Global Health Security Challenges in times of pandemic: Access to Personal Protective Equipment in the Covid-19 Crisis[1]

Desafios da Segurança da Saúde Global em tempos de pandemia: O acesso a Equipamentos de Proteção Individual na crise da covid-19

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Abstract

This article addresses the precariousness of the Global Health Security system, focusing on the distribution of Personal Protective Equipment (PPE) during health crises and taking the COVID-19 pandemic as a departure point and a center. The shortage of PPE was exacerbated by factors such as the high transmission rate of the virus, inadequate training on its use and disposal, flexibility in guidelines regarding prolonged use and reuse of equipment, and restrictions on the export of healthcare products. The collapse of the global PPE supply chain has exposed frontline healthcare workers, especially in low- and middle-income countries, due to inadequate healthcare infrastructure and socioeconomic disparities. The lack of effective action to maintain and equitably distribute existing PPE stocks further exacerbated their shortage, compromising the effective response to the pandemic. To strengthen the resilience of healthcare systems, strategies need to be developed to ensure safety and equity in the global supply chain of healthcare products, with interconnected and redundant networks of suppliers. International collaboration and investments in multilateral mechanisms play a crucial role in building a more resilient Global Health Security.

Keywords: Global health; Pandemics; Supply Chain; COVID-19; Global Health Security.

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Resumo

Este artigo aborda a fragilidade do sistema de Segurança da Saúde Global, enfocando a distribuição de Equipamentos de Proteção Individual (EPI) durante crises sanitárias e tendo como foco e ponto de partida a pandemia de covid-19. A escassez de EPI foi agravada por fatores como alta taxa de transmissão do vírus, falta de treinamento adequado sobre seu uso e descarte, flexibilização das diretrizes de uso prolongado, reutilização do equipamento e restrições à exportação de produtos de saúde. O colapso da cadeia de suprimentos globais de EPI expôs os profissionais de saúde na linha de frente, especialmente em países de baixa e média renda, devido à infraestrutura de saúde inadequada e à disparidade socioeconômica. A falta de ação efetiva para manter e distribuir equitativamente os estoques de EPI existentes exacerbou sua escassez, comprometendo o enfrentamento eficaz à pandemia. Para fortalecer a resiliência dos sistemas de saúde, é necessário desenvolver estratégias para garantir a segurança e equidade na cadeia de suprimentos global de produtos de saúde, por meio de redes interconectadas e redundantes de fornecedores. A colaboração internacional e investimentos em mecanismos multilaterais desempenham um papel crucial na construção de uma Segurança da Saúde Global mais resiliente.

Palavras-chaves: Saúde Global; Pandemia; Cadeia de Suprimentos; Covid-19; Segurança da Saúde Global.

Introduction

The health emergency caused by COVID-19, in the field of Global Health Security, brought the issue of access to Personal Protective Equipment (PPE) to the center of the debate, generating broad sociopolitical discussions regarding the topic. During the pandemic, there were significant shortages of PPE in many countries around the world, which created challenges in providing medical services and controlling the spread of the disease.

At the beginning of the crisis, in February 2020, the World Health Organization (WHO) already warned of insufficient global stocks of PPE, especially medical masks and respirators, and predicted that there would soon also be a shortage of aprons and protective glasses. The WHO prematurely warned that rising global demand would be driven not only by the number of COVID-19 cases, but also by misinformation, panic, and irrational stockpiling of PPE, resulting in an acute shortage of such equipment across the world. The ability to expand PPE production is limited, so it would not be possible to meet the demand for respirators and masks, especially if their widespread and inappropriate use continued (WHO, 2020).

