Surveillance and high vaccination coverage: how Portugal overcame the collapse and regained control of the pandemic

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Abstract *The uncertainties about COVID-19 require evaluating national responses to identify successes and failures in the pandemic control. This article analyzes Portugal´s response, particularly the contribution of its health and surveillance systems in dealing with the pandemic. An integrative literature review was conducted, including consultations of observatories, documents, and institutional websites. Portugal´s response was agile and showed unified technical and political coordination, including surveillance structure using telemedicine. The reopening was supported by high testing and low positivity rates and strict rules. However, the relaxation of measures as of November/2020 resulted in an increase in cases, collapsing the health system. The response involved a consistent surveillance strategy with innovative monitoring tools, which, combined with high population adherence to vaccination, led to overcoming that moment and kept hospitalization and death rates at new disease waves at low levels. Thus, the Portuguese case discloses the risks of disease resurgence with the flexibility of measures and the population´s exhaustion in the face of restrictive measures and new variants, but also the importance of articulation between technical coordination, the political sphere, and the scientific committee.*

Key words *Health systems, Health surveillance, Portugal, COVID-19*

Introduction

In December 2019, a new coronavirus was detected in Wuhan, China, named SARS-CoV-2[1], which quickly spread across the country[2]. In view of the potential for the spread of COVID-19, the World Health Organization (WHO) declared a state of public health emergency of international concern on January 30 and a pandemic on March 11, 2020[3].

Strict and agile measures by the Chinese government to control the spread of COVID-19 allowed gaining time and adjusting strategies to face the health situation. These measures were shown to be successful and recommendable for adoption by other countries[2].

In Europe, the first COVID-19 cases were reported in France on January 24, 2020[4]. And, in March, the European continent was already the epicenter of the pandemic[4,5], with the collapse of the health system in countries such as Italy and Spain[6,7].

The controversies about the best strategies to be adopted[8], along with the difficulties of some countries to contain and mitigate the pandemic, especially in the first year, resulted in a high scientific production in search for evidence that could guide health actions based on best practices. In addition to demands within the scope of therapies, vaccines and other immunobiologicals or the production of specific supplies, the way government actions were conducted has also been analyzed by specialists[9,10].

With the advent of mass immunization, there was a reduction in mortality rates and severity of cases[11], with the return to normal activities in most countries. However, inequalities in vaccine distribution led to the emergence of new variants that resulted in a resurgence of the pandemic in several countries[11].

The synthesis of the extensive literature on the diverse responses to the pandemic by different countries is necessary not only to systematize the actions to be prioritized during its course, but, above all, as a lesson for future viral pandemics. Although comparative analyses are relevant and necessary, exemplary case studies allow a deeper investigation of some dimensions of government responses.

Investigations on cases in South Korea, China and Singapore point to the importance of an effective surveillance system, including case isolation, adequate contact tracing and quarantine[6,12,13]. The lessons learned from previous epidemics (SARS, MERS) in those countries also enabled the surveillance system improvement[6,12,14]. For timely case detection, the countries have expanded testing capacity and introduced emergency organizational forms such as drive-thru testing centers[6,14]. Social distancing is also indicated as an impact measure, especially before the introduction of vaccines, in countries that implemented successful responses to the pandemic[15].

Although some studies analyze the response of Portugal to the pandemic as a successful one, the country has been rarely included in comparative analyses[10,16,17]. After the recording of the first cases of COVID-19 on March 2, 2020 and the first death 15 days later, the containment of the 1st wave occurred in approximately 45 days[4]. Even with the resumption of activities in May 2020, the country reached zero deaths on August 3, 2020[18]. This initial rapid control developed into a system collapse at a second moment, which led to learning, the development of innovative information technologies and the regaining of control over the pandemic. The importance of systematizing the produced knowledge about the response attained in Portugal is highlighted, emphasizing that this country had faced a period of fiscal austerity with an impact on its health system[19].

This article analyzes the measures adopted by the Portuguese government to face the COVID-19 pandemic and the characteristics of its health and surveillance systems, aiming at identifying the main reasons for the observed performance, the errors and successes that may constitute recommendations for other countries.

Methods

An integrative review adapted from the proposal by Whittemore and Knafl (2005)[20] about the response of Portugal to the COVID-19 pandemic was performed. Using the Journal Portal of the Coordination for the Improvement of Higher Education Personnel (CAPES, *Coordenação de Aperfeiçoamento de Pessoal de Nível Superior* – https://www.periodicos.capes.gov.br/), a search was carried out for articles published between January/2020 and December/2021 in the following databases: Web of Science, Science Direct, Scopus and PubMed Central. In all databases, the combination (Boolean operator "and") of the descriptors "Portugal" and "COVID-19" with "health system", "national response", "surveillance" was used, applying the search restriction to the title, abstract and keywords. The 197 articles (in English and Portuguese) were sent to

the Rayyan web application for selection using a "double-blind" format involving two researchers. Divergence situations were discussed by the two researchers until a consensus was reached. After identifying duplicates and reading the titles and abstracts, 167 articles were excluded, and 30 were read in full. Reports, opinion articles and articles that did not address the Portuguese response to the COVID-19 pandemic were excluded (Figure 1). Ten articles that met the study objectives were selected (Chart 1).

