Case Study

DIGITAL HEALTH
Volume 10: 1–13

DOI: 10.1177/20552076241272565
journals.sagepub.com/home/dhj

Paving initial forecasting COVID-19 spread capabilities by nonexperts: A case study

Idan Roth and Arthur Yosef

Abstract

Objective: The COVID-19 outbreak compelled countries to take swift actions across various domains amidst substantial uncertainties. In Israel, significant COVID-19-related efforts were assigned to the Israeli Home Front Command (HFC). HFC faced the challenge of anticipating adequate resources to efficiently and timely manage its numerous assignments despite the absence of a COVID-19 spread forecast. This paper describes the initiative of a group of motivated, though nonexpert, people to provide the needed COVID-19 rate of spread of the epidemic forecasts.

Methods: To address this challenge, the Planning Chamber, reporting to the HFC Medical Commander, undertook the task of mapping HFC healthcare challenges and resource requirements. The nonexpert team continuously collected public COVID-19-related data published by the Israeli Ministry of Health (MoH) of verified cases, light cases, mild cases, serious condition cases, life-support cases, and deaths, and despite lacking expertise in statistics and healthcare and having no sophisticated statistical packages, generated forecasts using Microsoft® Excel.

Results: The analysis methods and applications successfully demonstrated the desired outcome of the lockdown by showing a transition from exponential to polynomial growth in the spread of the virus. These forecasting activities enabled decision-makers to manage resources effectively, supporting the HFC's operations during the pandemic.

Conclusions: Nonexpert forecasting may become a necessity and be beneficial, and similar analysis efforts can be easily replicated in future events. However, they are inherently short-lived and should persist only until knowledge centers can bridge the expertise gap. It is crucial to identify major events, such as lockdowns, during forecasting due to their potential impact on spread rates. Despite the expertise gap, the Planning Chamber's approach provided valuable resource management insights for HFC's COVID-19 response.

Keywords

Analysis, case study, COVID-19 pandemic, forecasting, Microsoft® Excel, nonexpert

Submission date: 9 May 2024; Acceptance date: 16 July 2024

Introduction

In December 2019, the coronavirus disease 2019 (COVID-19) emerged in Wuhan, China. Despite the swift implementation of extensive containment measures by the Chinese government, within a few weeks, the disease had spread well beyond China's borders, affecting countries worldwide.[1] Among the nations facing the epidemic, Italy experienced one of the most severe outbreaks following the initial one, causing significant upheaval among its population.[2] The rapid surge in COVID-19 positive cases led the Italian government to issue a momentous decree on 8 March 2020, mandating a nationwide lockdown.[1,2] On 2 February, the Israeli Ministry of Health (MoH) issued a

Department of Information Systems, Tel Aviv-Yaffo Academic College, Tel Aviv-Yafo, Israel

Corresponding author:
Idan Roth, Department of Information Systems, Tel Aviv-Yaffo Academic College, Tel Aviv-Yafo, Israel.
Email: idanro@mta.ac.il

directive mandating a 14-day quarantine for travelers returning from China. On 26 February, the Israeli MoH added Italy[3] as the sixth country to be included in the quarantine measures and the first one from Europe.

On 11 March, the World Health Organization (WHO) officially declared the COVID-19 pandemic. At that moment, there were 118,000 verified cases in 114 countries worldwide, resulting in over 4000 fatalities. On the same day, Italy had already reported 12,462 cases and 827 deaths.[4] According to the Italian report, more than 10% of the worldwide cases were in Italy, with approximately 7% mortality. On that date, Israel reported 82 cases, and 9 days later, it will report the first COVID-19 fatality case.

The coronavirus has been recognized as a source of human infections since the 1960s. However, it was not until the past two decades that the virus' capacity to trigger lethal epidemics became apparent.[5] Seven human coronaviruses (HCoVs) have been detected[6,7] and are classified into low-pathogenicity (HCoV 229E, NL63, OC43, and HKU1) and high-pathogenicity coronaviruses (SARS-CoV, MERS-CoV, and SARS-CoV-2). The low-pathogenicity coronaviruses typically cause mild diseases with non-serious respiratory syndrome, while the highly pathogenic coronaviruses cause lethal human infections.[5]

Several explanations were offered for the fast-growing COVID-19 spread phenomenon; some pertained to health policy implementation[8] and some to globalization aspects, such as air network connectivity[9] and high-speed railways.[10] Other explanations referred to population characteristics, such as population density.[11] However, back then, COVID-19 unique characteristics were not fully understood.[12] Respiratory diseases can be transmitted through three distinct routes, namely, face-to-face close contact, contaminated hands touch of the face mucosa, or by aerosol. Viruses undergo continuous mutations, giving rise to new variants that can ultimately become more infectious than their predecessors, thereby altering the disease's epidemiological dynamics, such as the increasing role of aerosol in the epidemic spreading,[8] and thus, challenge the prevailing consensus regarding the spread of infectious disease.[13]

Robust models that predict the prognosis of COVID-19 were urgently needed to support decisions about shielding, hospital admission, treatment, and population-level interventions.[14] Early COVID-19 papers emerged at the beginning of 2020[15] and were primarily focused on mathematical models.[12] These papers attempted to derive insights and forecasts from China's experience, despite the Chinese authorities' unique methods for tackling the outbreak.[1,16]

Epidemic forecasting has a questionable history of accuracy, which was especially evident during the COVID-19 pandemic. Several factors contributed to these shortcomings, including inadequate data quality, incorrect modeling assumptions, failure to account for key epidemiological characteristics, limited past evidence regarding the effectiveness of available interventions, insufficient transparency, errors, indeterminacy, a narrow focus on isolated aspects of the issue, and insufficient expertise in critical fields.[17]

The unsuccessful management of the epidemiological investigation efforts by the Israeli healthcare system led to delays and ineffective efforts to prevent infection[18] and less effective treatment due to these delays.[19] Therefore, the Israel Defense Forces (IDF) and particularly the Israeli Home Front Command (HFC) were assigned the task of breaking the chain of COVID-19 infections.[20]

Thus, throughout 2020–1, the IDF played a significant role in combating the coronavirus. Thousands of soldiers, made possible by a conscript military, were deployed to support the Israel Police in implementing restrictions in civilian areas. They conducted patrols, isolated and secured locations, and blocked traffic routes. However, the majority of IDF support was provided by the HFC.