Addressing access to PPE during the COVID-19 crisis is essential for understanding the factors that negatively impact the fight against the pandemic. This article is characterized as a narrative literature review essay, of an exploratory and descriptive nature, of a qualitative type, with the selection bibliographic materials on the subject, published in scientific databases. As the crisis intensified, global healthcare systems became overwhelmed with potentially infected patients. Pessa Valente et al. (2020) point out the two main problems related to the topic: the shortage and inadequate use of PPE. They say frontline healthcare workers are dangerously ill-equipped, due to decades of lack of adequate investment in the public health sector, limited access to PPE, and a lack of adequate training.

The demand generated by the health urgency and panic behavior in the market have depleted PPE stocks around the world. In Brazil, the chronic problems of financing and access to health supplies via the

Unified Health System (SUS) were worsened by a profound global health crisis and severe disruptions in the global PPE supply chain. This article presents, through a literature review, an analysis of the challenges faced by Global Health Security in the context of the COVID-19 pandemic, focusing on access to PPE.

By exploring the importance of access to PPE, the authors sought to identify factors that affect the supply chain during a health emergency and the dynamics that contribute to its disruption during health crises. They also highlight the inappropriate use of equipment and the lack of adequate training as additional challenges that impact access and safety for healthcare professionals and the community. Finally, the authors aimed to comprehensively present the impacts of PPE shortages on the global response to the crisis. This process brought to light issues related to inequality in access to equipment, disparities between countries, and the influence of market behavior amid panic.

Global health and the use of PPE

In Brazil, the definition and regulation of PPE are established by Regulatory Standard No. 6 (NR-6), of Ordinance no. 3,214, of June 8, 1978, from the Ministry of Labor. According to the standard, PPE is considered to be any device or product for individual use used by workers, intended to protect them against risks that may threaten their safety and health in the work environment. The equipment must be for individual use and have a Certificate of Approval (CA), which attests to its effectiveness in protecting against agents that are harmful to health. PPE provided to healthcare professionals must have adequate characteristics to ensure compliance and effective use.

Several events highlighted the importance of PPE for healthcare professionals. Examples of this are the Severe Acute Respiratory Syndrome (SARS) epidemic in 2003; the H1N1 Influenza pandemic in 2009; the sarin gas attack on the Tokyo subway in 1995; the bombing of the Murrah Federal Building in Oklahoma City in 1995; and the terrorist attacks of September 11, 2001, in the USA. These situations highlighted the adverse effects on the health of the professionals involved, due to the lack of adequate PPE or its inappropriate use. In addition to highlighting the critical importance of using PPE in crisis and disaster response operations (Eyre; Hick; Thorne, 2016).

In the context of the COVID-19 pandemic, the highest viral load of the SARS-CoV-2 virus is found in sputum and upper airway secretions. Respiratory secretions are considered the main means of transmitting the virus, including the possibility of transmission through aerosols generated during certain procedures (MS, 2020). In this context, health professionals involved in combating the pandemic must wear protective glasses or a face shield, long-sleeved clothing or overalls with waterproof feet and hood, waterproof aprons, and respirators.

Furthermore, additional precautions are necessary to protect healthcare professionals and prevent transmission in the workplace, including the appropriate selection of PPE, as well as training for its use, correct removal, and proper disposal, in accordance with safety standards, as these materials are considered potentially contaminated (Jessop et al., 2020). It is equally important to understand the purpose of using PPE as part of a system to reduce cross-transmission of the disease between patients and healthcare professionals (Cook, 2020). Table 1 briefly presents relevant aspects related to the use of PPE during Covid-19.

Table 1 – Aspects about PPE related to Covid-19

1	COVID-19 is predominantly transmitted by contact or droplet transmission.
2	COVID-19 can be aerosolized through aerosol generation procedures, enabling airborne transmission.
3	PPE is just one part of a system to protect staff and other patients from the transmission of COVID-19.

continues...

Table 1 – Continuation

4	Recommendations for PPE use by international organizations are broadly consistent; however, the correct use of PPE by professionals is not consistent.
5	Proper use of PPE significantly reduces the risk of viral transmission and infection.
6	PPE must be compatible with the potential mode of viral transmission – contact, droplet, or airborne
7	Only airborne PPE includes an FFP3 mask, and this is reserved for aerosol generating procedures.
8	Excessive use of PPE is a form of misuse.
9	Improper use of PPE depletes limited supplies, leads to avoidable shortages, and increases risk to personnel.

