks control are quick availability of diagnostic tests and vaccines: in case of new health emergencies, ensuring timely development and availability of new health technologies is critical.

However, even for well-known pathogens, these technologies could not be widely available when needed, or they could come in later phases of the outbreak, or their access could be jeopardized on the territory, especially if not supported by health authorities [12]. Referring to COVID-19 outbreak, the significant global morbidity and mortality associated with the risk of economic and social well-being fall, sped up political efforts for vaccine development and distribution at unprecedented levels [13]. In fact, the SARS-CoV2 pandemic has transformed 'research and development' (R&D) of new diagnostic tests and vaccines in a commercial priority for several pharmaceutical industries. However, this highly profitable

**Table 1**
Pivotal weaknesses evidenced from previous pandemics

| Epidemic preparedness: lessons learned from the past | Pivotal weaknesses evidenced from previous pandemics | Main publications on the topic |
|---|---|---|
| Clinician perspectives | Inadequate financial resources to establish epidemics infrastructure and unpreparedness of medical and nurse staff<br>Distinguishing between good- versus bad-quality data was very difficult because of fast articles release and availability without proper peer review processes<br>Occurrence of the phenomenon of infodemic, demonstrating the unpreparedness of collectivity to understand the scientific debate | [6,7,13,15] |
| Diagnostics and vaccines availability | Absence of expanded and clearly defined roles for laboratory and diagnostic systems in infectious disease preparedness plans<br>In low- and middle-income countries, the access to diagnostic tests and vaccination is still profoundly uneven because of the insufficient economic investments | [14,15,30] |
| Collective scientific coordination for development of treatment strategies | Absence of shared diagnostic and treatment guidelines (or guidance documents) developed through a dynamic, collaborative planning process; frequent fragmentation of knowledge and spreading of misconceptions<br>No coordinate multinational research groups that could perform *in vitro* and *in vivo* studies in a timely way<br>Scarce oversee of methodology and design of studies to guarantee that they address the urgent clinical questions | [7,9–13,17] |
| Ensuring safety of healthcare workers | Lack of multidimensional approach to ensure mental well-being of the healthcare workers, including safety policies, guidelines, staff testing, and staff illness protocols<br>Paucity of pre-established pathways to short- and long-term mental health services to effectively handle depression and post-traumatic stress disorder | [21,23–27] |

market opportunity will probably fall back into an area of marketing failure when massive public investments and other policy interventions will be reduced.

As an example of this possible scenario, in low- and middle-income countries, the access to diagnostic tests and vaccination is still profoundly uneven because of the insufficient economic investment, leading to inequity to the population health and a significant impact on economic recovery [14].

Therefore, this recent pandemic taught us the importance of coordinate public investments and policies to guarantee the wide access to diagnostic tests and vaccines, as well as R&D support at any level, including long-term financial sustainability of vaccines and diagnostics development [15].

## Collective scientific coordination for development of treatment strategies

In responding to severity of SARS-CoV2 disease, several scientific societies tried to develop effective treatment strategies, including both non-pharmaceutical interventions (e.g. appropriate use of non-invasive and ventilation techniques) and pharmaceutical guidelines. However, excluding the very early weeks of pandemic, there was a subsequent development of multiple treatment strategies and guidance documents, mainly based on expert opinions and small case series, often burdened by serious methodological flaws [7]. As a consequence, several drugs were used on patients without sufficient data on their efficacy causing more harms than benefits [8–10].

Accordingly, this recent pandemic taught how expert opinions and articles published on scientific journals as well as congresses could serve as tools to exchange knowledge but also as weapons to spread misconceptions [16]. In this sense, the role of scientific societies in future pandemics should focus on: (a) define which type of pharmaceutical interventions may be adequately supported by data and could be tested in clinical studies; (b) oversee the methodology and design of studies to guarantee that they address the urgent clinical questions; (c) coordinate the establishment of multinational research groups that could perform *in vitro* and *in vivo* studies in a timely way; (d) secure the optimal distribution and application on data deriving from studies and ensure development of further studies and interventions. These activities are important both to spread correct knowledge and facilitate optimal allocation of treatments.

