

The difficulty in supplying health products amid the COVID-19 pandemic*La dificultad de abastecer productos sanitarios en medio de la pandemia de COVID-19**A dificuldade no abastecimento de produtos para saúde em meio à pandemia da COVID-19***Lisandra Rodrigues Risi^{1*}**

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The aim was to investigate the impact of the difficulty in supplying hospital supplies during the COVID-19 pandemic. This was an integrative literature review with a qualitative approach. The articles were collected from the following databases: Latin American and Caribbean Literature in Health Sciences and the National Library of Medicine, available in the Virtual Health Library. Fourteen articles addressing the shortage of healthcare products during the COVID-19 pandemic were selected for analysis. Among the 14 articles, four answered the guiding question: "What difficulties were encountered during the pandemic that led to disruptions in the supply of hospital supplies?" There is a need to formulate an action plan for future emergency situations, such as ensuring transparent communication with the population to reduce panic, limiting the purchase of essential supplies to ensure everyone has access, and developing other strategies to ensure future preparedness.

Descriptors: Health Products; Logistics; Scarcity; COVID-19; Shortages.**Resumen**

El objetivo fue investigar el impacto de la dificultad en el suministro de insumos hospitalarios durante la pandemia de COVID-19. Se realizó una revisión bibliográfica integradora con un enfoque cualitativo. Los artículos se recopilaron de las siguientes bases de datos: Literatura Latinoamericana y del Caribe en Ciencias de la Salud y la Biblioteca Nacional de Medicina, disponibles en la Biblioteca Virtual en Salud. Se seleccionaron para su análisis catorce artículos que abordaban la escasez de productos sanitarios durante la pandemia de COVID-19. De los catorce artículos, cuatro respondieron a la pregunta clave: "¿Qué dificultades se encontraron durante la pandemia que provocaron interrupciones en el suministro de insumos hospitalarios?". Es necesario formular un plan de acción para futuras situaciones de emergencia, como garantizar una comunicación transparente con la población para reducir el pánico, limitar la compra de insumos esenciales para garantizar el acceso universal y desarrollar otras estrategias para garantizar la preparación futura.

Descriptores: Productos para la Salud; Logística; Escasez; COVID-19; Escasez.**Resumo**

Objetivou-se investigar o impacto causado pela dificuldade do abastecimento de materiais hospitalares durante a pandemia da COVID-19. Trata-se de uma revisão integrativa da literatura de abordagem qualitativa. O levantamento dos artigos ocorreu nas seguintes bases de dados: Literatura Latino-Americana e do Caribe em Ciências da Saúde e *National Library of Medicine*, disponíveis na Biblioteca Virtual em Saúde. Foram selecionados 14 artigos para análise que abordassem o desabastecimento dos produtos para a saúde durante a pandemia da COVID-19. Dentro dos 14 artigos, foram encontrados quatro artigos que responderam à questão norteadora: "Quais as dificuldades encontradas durante a pandemia que acarretaram a ruptura do abastecimento da logística de materiais hospitalares?". Há a necessidade de formulação para elaborar um plano de ações para futuras situações emergenciais, como ter uma comunicação transparente com a população diminuindo o pânico causado, limitar a compra de insumos essenciais a fim de garantir que todos tenham acesso e elaborar outras estratégias para que estejamos preparados no futuro.

Descritores: Produtos para Saúde; Logística; Escassez; COVID-19; Desabastecimento.

Introduction

The novel coronavirus, called SARS-CoV-2, which causes COVID-19, had its first case recorded in December 2019 in the city of Wuhan. The virus, which belongs to the Coronaviridae family, causes a variety of diseases in humans and animals, especially in the respiratory tract¹.

On March 11, 2020, the Director-General of the World Health Organization (WHO) declared the new coronavirus a pandemic². In Brazil, the first recorded case of coronavirus was in February 2020 in the state of São Paulo. To prevent contamination, the Ministry of Health recommended that the population follow basic hygiene measures, such as washing hands with soap and water, using disposable tissues for nasal hygiene, and avoiding touching eyes, nose, and mouth without clean hands³. COVID-19 has had a global impact, due to the reach of the disease and the speed at which it spread⁴.