Source: Cook, 2020 .

In the same sense, Li et al. (2021), in a meta-analysis study, found that the use of face masks reduced the risk of COVID-19 infection among healthcare workers by 70% (Li et al., 2021). Hajiabdolbaghi et al. (2022) also pointed out that the use of PPE by healthcare professionals was associated with a drastic reduction in positive results in rapid diagnostic tests for COVID-19.

In a Cochrane collaboration review study, Jefferson et al (2023) pointed out that the use of masks in the community probably has little or no effect on the spread of the SARS-CoV-2 virus. In short, the work evaluated 12 individual clinical studies to compare the use of masks with their absence, in which participants should have been subject to strict control. However, the researchers themselves pointed out flaws in monitoring participants and missing important information, such as the quality of the masks, duration of use, adherence, and correct use by adults and children.

Additionally, most studies were carried out in different periods of high and low circulation of the influenza virus, with only one study conducted during the COVID-19 pandemic. Thus, almost all domains of the Cochrane risk of bias assessment instrument were scored as high.

These limitations in the review study, including the methodology used in the evaluated studies, the low adherence to the use of masks by many populations and the inconsistent or incorrect use of the protective item interfere with the results on efficiency, so that the methodology used by the review from Cochrane does not present conclusive results to answer whether masks work as a public health measure.

On the contrary, the appropriate use of PPE is seen as the best way to prevent the risk of COVID-19 infection among healthcare workers. For this reason, the US government, for example, issued an informative report with best practices for national implementation and guidance on the use of PPE, with the aim of ensuring the protection of healthcare professionals during the response to the coronavirus pandemic (HHS; FEMA, 2020). In Brazil, the Ministry of Health published a document called "*Recomendações de proteção aos trabalhadores dos serviços de saúde no atendimento de Covid-19 e outras síndromes gripais*" (Recommendations for the protection of health service workers in the care of COVID-19 and other flu syndromes), in April 2020, following the guidelines of the National Health Surveillance Agency (Anvisa) and consulting experts in the field (MS, 2020).

The document sought to assist health services and their workers in implementing actions and strategies to minimize exposure to respiratory pathogens, especially the new coronavirus. Furthermore, it listed the PPE that should be made available by services and used by health professionals responsible for treating suspected or confirmed cases of COVID-19, providing protection recommendations for health workers when handling cases (MS, 2020).

In aerosol-generating procedures, such as intubation or tracheal aspiration, non-invasive ventilation, cardiopulmonary resuscitation, manual ventilation before intubation, sputum induction, nasotracheal sample collections, and bronchoscopies, the use of surgical masks or respirators with filtration efficiency of 95% is recommended for particles up to 0.3µ, such as N95, N99, N100, PFF2, or PFF3 masks.

The Ministry of Health's recommendations are not limited to professionals who care for COVID-19 cases, but also apply to all health service workers, including those who perform support functions, such as receptionists, security guards, cleaning staff, and cooks. (MS, 2020). These workers must use appropriate PPE according to the environment in which they work, including the use of surgical masks, if necessary.

In addition to the use of PPE, the US Centers for Disease Control and Prevention (CDC) highlight the importance of common practices to protect healthcare workers and prevent the spread of infection. This includes respiratory hygiene, cough etiquette, proper placement/isolation, handling and cleaning of equipment, devices, clothing, and patient care environments, as well as safety protocols for needles and sharps.

The CDC has identified three operational levels of approach to the use of face masks: conventional, contingency, and crisis. In conventional mode, face masks are used routinely to protect healthcare professionals from infections caused by splashes and aerosols. In contingency mode, there is stress on the healthcare system. Thus, the CDC (2022) recommends conserving resources by selectively canceling non-emergency procedures, postponing non-urgent outpatient care that may require face masks, and prolonging the use of face masks for extended periods if possible.