However, it is easier said than done. When serious epidemics arise, and thousands of people get infected and hospital collapse under the request of assistance, coordinate and collaborative works become very difficult. Hence, a serious responsibility is needed from clinicians, academic, and public researchers, often competing for funding and resources, to conduct their activity bringing only the positive aspects of competitivity and ensuring harmony and reciprocal correctness toward the production of high quality and effective studies.

## Ensuring safety of HCWs

The role of HCWs in epidemics and pandemics emergency is pivotal. Sadly, many doctors, nurses, and assistants lost their lives during the first waves of COVID-19 pandemic. According to WHO data, it was estimated that between 80,000 and 180,000 HCWs could have died because of COVID-19 since the beginning of the pandemic [17]. Similarly, in the recent Uganda Ebola outbreak, up to 40% of infected HCWs died: importantly, the estimated risk of death in HCWs was significantly higher if compared with the general population. Similar data were recorded during the past Ebola outbreaks: 0.11% of Liberia's entire general population had died because of Ebola, as compared with 8.07% of its health workers [18]. Hence, it is not surprising that in the recent COVID-19 pandemic, most HCWs experienced insecurity explained by inadequate availability personal protective equipment (PPE), the insufficient resources, and the inconsistent information [19].

Another important aspect that should be ensured to face pandemics is the mental well-being of the HCWs. Preventive strategies of mental health disorders should be quickly implemented in case of pandemics, based on lessons learned from the past.

For instance, overtiredness because of intense and unanticipated workload both during initial and later phases of pandemics should be taken in account. In addition, during the COVID-19 pandemic, HCWs were involved in important ethical decision and triage on life-support in critical patients [20]. This factor associated with the shortage of drugs, PPE, and the physical risk of contracting the infection contributed to an increase of psychological disorders [21]. Studies that explored this issue have reported a prevalence of anxiety, depression, and sleep disturbance of 29–37%, 28–35%, and 40–43%, respectively [22,23].

Consequently, a multidimensional approach should be structured to ensure mental well-being of the HCW, including both the promotion of a better self-care and the access to mental health services and social support.

At first, discussing about prevention, the basic component of well-being that should be guarantee is the full meeting of physiological daily needs, such as nutrition and hydration, adequate level of fitness, rest, and sleep [24]. However, because of shortage of staff and overworking, these self-care aspects could often be underrated for HCW. Accordingly, ensuring these self-care daily needs, even in dedicated places within the healthcare setting could be an effective preventive strategy [25].

On the other side, discussing about treatment of health disorders, providing psychological care is also pivotal. This should be made through several actions, such as early identification of 'at-risk' subjects, predisposition of available psychological or psychiatric support to HCWs, and active monitoring subjects exposed to a potentially traumatic event [25,26].

## Epidemic preparedness: moving forward

In the following paragraphs, the clinician's perspective of principal needs for facing future pandemics are reported (and summarized in Fig. 1).

## The role of medical training and multidisciplinary teams

One of the major issues of the recent pandemic was the unpreparedness of medical and nurse staff. Indeed, the sudden succession of events of the SARS-CoV2 pandemic had imposed on several health systems to provide a dramatically high number of health care professionals, able to face a completely 'new' disease [27].

To be prepared for future pandemics, the importance of medical and nurse training should improve with the following aspects of knowledge: (a) definition and description of known data about the pathogen, along with the routes of transmission, the diagnostic tools, and the syndromic pictures; (b) description of the main infection control and prevention strategies and/or other protection measures; (c) how to identify the official information sources; and (d) communication strategies for the population and information for health education by health professionals. Finally, all these information should be made available through different ways, including residency training, remote training courses, scientific meetings and webinars, and updated scientific papers dissemination [28].