To characterize the country, its health and surveillance systems, Health Systems observatories and government documents were consulted. Data regarding the evolution of the pandemic were extracted from Our World in Data[4], from the European Centre for Disease Prevention and Control (ECDC) (https://www.ecdc.europa.eu/) and used information from the Portuguese Observatory of Health Systems (https://opss.pt/), bulletins and documents from the General Directorate of Health (DGS, *Direção Geral da Saúde* – https://covid19.min-saude.pt/), from the National Institute of Statistics (https://www.ine.pt/) and the POR-DATA website (https://www.pordata.pt/).

The information was synthesized in three dimensions: characteristics of the country; characteristics of the health system (Chart 2); evolution of the pandemic and adopted measures (Figure 2 and Chart 3) seeking to gather elements that would allow understanding the conditions related to the health system and the surveillance model for the country's performance when facing the COVID-19 pandemic.

Results

Characterization of the country and its population

Portugal is a unitary state with two autonomous regions (Azores and Madeira)[21]; it occupies an area of 92,212Km² and has 10.3 million inhabitants, being the fourth country with the largest elderly population in the European Union (EU). It has had a semi-presidential government system since 1974, and it has been consolidating its democracy based on a strong social protection system[22], albeit threatened by the economic crisis
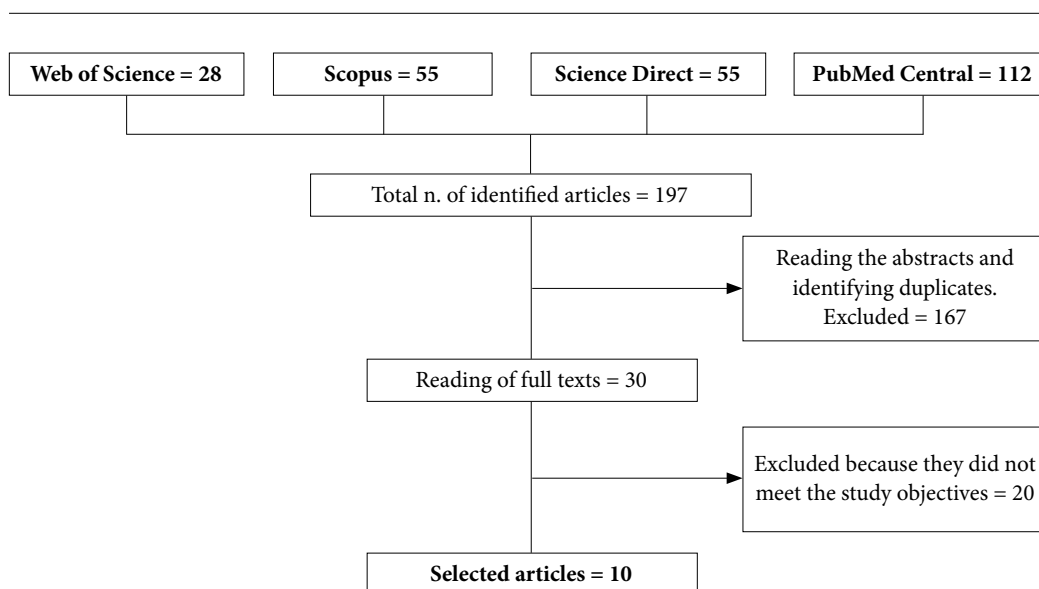

Figure 1. Number of articles on Portugal response to COVID-19 pandemic that were identified and selected based on the search strategies in the chosen databases.

Note: Search period: January 2020 to December 2021.

Source: Authors.

Chart 1. Articles on Portugal response to the COVID-19 pandemic selected from the literature search (January 2020 to December 2021).