The HFC assumed responsibility for coordinating information spread to the public and established a 24/7 public call center to support communities and municipalities. Additionally, the HFC oversaw the utilization of hotels nationwide to accommodate COVID-19 patients with light and mild symptoms and supervised hotels with quarantined civilians and, jointly with the MoH, orchestrated the transformation of sick patients and quarantined civilians from their homes to designated hotels.[21] Moreover, the HFC set up a dedicated COVID-19 hospitals within the premises of a civilian hospital.[21] Soldiers were actively involved in delivering essential supplies, such as food and hygiene kits, to families, particularly in Arab and ultra-Orthodox communities under lockdown due to high infection rates. Furthermore, troops were deployed to distribute food and medicine and offer assistance to the elderly population. Magen David Adom, the Israeli Red Cross organization, was reinforced by HFC soldiers at Magen David Adom call center, COVID-19 "Drive-thru" test centers, Blood Donation Services Battalion,[22] and packing and logistics personnel. Hospitals reinforced with babysitting for essential workers' children and hospital's army units, nursing homes support, Epidemiological Investigations Task Force, and COVID-19 testing lab[21] are additional examples of the endless list of HFC activities. The required amount of manpower for these activities was volatile and derived by the changing COVID-19 spread.

The COVID-19 spread rates had additional implications; lockdowns were imposed whenever hospitals reached maximum hospitalization capabilities. Thus, the percentage of beds occupied by COVID-19 patients was very important. In addition, the number of light and mild cases was also important because it affected the number of hotels needed to be contracted with; hence, forecasting activities were essential for these issues as well.

The first COVID-19 case in Israel was confirmed on 21 February 2020. The first author of this paper was recruited a month later on 17 March 2020 and asked to head the Planning Chamber and report to the HFC Medical Commander. Two days later, the first Israeli lockdown began.

The Medical Commander of the Israeli HFC during the COVID-19 outbreak faced numerous challenges. She stated at the beginning of the outbreak that with just a 1-week notice, she could have managed the situation more effectively by knowing how many people to recruit, what skills were needed, how to better distribute them across districts and sub-districts, and focus on the most critical logistical, managerial, and budgetary decisions.

Thus, the first author of this paper promptly contacted leading Israeli academic institutions and other knowledge centers, requesting forecasting support for COVID-19 spread and hoping to rely on robust epidemiology experience and vigorous mathematical and statistical background for HFC planning activities. Surprisingly, these efforts were in vain, and in the early days of COVID-19, none of them provided any COVID-19 forecasts.

The Planning Chamber members were not best suited for the job, did not have access to sophisticated statistical packages, did not hold any epidemiological knowledge, and did not have mathematical or statistical proficiencies. Nevertheless, they realized the necessity to provide some forecast to support the Hospital Preparedness Branch and Community Preparedness Branch under the HFC Medical Commander, which were among the units in need of any sort of forecast.

Hence, the starting point of the nonexpert Planning Chamber was data on the COVID-19 spread, which relied on the Israeli MoH daily data regarding light, mild, serious, and life-support conditions and death. In addition, foreign data from western countries were collected, with a focus on Italy, which faced COVID-19 challenges earlier than most of the countries. Microsoft® Excel for Microsoft 365 spreadsheet software was utilized to support the forecasting activities.

Three days after being recruited, on 20 March, the Planning Chamber started recording the daily data provided by the MoH, followed by initial forecasting attempts. These activities provided accurate forecasts of the progression of the epidemic and enabled the Israeli HFC Medical Commander to formulate a plan of action[23] on a weekly basis. The present research describes the early days of the Israeli COVID-19 forecasting challenges and the nonconventional solution applied and suggests that such a method may be easily replicated in similar events in the future.

Materials and methods

The present study addresses COVID-19 verified cases reported in Israel between 2 March 2020 (a total of 12 cases were reported by then since 21 February 2020) and 12 April 2020 when the reported cases soared to 11,145 cases, with more than 300 serious-condition and life-support condition active cases and more than 100 deaths. The verified cases were categorized by severity conditions as light, mild, serious, and life-support conditions and death cases (see Appendix) and provided on a daily basis by the Israeli MoH.

While sophisticated statistical packages, such SAS, Stata, or R exist, significant data analysis can be done with Excel.[24] Investigators use a correlation study to determine the extent to which two or more variables are related among a single group of people, and using Excel® for statistical analysis of data can facilitate all statistical analyses in a single file.[25] Excel can serve as an introductory tool to high-end business intelligence (BI) and decision support system (DSS) applications and can be used by all managers and business students for exploratory data analysis.[26] Furthermore, Excel enables researchers with little to no experience in quantitative analyses to easily perform quantitative analyses.[27]

Similar to certain high-end business intelligence (BI) and decision support system (DSS) platforms, Excel offers a comprehensive environment facilitating data management. It comes equipped with a plethora of built-in tools for querying, analysis, and reporting, complementing its capabilities for formatting, calculations, and graphical capabilities.[28] Excel also offers five trendline options (i.e. exponential, linear, logarithmic, polynomial, and power) for comparison R^2 measurements for the highest value. Assessing trendline reliability involves a comparison of the R^2 values among various available trendline choices. The trendline with the highest reliability is determined by its R^2 value approaching closest to 1.[29]

Due to the absence of more advanced statistical tools and the lack of expertise of the involved personnel, the verified cases with the corresponding severities reported by the MoH were recorded utilizing Microsoft® Excel for Microsoft 365 spreadsheet software daily, and thus, graphical representation and data analysis activities relied solely on off-the-shelf software. The Planning Chamber's forecast activities started on 20 March 2020, lasted for a couple of months, and were conducted from HFC premises.