In crisis mode, like the COVID-19 pandemic, the CDC (2022) recommends canceling all elective and non-urgent procedures, as well as outpatient appointments in which face masks are normally used, use of face masks beyond the manufacturer-designated shelf life during patient care activities, limited reuse, and prioritization of use for activities or procedures where splashes or aerosols are likely. The entity even recommended the use of homemade masks, including headbands or scarves, when surgical masks were completely unavailable.

The risk of infection and its consequences are well-recognized components of occupational risk for healthcare professionals. However, they are magnified during the emergence of epidemics. The infection of healthcare professionals reduces the healthcare system's capacity to provide care, especially in times of pandemic, when it is already overloaded. During the new coronavirus pandemic, Italy recorded one of the highest numbers of infections: almost 10% occurred in healthcare professionals. Only 13% of doctors in the country reported having access to PPE whenever they needed it (Savoia et al., 2020).

Excessive fear of contagion influenced professionals' perception of which PPE would actually be necessary to provide adequate protection, which worsened the shortage of this equipment on the market. Often, perceived needs were not always in line with the real needs for their tasks. Martin-Delgado et al. (2020) pointed out that almost half of professionals who did not perform aerosol-generating procedures reported complaints due to lack of protective glasses or N95 respirators. This finding highlights the lack of dissemination of clear information about the correct use of PPE. Using a different or higher level of protection than necessary is a form of misuse and tends to reduce the supplies available to healthcare teams in the future.

Lack of appropriate information for healthcare workers may be one of the causes of the increase in the number of infected professionals (Martin-Delgado et al., 2020). Receiving correct information about the use of PPE influenced risk perception among professionals contracting the infection. In this way, access to adequate information about the use of PPE was associated with a better ability to perform donning and doffing procedures (Savoia et al., 2020). Therefore, although it is necessary to increase PPE supplies for healthcare professionals, adequate training and clear instructions are equally important to ensure safety when dealing with infectious diseases, such as COVID-19.

The global shortage of PPE

As the pandemic spread, shortages of personal protective equipment for healthcare workers became a critical concern. Healthcare systems around the world have operated above maximum capacity for months in a row. According to modeling carried out by the WHO, it would be necessary to provide 89 million surgical masks, 76 million procedural gloves, 1.6 million protective glasses and 30 million aprons

monthly to health workers to combat COVID-19 (Jessop et al., 2020).

On May 28, 2020, the NGO Doctors Without Borders (MFS - *Médecin sans Frontière*) issued a press release calling for the PPE market to be regulated. The document reported that the COVID-19 pandemic caused shortages and increased prices of equipment, especially that needed to protect front line health professionals in facing the crisis (Burki, 2020).

These professionals are considered one of the most vulnerable and susceptible populations to becoming ill and transmitting COVID-19 infection. In China, where the pandemic began, 3,300 infected healthcare professionals were reported early. In July 2020, European countries had already recorded much higher numbers. In nine countries (Denmark, Germany, Hungary, Ireland, Italy, Russia, Spain, Turkey, and Ukraine), more than 150 thousand healthcare professionals had been infected by the Sars-CoV-2 virus, and it is estimated that the number in Europe has exceeded 200 thousand (EPSU, 2020).

In Brazil, the *Conselho Federal de Enfermagem* (Cofen - Federal Nursing Council) reported, in April 2020, the lack of PPE was registered in around 4,800 reports made by nurses since the beginning of the pandemic. In the same period, more than 4,600 sick days were recorded due to "flu-like symptoms" and 32 deaths occurred among nurses, numbers significantly higher than usual trends (Cofen, 2020).