Authors	Title	Journal/Year
Ares-Blanco S, Astier-Peña M, Gómez-Bravo R, Fernández-García F, Bueno-Ortiz M.	El papel de la atención primaria en la pandemia COVID-19: Una mirada hacia Europa.	*Atencion Primaria 2021; 53(8):102134.*
Aristodemou K, Buchass L, Claringbould D.	The COVID-19 crisis in the EU: the resilience of healthcare systems, government responses and their socio-economic efects.	*Eurasian Economic Review 2021; 11:251-281.*
Correia PMAR, Mendes IO, Pereira SPM, Subtil I.	The Combat against COVID-19 in Portugal: How State Measures and Data Availability Reinforce Some Organizational Values and Contribute to the Sustainability of the National Health System.	*Sustainability 2020; 12, 7513.*
Kuhlmann E, Brînzac MG, Burau V, Correia T, Ungureanu MI.	Health workforce protection and preparedness during the COVID-19 pandemic: a tool for the rapid assessment of EU health systems.	*European Journal of Public Health 2021; 31(supplement 4): iv14–iv20.*
Odone A, Gianfredi V, Sorbello S, Capraro M, Frascella B, Vigezzi GP, Signorelli C.	The Use of Digital Technologies to Support Vaccination Programmes in Europe: State of the Art and Best Practices from Experts' Interviews.	*Vaccines 2021; 9(10):1126.*
Queiroz G, Sá R, Matos J, Carmo S, Ferreira JD, Pinho-Bandeira T, et al.	Cordon sanitaire, a necessary evil? Evaluation of non-pharmacological interventions against COVID-19 in Ovar, Portugal.	*Acta Biomed 2021; 92(Suppl. 6):e2021459.*
Raposo VL, Violante T.	Access to Health Care by Migrants with Precarious Status During a Health Crisis: Some Insights from Portugal.	*Human Rights Review 2021; 22:459-482.*
Ricoca Peixoto V, Vieira A, Aguiar P, Carvalho C, Rhys Thomas D, Abrantes A.	Initial Assessment of the Impact of the Emergency State Lockdown Measures on the 1st Wave of the COVID-19 Epidemic in Portugal.	*Acta Med Port 2020; 33(11):733-741.*
Simões J, et al.	Organisation of the State, model of health system and COVID-19 health outcomes in six European countries, during the first months of the COVID-19 epidemic in 2020.	*Int J Health Plann Mgmt. 2021; 36(5):1874-1886.*
Waitzberg R, Hernández-Quevedo C, Bernal-Delgado E, Estupiñán-Romero F, Angulo-Pueyo E, Theodorou M, et al.	Early health system responses to the COVID-19 pandemic in Mediterranean countries: A tale of successes and challenges.	*Health Policy 2022; 126(5):465-475*

Source: Authors.

and the fiscal austerity policy in the first two decades of the 2000s[19].

After the economic crisis that took place between 2010 and 2014, and the resumption of economic growth from 2015 onwards, the GDP *per capita* ranged from €17,350.1 (2015) to €20,840.9 (2019)[23]. Between 2015 and 2019, there was a reduction in the unemployment rate, ranging from 12.9% to 6.6%, respectively[23]. However, the country experienced more inequality in 2020, reflected in the increase in the Gini coefficient and in the risk of poverty rate, which corresponds to the proportion of the population with an income below the established poverty threshold[24]. The

risk of poverty rate, which had reached 17.2% in 2018, the lowest percentage since 2003, reached 18.4% in 2020 after social transfers[24]. The Gini coefficient was 0.33 in 2020, revealing growth in inequalities in all regions of the country, except in the Autonomous Region of Azores[24].

Health system

The health system, of the Beveridge type, is funded primarily by citizens' taxes and guarantees access to health care to all residents in the country. The National Health Service (SNS, in Portuguese *Serviço Nacional de Saúde*), created

Chart 2. Preexisting health care infrastructure before the COVID-19 pandemic, Portugal, 2019.

Description	Preexisting Infrastructure
Primary Health Care (PHC)	
Network Assistance Units	1.173 (564 FHUs; 345 PHCUs; 264 CCUs)[30]
PHC coverage	CCUs = 95.9% of the population, FHUs = 62.3% of those registered in the PHC [30]
Hospital Care	
Hospitals	238 hospitals: 111 public hospitals or public-private partnerships that were part of the SNS and 127 private hospitals [31]
General Hospital Beds	3,5/1.000 inhab. (36,064 beds in 2019), of which 67.9% in public hospitals or SNS public-private partnerships [31]
Workforce	
Physicians	5.4/1.000 inhab.[31]
Nurses	7.4/1.000 inhab.[31]
Diagnostic Support Services	
Laboratories	The Portuguese Network of Laboratories for the Diagnosis of Influenza was set up in 2009, following the emergence of the influenza A(H1)pdm09 virus. In 2019, it consisted of 18 laboratories, under the coordination of the National Reference Laboratory for the Influenza Virus of the Department of Infectious Diseases of Doutor Ricardo Jorge National Institute of Health (INSA)[33].
Surveillance system	
Sentinel Doctors Network (RMS, Rede Médicos-Sentinela)	Coordinated by the Department of Epidemiology at INSA, it consists of general practitioners and family physicians working in health centers and voluntarily recruited to carry out notifications of health events. 159 physicians were registered in the network in 2017[34].
Emergency Health Services (EHS)	Services that are complementary to the SDN, especially where there is no network service. It works during the Integrated Surveillance period and depends on the voluntary participation of health professionals who notify and send biological products (National Surveillance Center)[35].
Laboratory	The National Surveillance Control Center for a given event sends participants in the Integrated Surveillance the necessary material for sample collection and arranges for the products to be sent back to the Laboratory. The results of the analyses are sent to the World Health Organization (WHO) and the European Surveillance System[35].
Disclosure of information	Epidemiological Surveillance Bulletins are prepared based on clinical and laboratory information and published on the National Health Observatory website (www.onsa.pt) as well as on the Directorate-General of Health (DGS, Direção-Geral da Saúde) (www.dgsaude.pt)[35].

Family Health Units – FHUs; Personalized Health Care Units – PHCUs; Community Care Units– CCUs; Primary Heath Care, Sentinel Doctors Network – SDN; Emergency Health Services – EHS; National Health Service – SNS, in portuguese, Serviço Nacional de Saúde.