Statistical analysis

The data were divided into subsets each containing patients characterized by different degrees of severity of their medical conditions. Each data subset was initially displayed with a Microsoft® Excel scatter chart plot, presenting cases by dates. These charts were then supplemented with the trendline feature to imply the general pattern of the daily change of each data subset. The default preference criterion for a trendline type was based upon seeking for the highest R^2 value. Finally, trendlines' equations and R^2 were added to the charts. Notwithstanding, data from Italy and additional western countries were also recorded in order to better understand the effect of lockdowns. The original data and analyses presented in 2020 relied on Microsoft® Excel equations and R-squared values only. A further analysis of the resultant equations with Chi-square, P values, and mean square error values was later computed and presented in Table 1.

Table 1. Chi-square, P-values, and mean square error results.

Data	Dates	Equation	R^2	MSE	χ^2	P-value	Comment
Verified cases	03.03–25.03	Exponential	0.9972	1178.99	41.29	0.008	Before lockdown
Verified cases	26.03–12.04	polynomial	0.9879	23,958.19	95.54	0.000	During lockdown
		Linear	0.9879	87,478.69	231.02	0.000	
Light condition		polynomial	0.9952	22,154.20	97.71	0.000	
		Linear	0.9657	159,489.50	471.47	0.000	
Mild condition		polynomial	0.8893	225.11	41.78	0.001	
		Linear	0.7209	567.56	66.41	0.000	
Serious condition		polynomial	0.9920	14.93	3.05	1.000	
		Linear	0.9875	23.36	4.29	0.999	
life-support condition		polynomial	0.9896	10.33	3.61	1.000	
		Linear	0.9544	45.35	10.08	0.900	
Death		polynomial	0.9932	6.88	2.64	1.000	
		Linear	0.9588	41.77	16.85	0.465	

Results

The earliest graph retrieved by the Planning Chamber data consisted of verified cases (see Figure 1), which displayed data between 3 March and 25 March. Israel's first lockdown restrictions began on 19 March; thus, the added verified cases on 25 March address citizens infected several days earlier, with symptoms, which were tested and found positive, likely before the lockdown began. The exponential growth with its associated R-squared value, which may imply the fear of the mysterious virus that was wildly spreading those days, characterized the early stage of the pandemic.[30,31]

An analysis of the COVID-19 spread during the first lockdown between 26 March and 12 April revealed that the lockdown affected COVID-19 spread rates, and although the number of verified cases continued to grow, the growth rate changed from exponential to linear growth (see Figure 2). A change to a polynomial equation provided slightly better results, with

$$y = -10.518^{\prime 2} + 715.11x + 1667.9, \ R^2 = 0.9967.$$

The phenomena of transitioning from exponential growth in early days to a steady polynomial growth occurred in many countries.[31,32]

Exponential growth involves a constant multiplier that drives an increase/decrease over time,

$$Exp(t) = ka^t, \ \frac{dExp}{dt} = ka^t lna.$$

Linear growth occurs at a constant rate, with equal increments added /subtracted over time,

$$Lin(t) = a_0 + a_1 t, \ \frac{dLin}{dt} = a_1.$$

Linear growth $(Lin(t) = a_0 + a_1 t)$, quadratic growth $(Q(t) = a_0 + a_1 t + a_2 t^2)$, and power growth $((Pow(t) = t^n))$ are special cases of polynomial growth:

$$Pol(t) = a_0 + a_1 t + +a_n t^n.$$

Any exponential growth function will grow significantly faster (long term) than any polynomial function (i.e. there exists t_1, such that $Pol(t) < Exp(t)$ for all $t \geq t_1$ when $k > 0, \ a > 1$).

Support for the changing nature of the COVID-19 spread was found by analysis of other western counties, and the effect of lockdowns, colored with red dots, demonstrated a couple of weeks later, prior to the partial release, colored with yellow dots.

This change was found both in daily verified cases data (Figure 3) and in daily death cases (Figure 4) and provided some support to the preferred linear COVID-19 spread over the polynomial alternative.

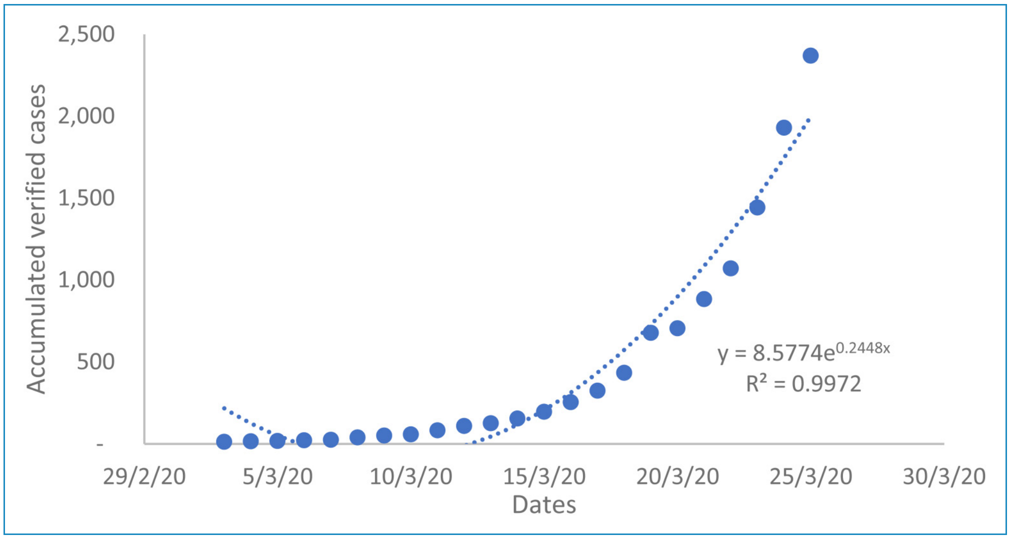

Figure 1. Verified cases 3.3–25.3.