While the production of medical equipment is dominated by a small group of multinational companies from European countries and the USA, the production of PPE has been massively displaced and outsourced to low-cost countries (Morales-Contreras; Leporati; Fratocchi, 2021), with China as the world's largest manufacturer. Before the pandemic, it was responsible for half of the world's supply of surgical masks and was the only place capable of mass-producing clinical gowns (Ranney; Griffeth; Jha, 2020).

Therefore, the acute shortage of PPE that characterized the early stages of the pandemic was likely inevitable. Chinese production is normally interrupted for a period of 10 to 14 days due to the Chinese New Year celebrations. In 2020, the festivities coincided with an explosion of COVID-19 cases in the country, additionally, public health policies that were introduced in response to the emergence of COVID-19 prevented many workers from returning to their factories (Burki, 2020).

Consequently, PPE exports from China were halted as the infection spread domestically in the country and around the world. Disruptions to global supply chains, international travel restrictions, unusually high demand, slow release of stockpiles from previous pandemics, and confusing and ever-changing guidelines on PPE have led to worldwide shortages of this equipment for healthcare workers (Jessop et al., 2020).

Disruptions in the global PPE supply chain, combined with a lack of effective global action to maintain, manage, and equitably distribute existing stocks, have exacerbated the problem of global access to equipment, especially in low- and middle-income countries. While discussions about equitable access to vaccines, medicines, and diagnostics have been held over the past decade, the same level of attention has not been given to PPE (Burki, 2020).

Faced with the increase in cases and deaths from COVID-19 among health professionals in the Americas, the Pan American Health Organization (PAHO) issued an alert to governments, highlighting the need to strengthen the capacity of health services at all levels and ensure the provision of PPE and training for everyone. However, Latin America faces significant challenges due to the heterogeneity of social development and economic growth, as well as the lack of adequate preparation of its health infrastructure to deal with the pandemic. Delgado et al. (2020) point out that seven in ten healthcare professionals in Latin America reported limited access to essential PPE and low support from health authorities, who should ensure them access to diagnostic tests and adequate PPE during the COVID-19 pandemic.

A PAHO report (2020) indicated that global PPE stocks would be insufficient, especially for surgical masks and respirators, with imminent shortages of surgical gowns and protective glasses expected. The growing demand, driven not only by the increase in the number of COVID-19 cases, but also by the panic and misinformation that led to the stockpiling and excessive purchase of these products,

has further worsened their insufficiency around the world. The capacity to expand PPE production is limited, and the demand for surgical masks and respirators cannot be met, especially due to the widespread and inadequate use of these equipment (OPAS, 2020).

In addition to severe shortages of PPE, Martin-Delgado et al. (2020) pointed to the lack of adequate training in infection prevention and use of PPE, as well as the absence of testing and isolation protocols readily available to healthcare professionals in Ecuador, Brazil, and Colombia. Only two in 10 professionals who performed high-risk procedures in these countries reported having adequate access to PPE in their workplaces.

Recognizing the Americas as the most unequal region on the planet, with historical social determinants that hinder or prevent the adoption of basic prevention measures against COVID-19, especially with regard to the most vulnerable populations, the Inter-American Commission on Human Rights launched, in April 10, 2020, a standard entitled "Pandemic and Human Rights in the Americas" (Resolution no. 1, of October 27, 2020), recommending that governments, among other measures, "Immediately adopt an intersectional human rights approach in all of their government strategies, policies and measures to deal with the COVID-19 pandemic and its consequences, including plans for social and economic recovery." (OEA, 2020; our translation).

Despite the spotlight on the COVID-19 pandemic, little is known about the coping and mitigation process in long-term care services (LTCS) for older adults in Latin America (LA), and little attention has been given to these institutions in Brazil. LTCS are home to thousands of older adults, and are considered social assistance structures. However, there is a lack of national operating standards for these services and provision of physical structure, human resources, or equipment to offer specific health care to residents (Watanabe; Domingues; Duarte, 2020).