Source: Authors.

by Law number 56, of September 15, 1979, guarantees universal, comprehensive, and free access to health care; although it admits the charging of some fees to users for the utilization of some services[25].

The SNS was created under the principles of centralized control and decentralized management[21] and it is organized based on the structure, operation and management of the Ministry of Health (MoH) which defines, conducts and funds the national health policy, regulates and inspects the activities of the NHS, as well as of the private sector. Direct administration within the MoH consists of four institutions: General Secretariat; Inspectorate-General of Health Activities; General Directorate of Health (DGS); and the Intervention Service for Addictive Behaviors and Addictions. It also includes the National Health Council (NHC), an advisory body related to the national health policy[26].

The DGS, the MoH's central service, is endowed with administrative autonomy, moni-
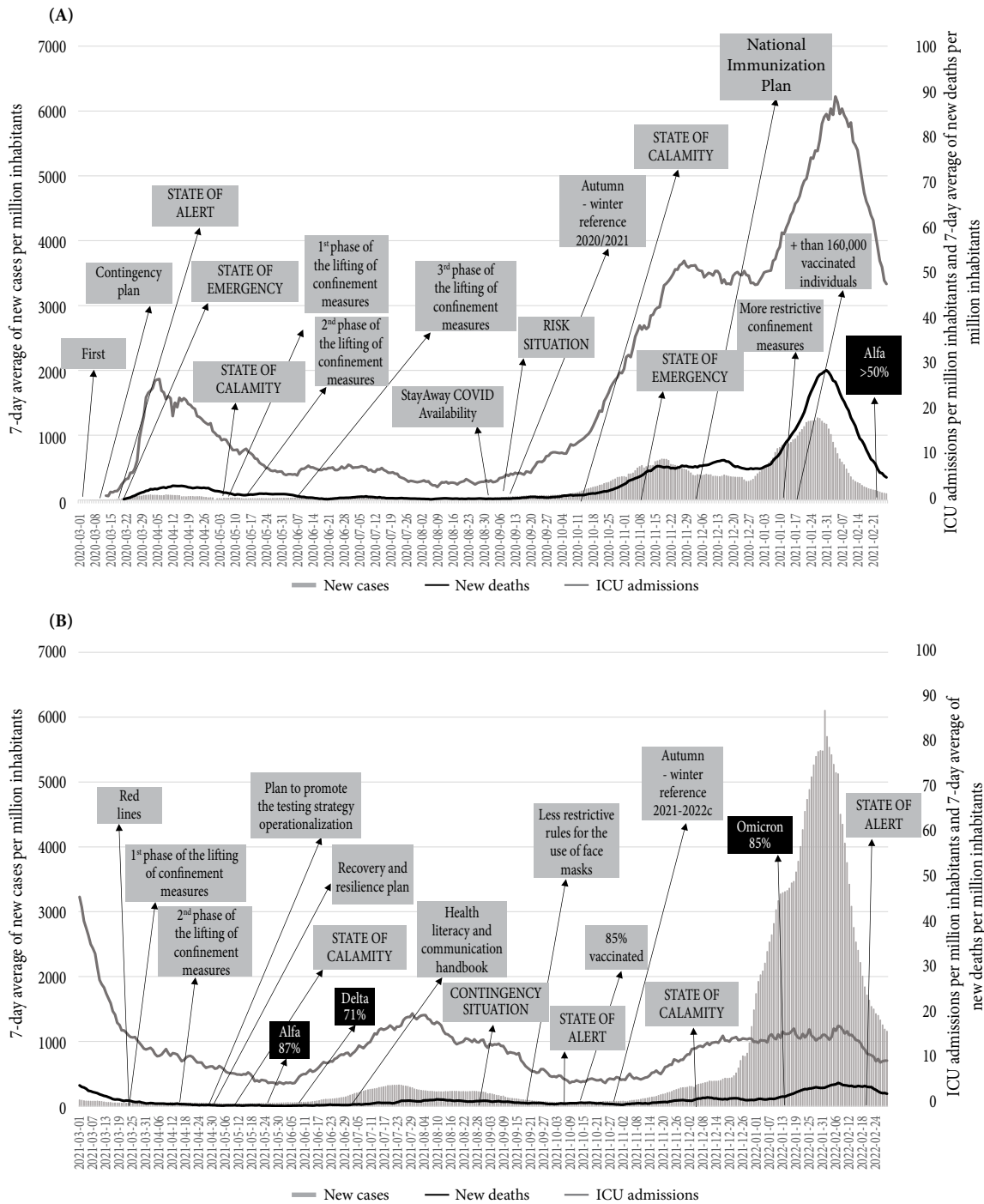
(A)

(B)

Figure 2. Evolution of the 7-day average of new cases and deaths per million inhabitants, admissions to Intensive Care Units per million inhabitants, and main measures and variants of concern, Portugal, March/2020 to February/2021 (A) and March/2021 to February/2022 (B).

Source: Authors.

tors the national epidemiological situation and, among other attributions, is responsible for de-claring the alert systems and coordinating the response in public health emergency situations[27].

Chart 3. Timeline with overview of measures and time frames.