Even in the first months of the pandemic, international authorities warned about the risk of shortages of health products, due to the excessive increase in the consumption of personal protective equipment (PPE) and medications associated with the treatment of COVID-19. The lack of these supplies hampered the fight against the novel coronavirus, as the shortage of materials, such as medications, hampered care for patients, and without PPE, healthcare professionals were exposed. This shortage contributed to the deaths of many people, including many healthcare professionals. In the current context, dynamic and innovative inventory management strategies are crucial to ensure the safety and quality of care for patients and healthcare workers⁵.

RDC No. 185, of October 22, 2001, defines health products as equipment, apparatus, material, article or system for medical, dental or laboratory use or application, intended for prevention, diagnosis, treatment, rehabilitation or contraception and which does not use pharmacological, immunological or metabolic means to perform its main function in human beings, but may, however, be assisted in its functions by such means^{6,7}.

This study is relevant to research, as it provides updates on the topic. This not only contributes to the appropriate measures but also influences further research on the topic. For healthcare professionals, who, as managers, must be involved in the logistics of healthcare products, understanding the difficulties that led to the disruption in the supply of hospital materials can influence processes in these sectors. For healthcare providers, identifying the problem allows for the establishment of actions to address it and improve care conditions^{7,8}.

During the residency, which took place amid the COVID-19 pandemic, the challenges associated with the shortage of healthcare products became clear. Many processes were postponed and even reinvented to meet the demand for medical supplies, resulting in losses for healthcare professionals and users. This led to the following question for formulating the research strategy: "What challenges were encountered during the pandemic that led to disruptions in the supply of hospital supplies?" Thus, this research focuses on healthcare product shortages during the

Methodology

This integrative review research will be conducted through the following steps: developing a question for the database search strategy; literature search; article selection; data extraction; methodological quality assessment; data synthesis; evidence quality assessment; and writing and publishing the results. An integrative literature review is a research approach that follows specific protocols and seeks to understand and make sense of a large body of documentation, specifically by determining what works and what doesn't in each context⁹.

In the first stage, the guiding question was developed with the help of the PICO strategy, where P is population or problem, I is intervention, C is comparison, and O is outcome, being: P – Hospital Materials; I – Materials Logistics; C – Not applied; O – Supply Disruption.

In the second stage, a literature search was conducted in the following databases: Latin American and Caribbean Literature in Health Sciences (LILACS) and National Library of Medicine (MEDLINE), available in the Virtual Health Library (VHL).

The descriptors used were determined by the Health Science Descriptors (DeCS) tool, with five descriptors chosen: "COVID-19"; "SARS-CoV-2"; "Hospital Materials Management"; "Outage"; and "Product Distribution." The Boolean operator "AND" will be used to cross-reference the descriptors. The literature search and article selection will take place between August 2021 and February 2022.

The inclusion criteria used are full articles that fully address the topic of the study; articles in English, Portuguese, or Spanish; and articles published in the last five years. The exclusion criteria are articles that do not address the proposed topic.

In the third stage, the articles were selected. The first stage consisted of reading only the titles of the retrieved documents. The second stage involved reading the abstracts of the retrieved documents. The third stage involved a general critical analysis of the retrieved documents. The selection process followed the methodological recommendations of the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) standards.

In the fourth stage, after critical analysis of the selected articles, the studies were classified by author, title, year of publication, language, and results presented.

Results and Discussion

Fourteen (14) articles addressing health product shortages during the COVID-19 pandemic were selected for analysis. One article was from the LILACS database, and thirteen (13) from the MEDLINE database. Of the fourteen (14) articles, thirteen (13) were in English and one (1) was in Portuguese. Two (2) articles addressed the shortage of protective masks, seven (7) articles addressed the shortage of medications, one (1) article addressed the cancellation of large-scale elective surgeries, one (1) article addressed the quantity of personal protective equipment consumed before



and during the pandemic and its budgetary impact, and three (3) articles addressed the supply chain. The 14 selected