According to Watanabe, Domingues and Duarte (2020), these institutions find it very difficult to acquire and maintain stocks of PPE for older adults and employees. In the same vein, Wachholz et al. (2020)[2] pointed out that the availability of PPE and testing capacity for SARS-Cov-2 proved to be quite unsatisfactory in LTCS in Brazil.

Overall, although the use of health services decreased by around a third during the pandemic, mainly among people with less severe illnesses (Moynihan et al., 2021), the lack of global coordination to combat the pandemic resulted in a near-complete collapse in supply chains for PPE, diagnostics, and other essential items in early 2020.

The global PPE supply chain

The speed at which the disease spreads has placed enormous pressures on healthcare systems around the world. Disruptions to the global PPE supply chain caused by the Covid-19 crisis have had a devastating impact on healthcare supply chains, leading to a drastic and unbalanced reduction in global supply availability. This shortage has compromised the provision of healthcare services and put lives at risk around the world, clearly highlighting the need to establish practices to ensure the sustainability of the supply chain, especially in relation to healthcare supplies.

Unequal access to medical supplies, including diagnostics and treatments, poses significant challenges for low- and middle-income countries (WHO, 2021). This disparity in purchasing power, coupled with trade barriers and insufficient domestic production capacity, results in severe shortages of essential medical supplies in resource-limited countries (WHO, 2021).

The pandemic crisis had direct effects on three dimensions of supply chains: supply, demand, and logistics (Raj et al., 2022). Multinational companies initially faced a supply shock. When the infection spread across India, for example, mask exports stopped to meet domestic demand. At the same time, several companies faced a demand shock. An increase in demand for essential products was observed; while, on the other hand,

2 WACHHOLZ, P. A. et al. Facing the pandemic of Covid-19 by the managers of care homes for older people in Latin America, 2020. In SciELO Preprints.

concerns were raised about delayed deliveries, delays in securing goods, unforeseen travel disruption, and labor shortages caused by contact restriction measures and reverse migration of city workers (Raj et al., 2022).

In the logistics dimension, pre-pandemic discussions on inventory management, centered on management strategies to reduce costs and increase efficiency, proved to be insufficient to deal with extreme events, such as the COVID-19 pandemic. The crisis highlighted the need to adopt new risk management and mitigation strategies to ensure the resilience of global supply chains (Raj et al., 2022).

Disruption in the healthcare supply chain directly affects the continuity of healthcare services and has serious consequences for human lives. PPE shortages have led to the adoption of product reduction, reuse, and replacement practices to address the lack of adequate supplies. This shortage, combined with confusing and constantly changing guidance, has resulted in anxiety and confusion among healthcare professionals (Hajiabdolbaghi et al., 2022).

Thus, the global shortage of PPE has led several countries to adopt practices of reducing, reusing, and replacing standard equipment with products of lower quality and/or not approved by manufacturers. These practices aimed to guarantee the continuity of health care, despite failing to maintain protective effectiveness, due to damage from long period of use and sealing problems (Valero et al., 2021).

As a COVID-19 mitigation strategy in a resource scarcity scenario, Liao et al. (2020) found methods that would allow the safe reuse of N95 respirators. In turn, Kampf et al. (2020) proposed the adoption of a risk analysis for the use of PPE in a scenario of scarcity of such equipment, in order to guarantee adequate treatment for patients and compatible protection for healthcare professionals for as long as possible without interruption (Kampf et al., 2020).

Alternatively, Bione et al. (2021) presented initiatives by professionals and companies related to 3D printing of equipment for frontline healthcare workers. These applications in these initiatives, especially the sharing of programs and products, made important contributions to public health during the period of the COVID-19 pandemic. Several studies consistently demonstrate that both industrially manufactured protective barriers and those produced using low-cost 3D printers are significant devices that act as a barrier to droplets and allow the protection of healthcare professionals against COVID-19 infection (Peccin et al., 2022).