Date	Facts
01/22/2020	The General Directorate of Health (DGS) put 3 hospitals (São João in Porto and Curry Cabral and Estefânia in Lisbon), in a state of alert.
February/ 2020	20% increase in the supply of medication in the SNS and disclosure of guidelines and rules for contingency of suspected cases for companies, ports and sea travelers.
02/26/2020	The DGS started publishing daily newsletters with the monitoring of suspected cases, an action predicted by the Portuguese surveillance system.
03/02/2020	Two first confirmed cases in the country.
03/09/2020	Disclosure of the National Contingency Plan, having as reference the WHO and ECDC guidelines, and the experiences of coping with previous pandemics.
03/01/2020 to 03/15/2020	Creation of field hospitals, implementation of social distancing measures, such as teleworking, creation of local contingency plans for suspected cases, closing of universities, museums, theaters, interruption of sports activities and other types of events.
03/11/2020	WHO's pandemic declaration.
03/13/2020	Declaration of state of alert (up to 04/09).
03/16/2020	Closing of borders and air traffic restriction.
03/17/2020	First death from COVID-19.
03/18/2020	Declaration of state of emergency (up to 05/03).
05/04/2020	Declaration of state of calamity, contingency and alert.
05/04/2020	Start of the 3-phase Deconfinement Plan (05/04, 05/18 and 06/01).
08/03/2020	Zero deaths from COVID-19.
09/01/2020	Stay Away COVID Application availability.
09/21/2020	Disclosure of the Autumn-Winter Health Plan 2020-2021.
11/09/2020	Declaration of state of emergency (up to April 30, 2021).
12/03/2020	National Vaccination Plan.
01/05/2021	Start of vaccination in the country.
01/08/2021	70,000 vaccine doses administered.
01/12/2021	Increase in the number of new cases in all age groups.
01/18/2021	Announcement of more restrictive confinement measures.
01/21/2021	Suspension of school activities for 15 days starting on 01/22.
01/25/2021	More than 160,000 people vaccinated, in a total of 255,700 vaccine doses.
01/28/2021	Vaccination Plan Update.

it continues

The country has a Public Health device for emergency situations, a management mechanism coordinated by the DGS that establishes a Center for Emergencies in Public Health, with representations of other government institutions, including those linked to the MoH, other ministries and federal entities, to generate the preparedness and response strategy[28]. This device was activated to face the COVID-19 pandemic and a task force was created under three work axes: evaluation (epidemiology and statistics), risk management and communication[29].

The SNS has invested in Primary Health Care (PHC) as a priority point of access to the health system[30]. In 2019, the 264 Community Care Units (CCUs) covered 95.9% of the population living on the continent and the 564 Family Health Units (FHUs) guaranteed coverage of 63.2%

of those enrolled in PHC[30]. There were 238 hospitals, 111 of which were part of the NHS. The country had 36,064 hospital beds, of which 67.9% were located in public hospitals or in public-private partnerships. There were 1,235 beds for in Intensive Care Unit (ICU) admissions, including neonatal and pediatric care and adult hospitalization[31]. Before the pandemic, the number of ICU beds was 3.5/1,000 inhabitants, which is low compared to the EU average of 5.3/1,000[32]. The number of physicians had been increasing, while the number of nurses was below the EU average[32]. The network of laboratories comprised 18 units[33]. The surveillance system has a network of sentinel physicians, emergency health services, laboratories and instruments for disseminating information[34,35] (Chart 2).

Chart 3. Timeline with overview of measures and time frames.

Date	Facts
03/13/2021	Disclosure of the "Red Lines" surveillance strategy, approved by the government on 03/11/2021.
03/13/2021	Resolution of the Ministerial Council n.19/2021, of March 13, establishing a strategy for lifting the confinement measures in the context of fighting the COVID-19 disease pandemic
04/03/2021	Publication of the 1st Red Line monitoring report by DGS and INSA
04/05/2021	2nd Phase of the deconfinement plan
04/19/2021	Plan to Promote the Testing Strategy Operationalization in Portugal – SARS-CoV-2, based on 3 intervention axes: directed, programmed and generalized testing.
04/22/2021	Recovery and resilience plan (RRP): national program, running until 2026, which aims to implement a set of reforms and investments to resume sustained economic growth, based on 3 dimensions: Resilience, Climate Transition and Digital Transition. The RRP foresees investments in the SNS of 1,383 million euros.
04/26/2021	Zero deaths from COVID-19.
04/29/2021	Zero deaths from COVID-19.
05/01/2021	Declaration of state of calamity.
06/23/2021	Dissemination of the Health Literacy and Communication Handbook to promote population adherence to vaccination.
07/01/2021	Rapid tests co-participated at 100%.
08/23/2021	Declaration of state of contingency (up to 09/30/2021).
09/13/2021	New recommendations on the use of face masks, more adapted to the current vaccination coverage phase and an epidemiological situation.
10/09/2020	85% of the population is fully vaccinated.
10/22/2021	Disclosure of the Fall-Winter 2021-2022 Reference.
10/01/2021	Declaration of state of alert (up to 10/31/2021).
12/01/2021	Declaration of state of calamity (up to 03/20/2022, initially).
12/15/2021	Transitory regime, non-mandatory use of face masks in public spaces.
12/22/2021	Parliament approves a resolution recommending the Government to strengthen the public health structure in the country.
02/19/2022	Declaration of state of alert (up to 03/07/2022).