Flowchart 1. Search and selection of studies. Rio de Janeiro, RJ, Brazil, 2023

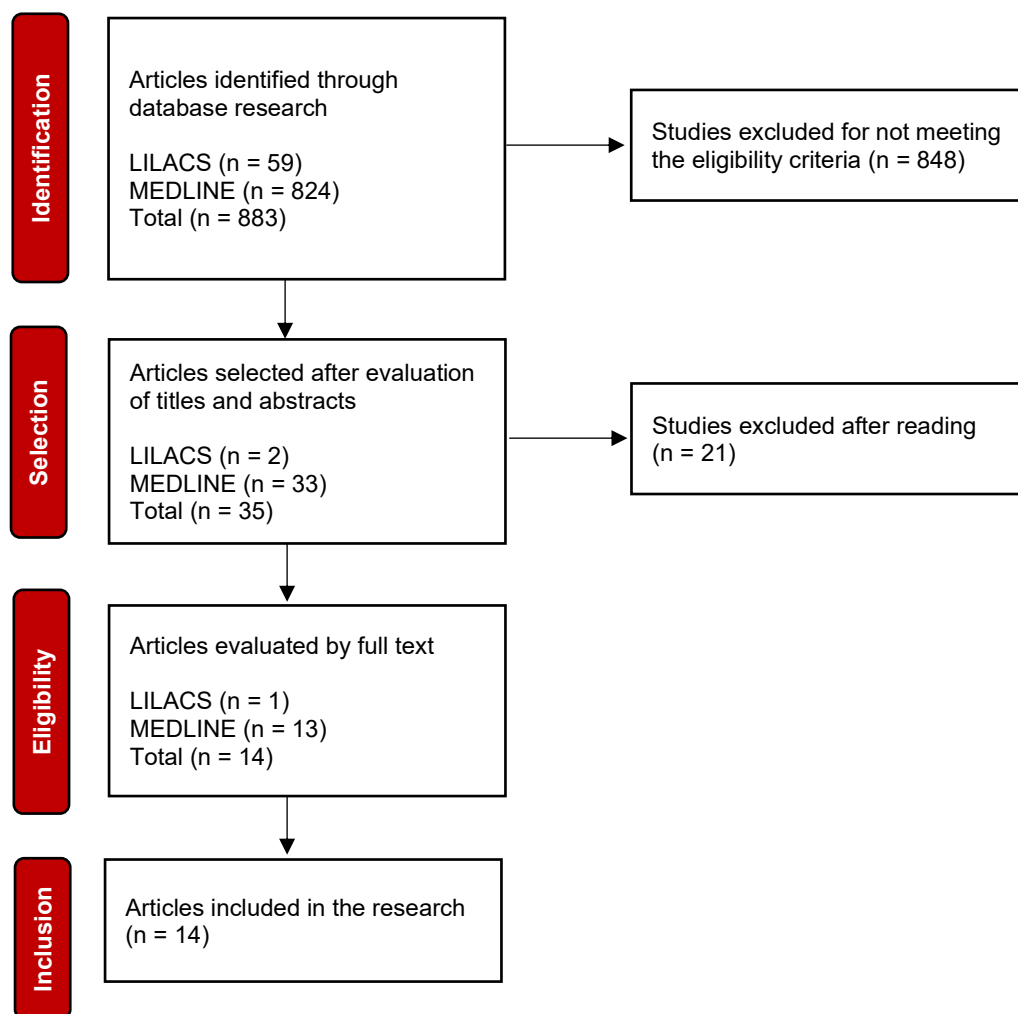


Chart 1. Studies selected for review. Rio de Janeiro, RJ, Brazil, 2023

Author	Year	Title	Language	Results
Melman, G J; Parlikad, A K; Cameron, E A B.	2021	Balancing scarce hospital resources during the COVID-19 pandemic using discrete-event simulation	English	The simulation model enabled analysis of resource allocation strategies. The most important conclusion is that the capacity to treat patients is greater in a baseline scenario; the worst-case scenario results in at least 20 times more cc rejections. Furthermore, the fencing strategy results in 10% more surgeries, but 50% more rejections. These results expose the context of multidisciplinary optimization: maximizing the number of surgeries performed while minimizing the number of rejections.
White, Anne M; et al.	2021	Get Me a Mask! The Challenge of Equipment Supply Chains	English	We identified four recommendations that can help address these inequities: implementing and supporting sustainable and effective reprocessing, empowering frontline innovation, advocating for ethical and transparent equipment donation, and supporting local and equitable corporate supply chains.
Snowdon, Anne W; Saunders, Michael; Wright, Alexandra.	2021	Key Characteristics of a Fragile Healthcare Supply Chain: Learning from a Pandemic	English	The findings suggest that healthcare supply chain fragility contributes to substantive challenges across healthcare systems, limiting or precluding proactive and comprehensive responses to pandemic management.
Silva, Karen A; et al.	2021	Impacto orçamentário na compra de equipamentos de proteção individual para enfrentamento da COVID-19	Portuguese	All items analyzed showed a significant increase in quantity used and, especially, in purchase price, reaching a 525% increase compared to pre-pandemic months. The increased costs were related to product shortages in both the domestic and international markets.
Kuo, Shihchen; Ou, Huang-Tz; Wang, C Jason.	2021	Managing medication supply chains: Lessons learned from Taiwan during the COVID-19	English	Strategies have been documented and recommended in Taiwan and the United States to mitigate drug shortages and ensure long-term drug quality and safety. Barriers to access medicines are nothing new, but the COVID-19 pandemic presents urgent and even new challenges to the stability and