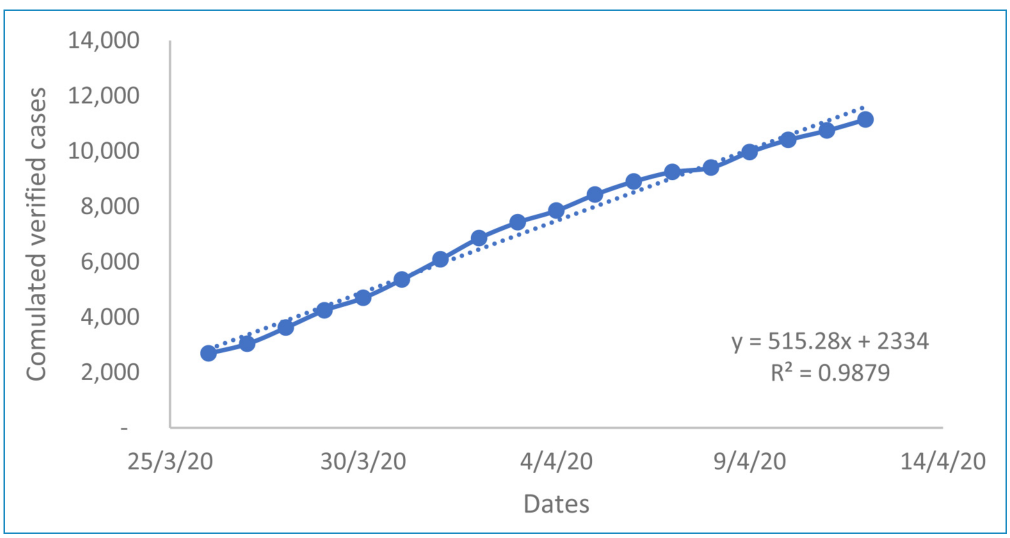

Figure 2. Verified cases 26.3–12.4.

An analysis of light-condition cases in the timeframe described above was best illustrated with a polynomial equation (see Figure 5). The data referred to active cases and omitted recovered cases. The number of light condition cases increased, but with diminishing slope.

A linear equation provided slightly inferior results with

$$y = 408.5x + 2490.2, \; R^2 = 0.9657.$$

A similar analysis of mild condition cases in the mentioned timeframe between 26 March and 12 April revealed that the lockdown led to a decrease of mild condition active cases (see Figure 6). A linear equation provided significantly inferior results with

$$y = 7.3798x + 67.725, \; R^2 = 0.7209.$$

A possible explanation of some misalignments between the reported data and the graph produced of mild condition cases may be related to issues with data, such as uniformity and quality of patients' definition.[13]

An analysis of active serious condition cases in the timeframe described above between 26 March and 12 April during the lockdown was best illustrated by a polynomial equation (see Figure 7). A linear equation provided excellent results as well, though, slightly inferior as follows:

$$y = 8.2848x + 38.183, \; R^2 = 0.9875.$$

The behavior of the life-support condition active cases was similar to the other condition types, and during the

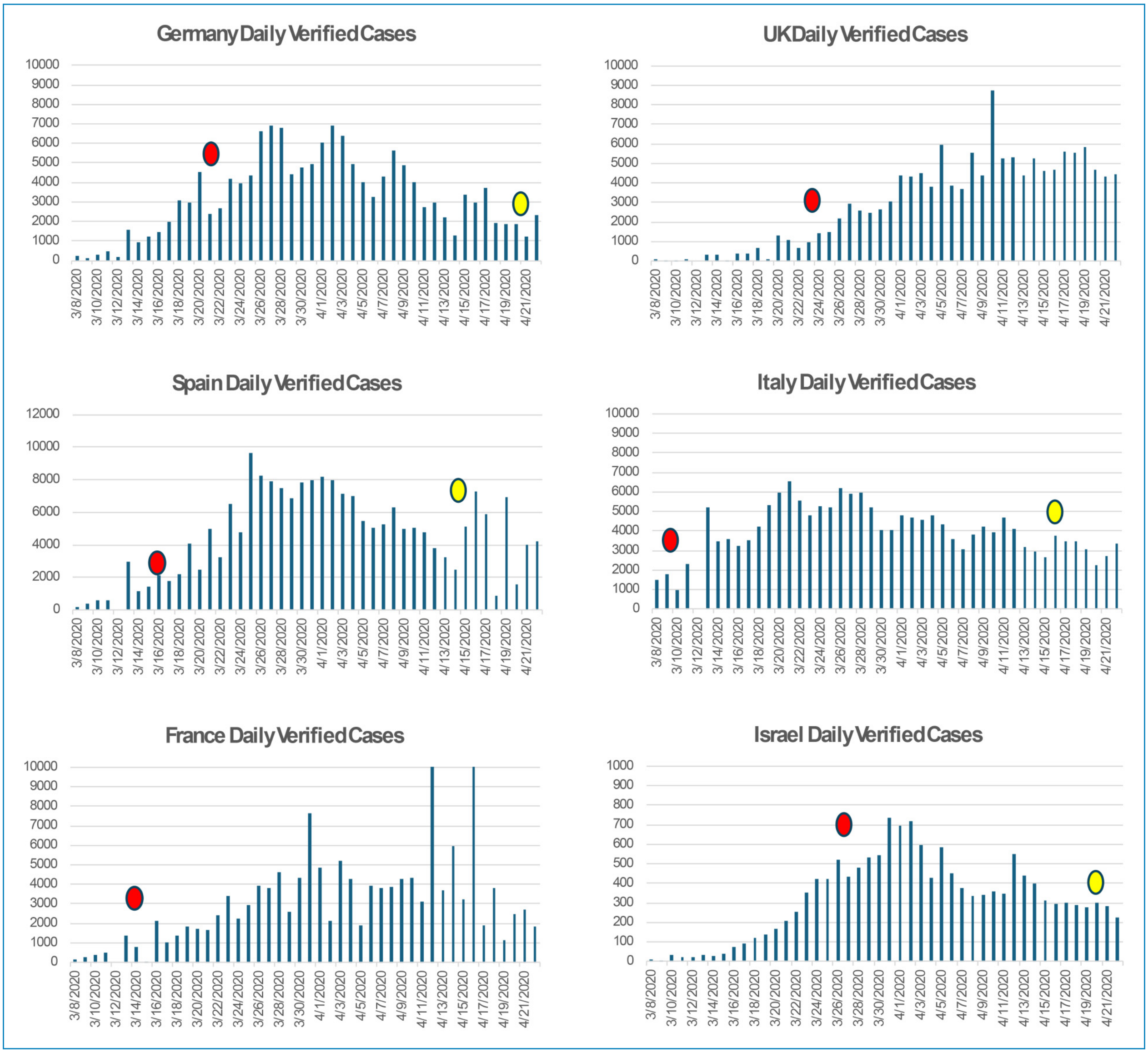

Figure 3. Verified cases in five European countries 08.3–22.04.

lockdown, the polynomial equation described best the growth in numbers (see Figure 8).