SNS, National Health Service, in Portuguese Serviço Nacional de Saúde; INSA, Doutor Ricardo Jorge National Institute of Health; DGS, General Directorate of Health, in Portuguese Direção Geral de Saúde.

Source: Authors.

Evolution of the epidemic and responses by the Portuguese government

Although the first two cases of COVID-19 were confirmed on March 2, 2020[4], the government had adopted measures preparing to face the health crisis since January/2020[28,36] and, at the end of February, it started publishing daily newsletters with the monitoring of suspected cases.

Preparedness plans used to deal with previous pandemics were adapted to guide the initial response and the adoption of contingency measures[37]. The National Contingency Plan followed the WHO and ECDC guidelines and defined the alert and response levels determined by the epidemiological evolution of the infection, risk assessment and impact for the country[28].

Portugal had a firm and fast response. Soon after the first cases, the country suspended events, closed schools, imposed travel restrictions, closed borders and limited non-essential activities[38]. There was a political coordination in this action, with decisions being taken by the President of the Republic, together with the Prime Minister, supported by the Council of Ministers, the Parliament and technical staff of the DGS.

There was a ban on air traffic between Portugal and non-EU countries[39] and the disembarkation of passengers and crews from cruise ships in ports[40]. Passengers from non-EU countries were authorized exclusively for essential trips, with a negative laboratory test[39]. Transit in the country was limited, including, for example, a sanitary cordon for two months in the municipality of

Ovar, due to the outbreak in the first weeks of March/2020[41].

The state of emergency, declared on March 18, 2020[42], ensured control of social isolation and transgression of the new rules was considered a crime of civil disobedience.

The Security Forces contributed to ensure that the rules were complied with during the blockade and the media disseminated information to the community, which also played an important role in this adherence[38]. Military forces acted in the creation of field hospitals and in the collaboration of the military laboratory[38].

During the blockade, the country kept children's daycare and schools open to accommodate the children of essential service professionals, including the health sector[21,43], a measure of preparation and protection of the health workforce[43].

This set of measures related to social distancing resulted in a high Stringency Index (SI), an indicator proposed by the University of Oxford to measure the rigor of restriction/lockdown policies adopted by governments[44], which varied between 82.41 and 87.96, in the period from March 19 to May 3, 2020, one of the highest among European countries[4].

Seeking to overcome the initial difficulties in obtaining Personal Protective Equipment (PPE) and necessary medical supplies, Portugal resorted to centralized procurement of tests and PPE and then organized itself to produce PPE internally[37]. It also received donations and ventilator loans to expand its ICU bed capacity[37].

In the 1st wave of the pandemic (first months of 2020) there was an increase in cases, but without "a more prominent peak"[38] and the containment and attenuation measures implemented early and in an articulated manner contributed to the reduction of severe morbidity and mortality in this initial phase[38,45] (Figure 2).

The accord between the head of the government, the Parliament and the heads of the DGS is highlighted regarding the conduct of centralized governance to coordinate the national response, in constant dialogue with a scientific advisory committee[37] and the nomination of five State Secretariats to implement the state of emergency[21,38].

The pandemic required adaptations from health professionals and changes in the work process[43]. In the initial phase, the PHC decreased face-to-face consultations for non-COVID-19 cases and prioritized childhood vaccination[46]. Although the PHC did not undertake the task of diagnosis at that time, family physicians followed up the cases using an application or through telephone contact[46].

Regarding the workforce, the relocation of SNS workers was prohibited, a subsidy was established for the remuneration of physicians trained abroad and on leave, and international support was received related to the availability of health workers during the most critical phase[43]. The hiring of professionals was also simplified, a 'student bank' was created[21] and the hiring of retired and inactive professionals, payment of overtime and cancellation of leaves[37] was enabled.

An exceptional expenditure authorization system was created, allowing necessary expenditures on equipment, goods and services[21,47].

Undocumented immigrants were temporarily qualified for assistance by the SNS. The government granted temporary residency rights to all immigrants and asylum seekers who had applied by March 18, 2020[37,48]. The regularization process allowed equal treatment to foreigners and exemption from the costs of services related to COVID-19[37,48] was established.

The first deconfinement measures began on May 4, 2020, through a sustained reduction in hospitalizations and occupation of ICU beds and expansion of testing capacity[49]. The reduction of confinement measures, with the maintenance of monitoring and follow-up of epidemiological data, followed a calendar with a 15-day interval between each phase[49]. Thus, gradually, restrictive measures related to public transportation, work, commerce, public services and sports and cultural activities were relaxed[49].

Testing was restricted at the start of the pandemic[4], but contact tracing was already foreseen[28]. The effort with the involvement of academia and also private laboratories made it possible to expand the testing capacity; one of the country's priorities[50]. With an initial capacity to perform 10,000 tests/day, the expectation was to reach 21,000 tests a day[50]. On November 23, 2020, Portugal reached 4.3 million PCR tests, with a positivity ratio of 15.9%[51]. In that same month, the overall fatality rate was 1.6% and the fatality rate in individuals aged over 70 years was 9.7%[51].