Global preparedness and mitigation strategies

The pandemic has revealed the need for more effective global coordination to tackle public health crises. The lack of international cooperation has resulted in a breakdown in supply chains, making it difficult to access the necessary resources around the world. The scientific community quickly realized that the pandemic caused by Sars-CoV-2 would pose a significant health challenge for our generation. In addition to the disease's high speed of spread and its ability to cause complex and often fatal conditions, there was a lack of scientific knowledge about its epidemiological, pathophysiological, microbiological, and immunological aspects.

Assessing the international community's preparedness and response capacity to mitigate pandemic crises is a complex task. The Global Health Security Index (GHSI) was established with the aim of assessing the response capabilities of countries to outbreaks of infectious diseases that can lead to epidemics and pandemics, posing threats to global security. Developed by the Nuclear Threat Initiative (NTI) and the Johns Hopkins Center for Health Security (JHCHS), in partnership with the Economist Intelligence Unit (EIU), the GHSI is a comprehensive assessment of the health security of 195 countries that have adhered to the International Health Regulations (IHR).

The GHSI uses a broad set of publicly available quantitative data to measure the institutional capacity of the health sector to deal with health risks. It analyzes 34 indicators and 140 questions, divided into six categories: prevention, detection and notification, rapid response, health system, compliance with international standards, and risk environment. Each component is evaluated on a scale of 0 to 100, with 100 indicating the best health conditions. The aim of the GHSI is to stimulate debate and promote changes in relation to national health security in confronting

outbreaks of infectious diseases that can evolve into epidemics and pandemics.

GHSI results revealed wide variation across countries in terms of capacity to prevent, detect and control outbreaks, with around half of countries reporting operational readiness capabilities to respond to public health emergencies. Surprisingly, countries better ranked in the index, such as the USA and the United Kingdom, had catastrophic results in facing the COVID-19 pandemic. On the other hand, countries such as Vietnam and New Zealand, with relatively low GHSI ratings, have demonstrated superior performance in mitigating pandemic impacts.

The COVID-19 experience has shown that existing metrics to assess the health system's ability to prepare for and respond to pandemics are insufficient to predict outcomes in critical events. This indicates the need to give greater weight to other areas in preparedness efforts. The GHSI showed no significant associations with standardized infection rates or fatality rate (Covid-19 National Preparedness Collaborators, 2022). It is important to highlight that the index prioritizes biomedical variables of epidemiological surveillance, which may partially explain the countries' classifications. Many are struggling to maintain or develop their national preparedness capabilities, primarily due to a lack of resources, competing priorities, and high health worker turnover.

While the GHSI fails to adequately assess preparedness for health crises, measures such as trust in government and interpersonal trust, as well as low levels of government corruption, have shown statistically significant associations with lower standardized infection rates. Likewise, low levels of government corruption are related to greater reductions in mobility and greater COVID-19 vaccination coverage (Covid-19 National Preparedness Collaborators, 2022).

Cohen and Rodgers (2020), when investigating the reasons behind the severe shortage of PPE in the US during the COVID-19 pandemic, argued that the lack of effective action by the federal government in maintaining and distributing national stocks, along with disruptions in the global PPE supply chain, worsened the crisis. The US is the world's largest importer of face masks, protective glasses, and medical gloves, making the country highly vulnerable to disruptions in exports of medical supplies. The authors concluded that market prices are not adequate mechanisms to regulate health inputs—which are global public goods.

In fact, according to the WHO, since the start of the COVID-19 outbreak, PPE prices have increased significantly. Surgical masks increased sixfold, N95 respirators tripled in price and gowns doubled in value. It is estimated that global PPE production would need to increase by 40% to meet global demand at the start of the pandemic (OMS, 2020). This situation highlights the challenges faced by health systems in accessing PPE and essential supplies, especially in low- and middle-income countries, worsening inequalities and extreme income concentration.