Likewise, a linear equation provided also acceptable results, albeit being slightly inferior as follows:

$$y = 5.937x + 34.987, \ R^2 = 0.9544.$$

Sometimes, the Planning Chamber preferred to adopt forecasts despite their apparent results. The death forecast is an example for such cases. The equation with the superior fit was again polynomial with R^2 approaching 1 (see Figure 9(a)), while the linear equation generates an inferior R^2 of 0.9588 (see Figure 9(b)). Though, taking into account the slowing growth in COVID-19 spread due to the lockdown effect, together with a visual glimpse at the two graphs, may suggest that despite the different R^2 results, the linear equation potentially might better forecast the increase in death cases in the near future.

Chi-squared, P values, and mean square error results of the graphs above are presented in Table 1. In some cases, where trendlines provided significant R^2 values, and the visual graphs supported the convergence of the reported cases with the forecasted cases, a future analysis revealed that the forecasted data were almost perfect. One example was when the Planning Chamber anticipated on 5 April that on 12 April, 184 serious condition cases would be hospitalized (the analyses results were 183.84 and rounded to 184), whereas a week later, the actual amount of serious condition cases was 183.

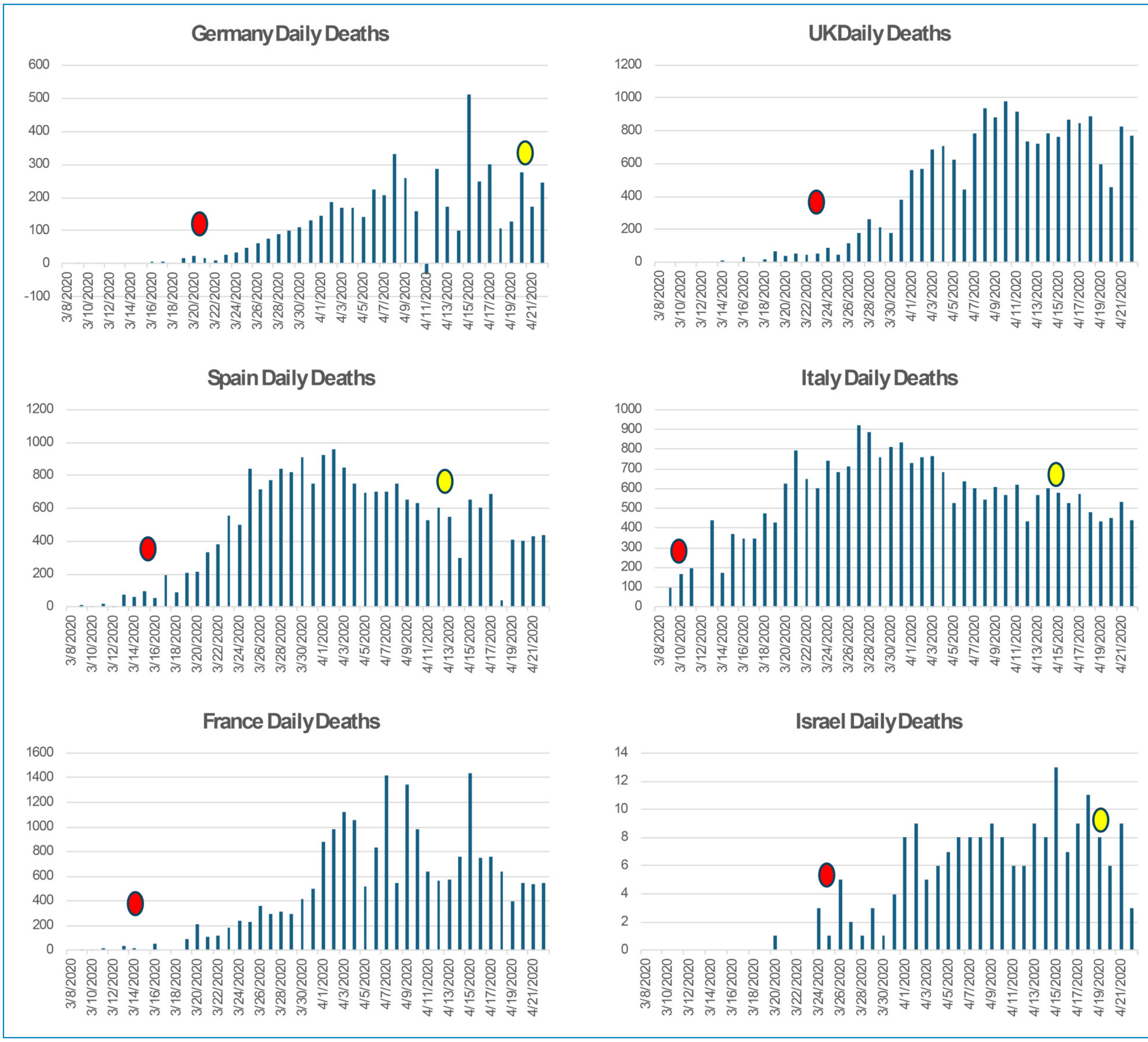

Figure 4. Daily deaths in five European countries 08.3–22.04.