		pandemic and preparedness planning for the future		integrity of the drug supply, necessitating a rethink and strengthening of effective pharmaceutical product management strategies.
Romano, Sónia; et al.	2021	Time-trend analysis of medicine sales and shortages during COVID-19 outbreak: Data from community pharmacies	English	The pandemic resulted in a surge in demand for medicines and reported shortages during the initial stages of the outbreak. The peak rate of drug sales was recorded on March 13, 2020, four days after the WHO declared COVID-19 a pandemic. By the end of March, sales had already fallen to similar levels to those of 2019. The peak rate of drug shortages was reached approximately one week after peak sales, and by the end of the study period, it was below pre-COVID-19 levels. The drugs analyzed were paracetamol, ascorbic acid, dapagliflozin plus metformin, rosuvastatin plus ezetimibe, formoterol, and hydroxychloroquine, as these pharmaceuticals recorded the highest growth rate in sales and shortages compared to the same period the previous year. Hydroxychloroquine exhibited the most diverse trends in sales and shortage patterns.
Sen-Crowe, Brendon; McKenney, Mark; Elkbuli, Adel.	2021	Medication shortages during the COVID-19 pandemic: Saving more than COVID lives	English	A report of 44,672 confirmed COVID-19 cases suggests that 6,168 (14%) patients suffered from severe hypoxic respiratory failure and 2,087 (5%) required mechanical ventilation. When ventilated, patients often require varying amounts of sedation and/or analgesia, depending on their condition. For example, fentanyl is commonly used for analgesia, while propofol is used for sedation. Additionally, midazolam can be infused if heavy sedation is required. These medications are essential not only for patient comfort but also for minimizing the risk of self-extubation. However, all three medications are currently in short supply.
Badreldin, Hisham A; Atallah, Bassam.	2021	Global drug shortages due to COVID-19: Impact on patient care and mitigation strategies	English	In addition to the shortages caused by the increased demand for repurposed drugs, the fact that many drugs and raw materials are sourced from countries like India and China has also caused direct shortages. The pharmacist can navigate alternative therapeutic options alongside other members of the healthcare team until the shortage is resolved.
Kirubarajan, Abirami; et al.	2020	Mask shortage during epidemics and pandemics: a scoping review of interventions to overcome limited supply	English	Of the 11,220 citations in the database, a total of 47 articles were included. These studies covered six broad categories of conservation strategies: decontamination, reuse of disposable masks and/or extended use, layering, reusable respirators, non-traditional replacements or modifications, and stored masks. Promising strategies for mask conservation in the context of pandemics and epidemics include the use of stored masks, extended use of disposable masks, and decontamination.
Ayati, Nayyereh; Saiyarsarai, Parisa; Nikfar, Shekoufeh.	2020	Short and long term impacts of COVID-19 on the pharmaceutical sector	English	The short-term impacts of the COVID-19 pandemic include changes in demand, regulatory revisions, changes in the research and development process, and changes in telecommunications and telemedicine. Furthermore, slowing industry growth, approval delays, a shift toward self-sufficiency in the pharmaceutical production supply chain, and changing trends in healthcare product consumption, along with ethical dilemmas, can be anticipated as long-term impacts of the COVID-19 pandemic on the pharmaceutical sector at both the global and local levels.
Shuman, Andrew G; Fox, Erin R; Unguru, Yoram.	2020	COVID-19 and Drug Shortages: A Call to Action	English	Despite the incremental increase in demand for scarce products, including medications, the current pandemic will invariably alter the structure and composition of the workforce, as staffing shortages may also be present. Pharmacists must work not only to keep up with increased medication needs but also to engage with physicians to identify and provide reasonable alternatives. Online resources for monitoring and responding to medication shortages can help with these tasks.
Piatek, Olga Iwona; Ning, James Chien-Min; Touchette, Daniel R.	2020	National drug shortages worsen during COVID-19 crisis: Proposal for a comprehensive model to monitor and address critical drug shortages	English	The FDA's Drug Shortage Task Force identified lower-priced drugs and sterile injectables as potential targets for drug shortages. Recommendations to address the shortages included taking steps to increase understanding of the reasons for shortages and procurement practices; developing a drug quality measurement and management system; and considering new procurement approaches to help ensure reliable supplies.
Mirchandani, Prakash.	2020	Health Care Supply Chains: COVID-19 Challenges and Pressing Actions	English	Healthcare requires five categories of products: pharmaceuticals, personal protective equipment, medical devices, medical supplies, and blood. Each of these categories has a distinct supply chain, and failure in any of these chains can wreak havoc on the healthcare system.
Zeidel, Mark L; Kirk, Carolyn;	2020	Opening Up New Supply Chains	English	To assess demand levels for various products, M-ERT consulted purchasing officials from BIDMC and other institutions. The team is now assessing the amount of PPE and other materials that will be needed in Massachusetts