With approximately 23.4% of elderly individuals in the population, according to provisional census results of 2021, a group identified as high risk right from the start, visits to homes for the elderly were suspended and resumed on May 18, 2020[52].

In addition to a proportionally high elderly population, the low testing capacity at the start and the availability of doctors, nurses and beds

lower than in other EU countries were factors that compromised Portugal's capacity to prepare for the pandemic[53]. Thus, the country ended up adopting stricter restrictive measures, a combination also observed in other countries with health systems considered to be less prepared[53].

With the reopening[49], the number of cases increased again in June/2020, but resumed the downward trend, reaching the lowest number of infections since March[54] in the first week of August/2020.

The StayAway Covid application, for the monitoring of contacts, was made available in September/2020, with voluntary adherence[32]. In that same month, considering the possible increase in cases of COVID-19, the seasonality of the flu and the population's health needs, the MoH published the 2020-2021 autumn-winter action plan[55].

Towards the development of e-Health, strategies such as the Web Portal, smartphone applications, videos to promote immunization campaigns, e-mail reminder systems (about vaccination deadlines and consultations) and electronic immunization record system were adopted[56].

Telemedicine was expanded and widely utilized during the pandemic[32]. The SNS 24-hour free telephone line was expanded to incorporate screening, follow-up, actions related to testing and the creation of a psychological support line[32].

For the return of classes, guidelines were published for the management of cases and outbreaks of COVID-19 and it was established that the local health authority would be responsible for carrying out epidemiological inquiries in outbreak situations and determining the closing of the involved classes or the school in high-risk situations[57].

The rapid increase in cases and deaths as of October 2020 led the country to declare a new state of emergency in November, when the highest number of cases in that year was recorded (7-day moving average of 632.21 cases/million inhabitants)[4], as shown in Figure 2. The entry of the Alpha variant, a more transmissible one, which on February 22, 2021 corresponded to 55% of the tests, together with the exhaustion due to restrictive measures and relaxation of these measures, may be related to the lack of control verified from January 28/2021, when the 7-day moving average doubled, reaching 1,267.77 cases/million inhabitants (Figure 2). Without effective control, the 2nd wave of the pandemic resulted in the collapse of the Portuguese health system[32]. The occupancy rate of ICU beds exceeded 90% in hospitals in the North region[56]. It should be noted that in the

beginning of the pandemic, Portugal had limited hospital capacity, being the European country with the lowest number of ICU beds per 100,000 inhabitants[58] and, even doubling the number of ICU beds between March/2020 and March/2021, hospitals in some regions were overwhelmed[32].

The significant decrease in the number of cases (7-day moving average of around 50 cases/million inhabitants) during several months of 2021 was associated with the increase in mobility restrictions and social distancing measures between January-June/2021 (average SI of 70.68, reaching 87.93 in March), the population's adherence to these guidelines, the adoption of epidemiological criteria for reopening, and the "Red Lines" strategy.

This monitoring and control strategy was created in March/2021, considering the success when facing the 1st wave and the collapse experienced in the 2nd wave[59]. Critical limits were established for a set of indicators that, when adequately monitored, could guide measures to be adopted for each moment of the epidemic[59]. Three main indicators were defined: cumulative incidence at 14 days per 100,000 inhabitants; real-time (Rt) infection effective reproduction number; number of ICU beds occupied by COVID-19 patients. In addition to four secondary indicators: percentage of positive tests among the tested samples (test positivity rate); percentage of cases and contacts isolated and traced in the first 24 hours after notification; percentage of confirmed cases reported late; emergence and spread of Variants of Concern (VOC)[59].

It is noteworthy that the DGS and Dr. Ricardo Jorge National Institute of Health (INSA) systematically disseminated on their websites monitoring reports on the epidemiological situation, with details of the observed values for the "Red Lines" indicators. Genomic surveillance, developed by INSA with the support of public and private laboratories and academic institutions, also represented an important tool in the fight against the pandemic[60].

Amidst the 2nd wave, Portugal started vaccinating the population on January 5, 2021[61]. The Immunization Plan established priorities according to groups of diseases, risk of exposure, age and workers in essential services[62].

The global difficulties regarding the availability of vaccines initially determined a slower process, leading the country to activate the task force to accelerate the immunization process[32]. The acceptance of the vaccine by the Portuguese population, associated with management efforts

aimed at increasing immunization rates, contributed to the fact that more than 70% of the population was vaccinated with two doses by the end of August/2021, a percentage well above the 48% rate in Europe[4,32], reaching 85% in early October/2021 (Chart 3).

The reduction of restrictive measures and the circulation of the Delta variant led to an increase in cases between May-June/2021, which can be considered as a 3rd wave (Figure 2). In this case, the significant percentage rates of vaccination may explain the lower proportion of deaths in relation to the number of cases than that observed in the previous waves (Figure 2).