Discussion

Data analysis usually requires commercial statistical packages that might not be readily available at least not at a specific computer used for data collection. However, most everyday computers are equipped with word processing and spreadsheet software like Microsoft® Office.[33] Alvarez et al.[23] argued that a decade ago, mathematical modeling of epidemic events was the realm of privileged epidemiologists who had (a) a fast computer, (b) programing experience, and (c) and access to epidemiological data, whereas today, these three ingredients are reduced to a convectional laptop, and thus, mathematical modeling of epidemic can be carried out with Microsoft® Excel spreadsheet. Hence, Excel can easily support nowadays data analysis activities in the medical domain,[33] as well as data analysis activities in various COVID-19 areas, including forecasting the progression of an epidemic,[23] survival analysis,[34] death probability,[35] or in modeling vaccination strategies.[36]

Nevertheless, in addition to the growing ubiquity of laptops, it is argued that substantial mathematical expertise is still often required for the implementation of mathematical modeling,[12,31] involves assumptions and measures, such as social distancing and testing efforts,[23] and requires statistical expertise, which also encompasses assumptions.[35]

The quality of the response to COVID-19 challenges is influenced by the level of preparedness,[4] and thus, simple analysis process, which led to accurate forecast,[23] increased the availability of human and material resources by formulation of a plan of action[23] and enabled the HFC Medical Commander to manage the HFC medical activities more

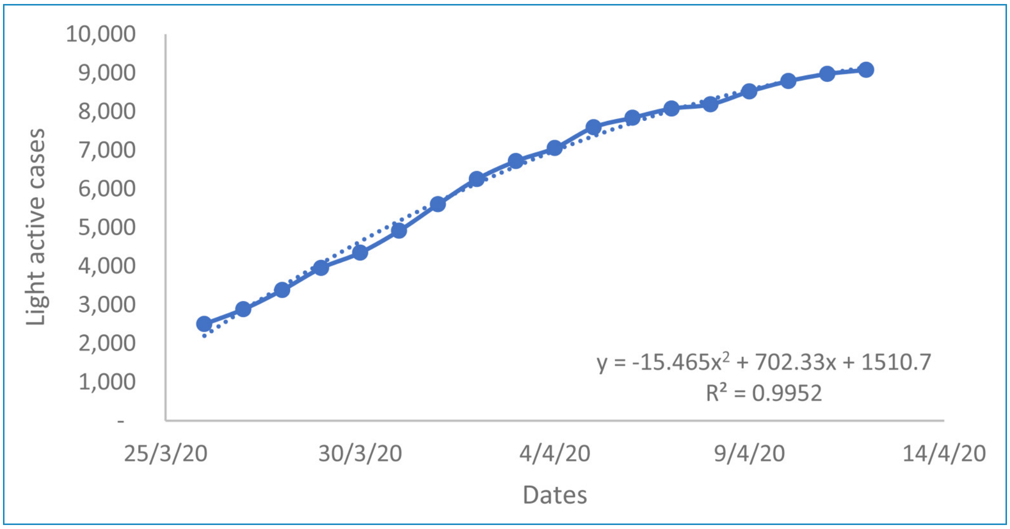

Figure 5. Light cases 26.3–12.4.

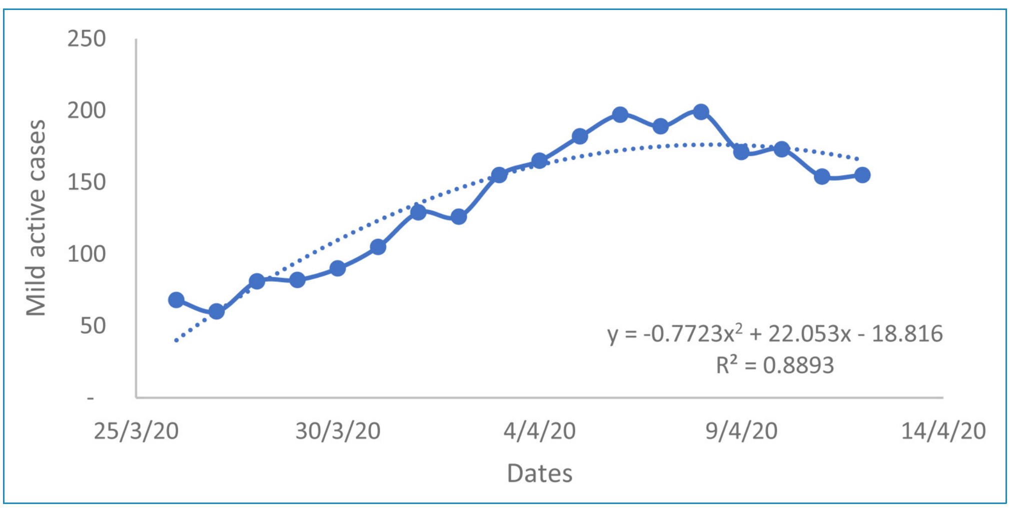

Figure 6. Mild cases 26.3–12.4.

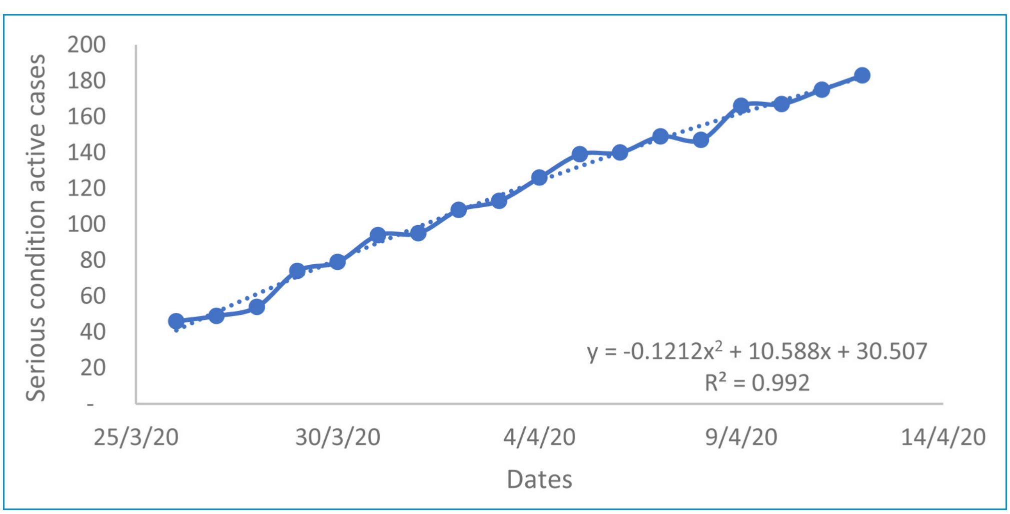

Figure 7. Serious condition cases 26.3–12.4.