With the aim of reducing inequalities across countries in the Americas, PAHO established the Pan American Health Organization Strategic Fund, officially called the "PAHO Regional Revolving Fund for Strategic Public Health Supplies." This regional fund allows for the joint procurement of essential medicines and strategic public health supplies for countries in the region. Its purpose is to improve access to these items with quality, safety, and effectiveness, while promoting efficient and sustainable health systems.

The PAHO Strategic Fund 2020 Annual Report outlines a series of actions. As of December 31, 2020, it placed purchase orders worth more than $235 million in medicines and supplies, including supporting national COVID-19 responses and sending diagnostic kits, PPE and essential medicines to patients on intensive care. The main focus of the PAHO Fund was to mitigate COVID-19 related supply chain disruption for essential medicines needed in priority programs such as HIV, tuberculosis, and malaria, as well as ensuring accessibility to medicines to maintain the quality of health services (PAHO, 2021).

Final considerations

This article presents evidence-based reflections indicating that efficient preparation and response to health crises go beyond a country's biomedical

and technical capabilities. Furthermore, the need for investments in health infrastructure, robust supply systems, and strategies to reduce inequalities are fundamental to ensuring an effective response in crisis situations. The COVID-19 pandemic has brought us important lessons, as well as challenges that must be faced to improve global health security and strengthen health systems' resilience to future health emergencies.

Trust in government, international cooperation, transparency, and adaptability are crucial aspects of dealing with pandemics and public health emergencies. However, reflections regarding the existence or not of differences in access and use of PPE due to national leaders in denial have a dimension and complexity that are beyond the scope of this essay, deserving further in-depth study that cannot be covered in this analysis, suggesting subsequent studies to explore the issue.

The COVID-19 pandemic has starkly exposed the fragility of the global health system, highlighting the devastating social and economic repercussions that a health crisis of global proportions can cause. The sharp increase in the number of cases overwhelms the healthcare system, leading to shortages of essential medical resources. At the same time, demand for healthcare supplies exceeds production capacity, resulting in a shortage of supply for healthcare professionals.

During the COVID-19 crisis, healthcare professionals who are on the front lines of fighting the pandemic stood out as a group at high risk of infection. Direct contact with infected patients, the intense workload, and constant changes in guidelines and protocols, together with the shortage of PPE, have made these professionals more vulnerable, increasing their anxiety and other mental health problems, in addition to resulting in an alarming number of preventable infections and deaths.

This situation has been exacerbated by several factors, such as the high transmission rate of the virus, shortages of PPE for healthcare workers, lack of adequate training on the use and disposal of PPE, and relaxation of guidelines on the prolonged use and reuse of protective equipment. Once infected, they become potential asymptomatic transmitters, spreading the virus to other professionals, patients, communities, and family members. Low- and middle-income countries still face greater challenges due to chronic inequities in access to healthcare.

The lack of effective action to maintain and equitably distribute existing stocks further aggravated the problem. As the pandemic accelerated, PPE shortages resulted in regulations to prohibit the export of products that could jeopardize domestic supply, resulting in asymmetries in global access to healthcare inputs, exacerbating structural inequalities in the field of Global Health and challenging governments, institutions, and professionals to find solutions to mitigate the shortage of health products. Low- and middle-income countries, such as those in Latin America, have been particularly affected by the lack of access to PPE, due to their inadequate healthcare infrastructure and heterogeneous social and economic development.

Investment in multilateral mechanisms for joint resource acquisition and management, such as the PAHO Strategic Fund, can play a crucial role in strengthening health systems in a post-pandemic scenario. To redesign a Global Health Security framework that is more resilient in the face of health emergencies, technological, managerial, and governance innovations are needed that connect health systems and develop integrated and sustainable global health supply chains.

It will be essential to develop appropriate strategies to keep the global supply chain of health products safe, fair, and equitable. It is crucial to prioritize new projects that reduce the logistical dependence of the healthcare supply chain, opting for interconnected and redundant networks of suppliers in order to avoid sudden interruptions in supply that could result in a lack of care and an increase in infections and preventable deaths.

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Contribution of the Authors

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