Linville-Engler, Ben.				next year. The Commonwealth helped prime the pump by placing strategic orders for goods, including 3 million gowns, to enable these Massachusetts-based supply chains to become permanent. Manufacturers also sell products directly to healthcare providers, first responders, and other buyers.
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Among the 14 articles, four directly answered the guiding question: "What difficulties were encountered during the pandemic that led to disruptions in the supply of hospital supplies?" Four articles address the challenges faced by healthcare professionals and users of healthcare systems. Six articles offer recommendations that can help in future crises.

One such study addresses the impact of the pandemic on the pharmaceutical sector through increased hospitalizations, the incidence of COVID-19-related pneumonia, and the increased demand for assigning patients to ventilators, contributing to shortages of related prescription drugs¹⁰. Healthcare supply chain crises have occurred in the past, such as during the Ebola outbreak, where the supply chain was unable to support an effective response during the major outbreak in 2014–2016. Another example was the H1N1 influenza pandemic in the US, when there was a significant shortage of N95 respirator masks and face shields. This brings us to six characteristics of supply chain fragility: decentralized and distributed supply chain management; limited or no supply capacity to manage a surge in demand; dependence on a single jurisdiction or supplier sourcing; lack of supply transparency; lack of product and product data standardization; and a reactive pandemic response strategy¹¹.

A study characterizing outpatient medications sold out during the pandemic in Portugal shows that the largest increase in medication sales occurred shortly after the WHO declared COVID-19 a global pandemic. This growth may be due to the population's lack of awareness of the pandemic's consequences and fear of going into lockdown. People began stockpiling in anticipation of potential drug shortages, hindering access. Some measures were taken to prevent drug hoarding, such as recommending that users purchase only one package of medication and having it delivered to their homes to prevent patients from hoarding medications or visiting the pharmacy too frequently, potentially exposing themselves to the coronavirus¹².

Another article discusses the challenges healthcare professionals faced in adapting to changes and maintaining safety standards with limited supplies of N95 masks and other PPE, and how the shortage of these materials cost the lives of professionals around the world¹³. One of the causes of the PPE shortage was that the world's largest producer was the epicenter of the disease. The shortage was also caused by misinformation and panic, which led the population to buy products out of control¹⁴.

The risk of drug shortages has affected patients because, due to the lack of commonly used medications, alternative drugs may be prescribed with less efficacy or put the patient at greater risk of developing unwarranted adverse effects and increasing the risk of drug overdose due to changes in concentrations. Prolonged shortages can

increase the risk of patient deterioration, worsen disease severity, postpone or cancel essential surgical procedures, prolong hospital stays, and increase mortality rates¹⁵. The study also shows that shortages of neonatal resuscitation equipment contribute to disparities in neonatal and infant mortality¹³.