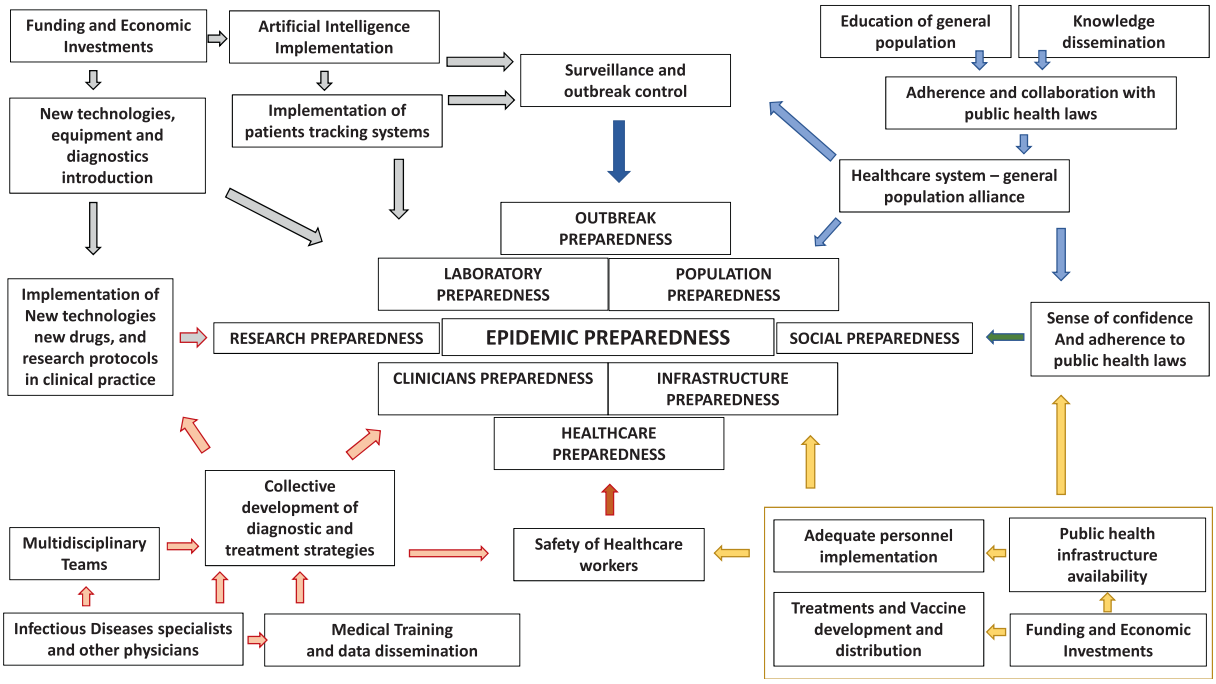


**Fig. 1.** Overview of key factors to be considered in pandemic preparedness and their interconnections.

However, medical training alone is not enough. Indeed, another unique challenge during pandemic/epidemic ID is that medical and diagnostic innovations can only be clinically tested during an outbreak; and this should occur as normal part of medical assistance. Hopefully, this should occur in parallel in several fields of assistance and research, including basic sciences, diagnostic, medical, and surgical specialties. This requires a strong and coordinated activity between several physicians, nurses, and researchers.

To address challenges in pandemic waves, it is crucial to strengthen clinical and research activity through multidisciplinary groups during peaceful times. This proactive approach ensures effective work even when healthcare systems are under pressure. Prioritizing multidisciplinary teams as a public health-driven strategy enables them to provide training, assistance, and research during emergencies.

## The role of new technologies, equipment, and artificial intelligence

To be prepared for future ID outbreaks, the pivotal aspects are the timely identification of the pathogen and the subjects exposed to it, the tracking and mitigation of spread within the community (to break the chain of transmission), the implementation of appropriate treatment for infected patients, and, finally, the risk communication to the public [29,30].