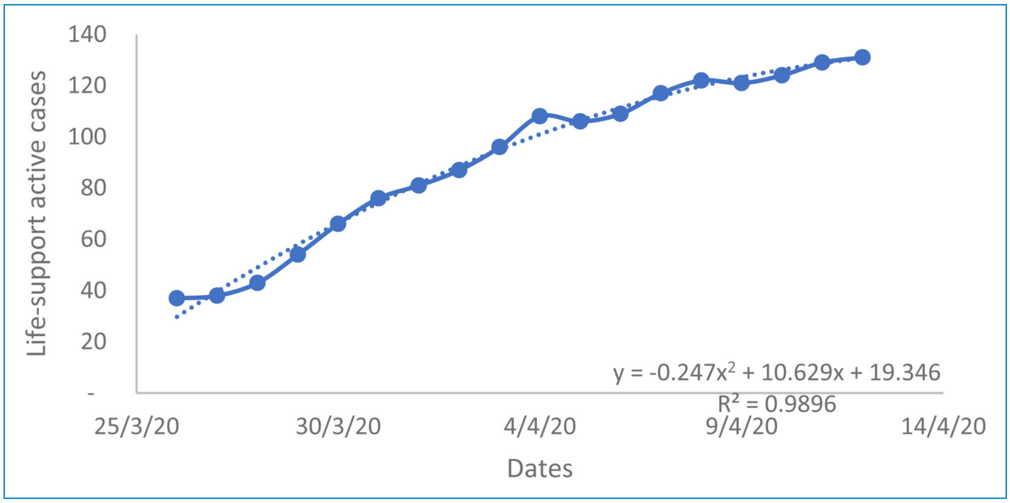

Figure 8. Life-support cases 26.3–12.4.

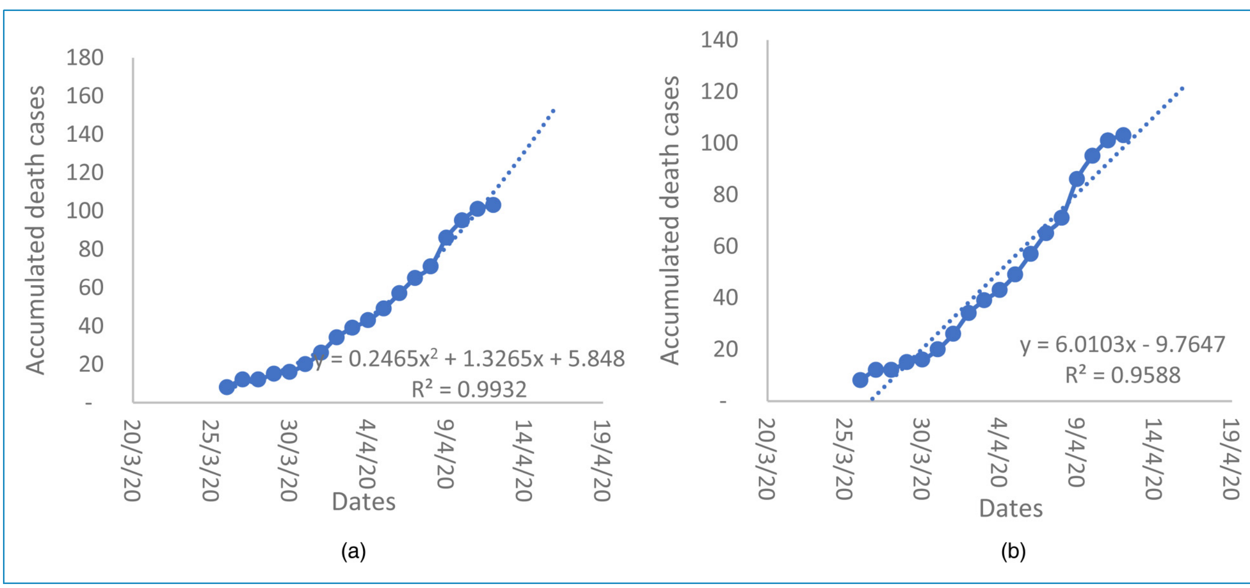

Figure 9. (a) Death cases 26.3–12.4. (b) Death cases 26.3–12.4.

precisely[4] with a somewhat less uncertainty of the future requirements that were under her responsibility. While forecast activities were short-term, they adequately supported HFC needs and provided evidence of the Israeli army and its HFC capabilities to handle new and unplanned international and national challenges.

The HFC Medical Commander's request for forecast predictions was met, and the desired 1-week notice period was pursued. This timeframe proved appropriate, allowing sufficient time for organizing activities and achieving higher accuracy levels compared to longer forecast durations. This forecast decision was later applied by Sprecher's team.[13]

Furthermore, decades of studies on disaster management highlighted the importance of actions for prevention and preparedness.[4] Thus, the quick response by nonexperts, relying solely on Excel's built-in functionalities without using any mathematical or statistical equations or making assumptions, likely impacted the quality of the response and the level of preparedness of the Israeli HFC.

The first author served in reserve duty a total of 180 days during 2020, in several periods. The first period ended on May 21st 2020, exactly 3 months after the first COVID-19 case was identified. By that time, early national forecast attempts were made, two noticeable endeavors were Gartner Institute forecast model, followed by Prof. Eli Sprecher model, from Tel Aviv Sourasky Medical Center.[13] The recognition that the forecast challenge was now carried out by national and expert personnel led the Planning Chamber to cease its forecasting activities and focus on other HFC challenges in light of the available forecasts.

The efforts described above, carried out with a popular and standard spreadsheet software, may demonstrate the potential impact of proficiency in of-the-shelf productivity tools and the value associated with profound training of knowledge workers in productivity tools.

However, demographic characteristics and differences in COVID-19 spread trends may imply the importance of adoption of the appropriate resolution, where the nature of COVID-19 spread may be better explained at a regional level.[4]

However, the present study has some limitations. First, it relied on public COVID-19-related data, which might have inconsistencies or inaccuracies. Issues with data quality and uniformity, such as patient definitions, could have affected the validity of the results. Second, the analysis focused on a specific set of data and variables (e.g., verified cases, severity of cases), potentially overlooking other important factors, such as the time of exposure, quantum production rate, mask wearing, and the infector proportion, required for public health policies when evaluating the spread risk.[8] Third, the methods and findings might be specific to the context of the Israeli Home Front Command and the COVID-19 situation in Israel and to the variants that existed at that time, where new variants or new respiratory viruses may affect the spread trajectory,[8] and new protection measures, including on air and sea traffic,[4] may limit the applicability of the results to other countries or contexts. Lastly, the reliance on data from the Ministry of Health and other public sources may introduce biases based on how the data were reported and collected during the pandemic.