By the end of 2021, the pandemic worsened, leading the country to declare a state of calamity on December 1, 2021[63]. The 4th pandemic wave, with the introduction of the Omicron variant in November/2021, resulted in a very high occurrence of cases (7-day moving average of 6,105.81 cases/million inhabitants on January 31, 2022), which, as it occurred in the 3rd wave, also did not correspond to an increase of the same magnitude in hospitalizations and number of deaths (Figure 2).

Discussion

It can be said that Portugal had four noteworthy moments in controlling the pandemic: a) rapid control during the 1st wave, flattening the curve and sparing the national health system; b) the moment of lack of control, with high mortality and collapse of the health system; c) the establishment of a robust surveillance strategy for the monitoring and control of COVID-19 in the national territory; and d) adequate and timely expansion of vaccination coverage.

The performance observed during the 1st wave has been assessed as positive[21,37,38,45] and resulted in a lower number of deaths[38,45], new cases, ICU admissions and occupation of hospital beds than the projections based on the initial data[45]. The analysis of excess mortality by waves confirms this assessment, when compared to neighboring European countries. In the 1st wave, Portugal had the lowest percentage of excess mortality (18%) compared to Spain (156%), Italy (68%) and France (61%). However, in the 2nd wave, the situation was reversed and Portugal led among the four neighboring countries with 72%, followed by Spain with 22%, Italy and France with 11% each[4]. The following aspects have been pointed out as explanations for the success in controlling the 1st wave and, after the period of collapse, its

recovery: the management coordination that was enabled through the articulation between the executive government and the parliament, with the collaboration of the different entities involved in the crisis management (local governments, hospitals, military forces, media and researchers)[38]; the existence of a centralized health system[37] and the population's adherence to the compliance with social isolation guidelines[38,45,64]. The crisis management was also described as firm[38,53] and fast[38,45].

The fact that the pandemic onset in Portugal occurred more than one month after the 1st European case may have influenced the population's perception of risk, contributing to the adoption of preventive behaviors[37,64]. However, this may have implied complications in routine care and in the financial situation[64].

The participation of PHC in the response to the pandemic differed between countries[46] and, in the case of Portugal, considering the good PHC coverage, it was possible to give this level of care a more central role. On the other hand, the epidemiological surveillance, especially after the 2nd wave, awareness and prevention campaigns and transparent communication were some of the prioritized aspects[38,46], illustrating the relevance and convenience of integration between PHC, surveillance and social communication in health. Portugal is an example of good practices in the management of pandemic crises, with emphasis on organizational values such as legality, government transparency, citizenship appreciation, efficiency, effectiveness and sustainability[38].

Among the worldwide consequences of COVID-19, the high increase in unemployment is highlighted by the International Labor Organization. It is estimated a decline in the GDP of around 6.9% in Portugal for 2020, an economic impact among the highest ones. In April/2020, the number of unemployed individuals in 74 municipalities was more than twice the number registered in April/2019[65].

Measures such as quarantine and social distancing, the closing of borders and/or limiting the entry of foreigners, although effective in mitigating the pandemic, generate economic implications, particularly due to the contribution of tourism to the Portuguese economy[65] and, therefore, they must be monitored.

The present study contributes to the understanding of the Portuguese response to the pandemic and points out successes and failures to be considered by other nations in future health crises. However, as it is based on a review, it has

limitations. Therefore, it is advisable to carry out further investigations that can establish comparative methodological strategies capable of explaining the how and why of the differences in responses to the pandemic between countries, including Portugal.

The Portuguese response to COVID-19 showed that political stability contributed to the creation of a consensus in the implementation of control measures approved by the population. On the other hand, the existence of a national health system (the SNS) of a public nature corresponded not only to a pre-existing infrastructure, but to a capacity to plan and perform the required epidemiological surveillance, as well as provide hospital care for severe cases. Another aspect is related to the agility in adopting measures to fight the pandemic. The preparation started two months before the first case, always with transparency regarding surveillance and monitoring of cases and suspected ones. Adherence to the "Test-Track-Trace" strategy led the SNS to carry out many tests, aimed at identifying contacts.

On the other hand, the resurgence of the pandemic that constituted the 2nd wave shows that the health situation requires constant vigilance. Despite preparations for a possible 2nd wave, there was a delay in adopting measures related to social distancing, possibly due to the resulting economic impact. The adequate measures during the 1st wave did not prevent the country from experiencing the collapse of its health system in the 2nd wave but resulted in learning from the adoption of the "Red Lines" and efforts to implement vaccination. Although the epidemiological situation must be closely monitored, in view of the uncertainties regarding the consequences of this health crisis, Portugal has demonstrated the importance of adopting articulated and technically well-established political-administrative measures.

Collaborations

SG Barros: contributions to the study conception and design, collection, analysis and interpretation of data and writing of the manuscript. DN Cruz: contributions to the collection, analysis and interpretation of data and writing of the manuscript. JC Souza: contributions to data collection and interpretation and manuscript review. LA Silva and MCS Guimarães: contributions to the study design, collection, analysis and interpretation of data and manuscript review. MM Rezende: contributions to the collection, analysis and interpretation of data and manuscript review. JS Paim and LMV Silva: contributions to the study conception and design, analysis and interpretation of data and critical review of the content.

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