During the COVID-19 pandemic, healthcare systems were under immense pressure, and governments introduced public health measures to slow the spread of infection. However, these measures were aimed at COVID-19 patients, and non-COVID-19 patients continued to require urgent care¹⁶. The shortage affects not only COVID-19 patients, but also patients with common illnesses who require medications, such as patients with heart disease, autoimmune diseases, and cancer patients, and this shortage can result in preventable deaths¹⁷.

There are five categories of products essential to the proper functioning of the healthcare system, and action plans are in place to address the crisis. Within pharmaceutical products, the immediate action plan is to monitor the supply of medicines and ensure transparent access that will provide advance warning of any distribution disruptions.

A long-term solution is to develop a dual supply chain in which three-quarters of domestic demand is met by domestic production. This will improve the traceability, resilience, and responsiveness of our pharmaceutical supply chain. For medical devices, we must create a more agile supply chain by improving product design and judiciously relaxing underlying regulations. For medical supplies developing contingency plans for medical supplies will help us better prepare for the next deadly virus. For blood, a decentralized collection system with centralized storage and distribution to handle demand variability across hospitals appears to be the most viable option.

In PPE, a long-term action plan would be a carefully maintained emergency stock, rotated to keep the stock fresh, which will prevent this situation from happening again¹⁸. There have been some adjustments to the recommendations for the use of PPE, such as N95 masks, which now allow for prolonged use and/or limited reuse, when acceptable, prioritizing use for people at higher risk of contracting the virus and allowing replacement every 30 days or when they are damp/damaged¹⁴.

In response to the critical shortage, the Massachusetts Technology Collaborative (MassTech) formed a team to help Massachusetts-based manufacturers open new supply chains and produce materials needed to combat the pandemic. The Manufacturing Emergency Response Team (M-ERT) helped develop domestically produced supplies of NP swabs, face shields, isolation gowns, face masks, and disinfectants. It also accelerated production of new ventilators, is helping establish a



domestic source for ventilator filters, and created a plan for rapid ventilator fulfillment¹⁹.

An article presents promising strategies for mask preservation during the pandemic, such as the use of stored masks, the prolonged use of disposable masks, and the most effective method, decontamination with UV radiation (15 W 254 nm lamps for 15 minutes). Strategies considered less effective were the use of cloth masks, layering multiple surgical masks, or re-donating previously used masks that were not sterilized²⁰.

Other actions to mitigate the COVID-19 pandemic crisis and address future challenges include participating in your organization's drug shortage task force or scarcity rationing committee to provide frontline insights and recommendations for management alternatives and strategies, and staying up-to-date on the most current drug shortage information²¹. Some recommendations can help in addressing this, such as implementing and supporting sustainable and effective reprocessing; empowering frontline innovations; advocating for ethical and transparent equipment donations; and supporting local and equitable corporate supply chains¹³.

Before the COVID-19 crisis, Taiwan established early preparedness and contingency plans to address potential drug shortages. This included creating an information network, including an online platform for public reporting of drug shortages, and immediately activating an assessment and management protocol to identify alternative drugs and therapeutic approaches. The government provides updated information through various

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channels, holding conferences and tracking public opinion, to raise public awareness of drug supply issues and combat misinformation. Two guidelines have been issued to prevent drug misallocation and overstocking²².

Another article highlights the need to periodically assess drug inventory and manufacturing capacity to meet needs during shortages and crises, thus identifying critical failures that may occur during shortages. This analysis should include comparisons of alternative therapeutic approaches, monitoring drug shortages, and the use of new manufacturing technologies²³.

Conclusion

The selected studies demonstrated how unprepared we were to deal with the COVID-19 pandemic and the failures that led to shortages of essential supplies for the proper functioning of health systems. Fear of an unknown disease ultimately influenced actions that hindered the pandemic's response. Some places, like Taiwan, managed to weather the crisis with a plan developed before the pandemic; others, like Massachusetts, reinvented themselves during the pandemic and created a strategy. We need to learn from what we've experienced during these years of the pandemic and formulate a plan of action for future emergencies, such as maintaining transparent communication with the population to reduce panic, limiting the purchase of essential supplies to ensure everyone has access, and developing other strategies to prepare for the future.

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