Notably, accuracy and quickness of many of these interventions rely on availability of dedicated and efficient technologies and equipment. For example, during the recent Lassa fever epidemic [31] or the current COVID-19 pandemic, several technologies, including the wider implementation of older equipment (e.g. polymerase chain reaction for pathogens detection) or the use of new methodologies (e.g. artificial intelligence) had a great impact on detection, tracking, and spread mitigation of viruses [32].

Overall, it is important to say that this topic covers many areas of pandemic response, and going outside the clinician point of view is not the scope of this work. However, by only considering clinical aspects, it is currently clear that the implementation of advanced technologies and artificial intelligence is pivotal to achieve several medical objectives during epidemics: (a) diagnosis of infected subjects in a timely and efficient way; (b) faster and more correct collection of patient's data; (c) detection, tracking, and quarantine of infected persons to reduce the spreading of the pathogen; and (d) help medical doctors and nurse in decision making and clinical monitoring [33].

In sum, to be prepared for future pandemics, health professionals should be timely trained to implement and use new technologies either as a way to strengthen their ability to diagnose, monitor, and treat a new infectious pathogen or as a way to improve clinical data storage, decision making, or choice of future research projects.

## The role of ID doctors

ID physicians are involved in both direct care and programming activities focused on prevention, teaching, and management of infections in most hospitals worldwide. Many studies have demonstrated that ID physicians provide important value especially when involved in management of infections in a large number of scenarios [34–44].

During the COVID-19 pandemic, ID staff faced an extreme working overload, which was associated with a high level of mental stress and anxiety, as described below. In this scenario, many antimicrobial stewardship principles were disregarded with consequent increase of use of unnecessary antibiotic treatment and occurrence of outbreaks of multidrug resistant pathogens [45,46]; indeed, the aforementioned workforce shortages also affected the ID specialists.

Importantly, despite being one of the most consulted doctors in many hospitals, the overall number of ID physicians is not keeping

up with the need. For example, the average number of ID doctors in European countries may vary between 4 and 53 per million of inhabitants [47]. Similarly, in the US, the national average density was 1.76 ID physicians per 100,000 persons in the 2017 with high disparity between different counties [48].

To be prepared for future pandemics, it is time to reconsider the role of ID specialists within hospitals and within the epidemic response teams. In fact, the most interesting aspect of the studies previously cited [7,12–14,36,44] was the role of ID physician not only limited to one specific task, such as diagnosis or treatment of infections. The most beneficial implementation of ID specialists was their complete inclusion in all the decision-making phases of the process of care of patients.

Hence, taking into consideration the other aspects of epidemic preparedness elucidated in previous paragraphs, it is clear that within the continuum of actions that health authorities should implement, it is fundamental that ID physicians should be precisely allocated to ensure their maximal efficiency without the risk of working overload and staff exhaustion.

## Final remarks and conclusions

In our view, healthcare authorities play a crucial role in epidemic preparedness. They should provide a risk management plan for effective resource, diagnostic, and personnel management. These plans should ensure availability of PPE, diagnostics, treatments, and provide emergency training. Communication among public health authorities, hospitals, clinicians, and the scientific community should be facilitated to disseminate quality information, protocols, and optimize patient management. Hospitals and clinicians must be adaptable, participate in studies, and address mental health needs of HCWs. In addition, plans are needed to improve the quality and quantity of ID physicians for better infection management and leadership.

## Author contributions

MB, LB, DFB, and VC contributed in conceptualization, literature search, writing, review, and editing the manuscript.

## Transparency declaration

### *Conflict of interest*

MB reports consulting fees from Pfizer, AstraZeneca, MSD, and Gilead; payment honoraria for lectures from Pfizer, MSD, and Gilead; and participation to advisory board for Pfizer, AstraZeneca, MSD, and Gilead. All other authors have nothing to disclose.

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