Conclusion

The COVID-19 outbreak required swift, decisive actions under significant uncertainty. In Israel, the Israeli Home Front Command (HFC) managed substantial responsibilities, necessitating effective resource management without a comprehensive COVID-19 forecast. This study detailed the Planning Chamber's efforts, which, under the HFC Medical Commander, collected public COVID-19 data and provided weekly forecasts on case severities and deaths using Microsoft® Excel. The forecasting activities enabled effective resource management, supporting HFC operations during the pandemic. The methods, despite their simplicity, were successful and demonstrated potential for use in future scenarios involving unknown phenomena and lacking expertise. In conclusion, while nonexpert forecasting was essential and beneficial, it should be a temporary measure until expertise is available. Identifying major events, such as lockdowns, is crucial due to their impact on spread rates. The Planning Chamber's approach, despite the expertise gap, provided valuable insights for HFC's COVID-19 response, highlighting the importance of quick, data-driven decision support in crisis situations. We acknowledge our study's limitations and suggest further research to explore relationships between verified cases and spread rates in other contexts, such as other countries and other viruses, to better understand the contribution extent of nonexpert efforts.

Acknowledgments: None.

Contributorship: Idan Roth who headed the Planning Chamber team was responsible for data collection, data analysis, literature review, and the first draft. Arthur Yosef was responsible for editing and for the second draft. All authors reviewed the manuscript and approved its final version.

Declaration of conflicting interests: The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical approval: This work relies on aggregated and anonymous data; thus, an ethic committee was not needed.

Funding: The authors received no financial support for the research, authorship, and/or publication of this article.

Guarantor: Idan Roth.

ORCID iD: Idan Roth https://orcid.org/0000-0001-6944-2665

References

1. Fanelli D and Piazza F. Analysis and forecast of COVID-19 spreading in China, Italy and France. *Chaos Solitons Fractals Internet* 2020; 134: 109761.
2. Cesari M and Proietti M. COVID-19 in Italy: ageism and decision making in a pandemic. *J Am Med Dir Assoc Internet* 2020 [cited 2024 Jul 7]; 21: 576–577.
3. Maor M, Sulitzeanu-Kenan R and Chinitz D. When COVID-19, constitutional crisis, and political deadlock meet: the Israeli case from a disproportionate policy perspective. *Policy Soc Internet* 2020; 39: 442–457.
4. Sanfelici M. The Italian response to the COVID-19 crisis: lessons learned and future direction in social development. *Int J Community and Social Development Internet* 2020; 2: 191–210.
5. Khan M, Adil SF, Alkhathlan HZ, et al. COVID-19: a global challenge with old history, epidemiology and progress so far. *Molecules Internet* 2020; 26: 39.
6. Cui J, Li F and Shi Z-L. Origin and evolution of pathogenic coronaviruses. *Nat Rev Microbiol Internet* 2019 [cited 2024 Jul 8]; 17: 181–192. https://www.nature.com/articles/s41579-018-0118-9
7. Kesheh MM, Hosseini P, Soltani S, et al. An overview on the seven pathogenic human coronaviruses. *Rev Med Virol Internet* 2022; 32. http://dx.doi.org/10.1002/rmv.2282.

8. Rowe BR, Canosa A, Meslem A, et al. Increased airborne transmission of COVID-19 with new variants, implications for health policies. *Build Environ Internet* 2022; 219: 109132.
9. Choi Y, Zou L and Dresner M. The effects of air transport mobility and global connectivity on viral transmission: lessons learned from COVID-19 and its variants. *Transp Policy (Oxf) Internet* 2022; 127: 22–30.
10. Pang J, He Y and Shen S. High-speed railways and the spread of COVID-19. *Travel Behav Soc Internet* 2023; 30: 1–10.
11. Coşkun H, Yıldırım N and Gündüz S. The spread of COVID-19 virus through population density and wind in Turkey cities. *Sci Total Environ Internet* 2021; 751: 141663.
12. Mandal M, Jana S, Nandi SK, et al. A model based study on the dynamics of COVID-19: prediction and control. *Chaos Solitons Fractals Internet* 2020; 136: 109889.
13. Steinberg DM, Balicer RD, Benjamini Y, et al. The role of models in the COVID-19 pandemic. *Isr J Health Policy Res Internet* 2022; 11. http://dx.doi.org/10.1186/s13584-022-00546-5.
14. Sperrin M and McMillan B. Prediction models for COVID-19 outcomes. *BMJ Internet* 2020: m3777. http://dx.doi.org/10.1136/bmj.m3777.
15. Boldog P, Tekeli T, Vizi Z, et al. Risk assessment of novel coronavirus COVID-19 outbreaks outside China. *J Clin Med Internet* 2020; 9: 571.
16. Bo W, Ahmad Z, Alanzi ARA, et al. The current COVID-19 pandemic in China: an overview and corona data analysis. *Alex Eng J Internet* 2022; 61: 1369–1381.
17. Ioannidis JPA, Cripps S and Tanner MA. Forecasting for COVID-19 has failed. *Int J Forecast Internet* 2022; 38: 423–438.
18. Inchi L, Bord S and Madjar B. Lessons from the epidemiological investigation efforts during the COVID-19 epidemic in Israel. *Eur J Public Health Internet*. 2022; 32(Supplement_3). http://dx.doi.org/10.1093/eurpub/ckac131.086
19. Sullivan DJ, Focosi D, Hanley DF, et al. Outpatient randomized controlled trials to reduce COVID-19 hospitalization: Systematic review and meta-analysis. *J Med Virol Internet* 2023; 95. http://dx.doi.org/10.1002/jmv.29310.
20. Levy Y. The people's army "enemising" the people: the COVID-19 case of Israel. *Eur J Int Secur Internet* 2022; 7: 104–123.
21. IDF Efforts to Help Civilians During COVID-19 *Internet* IDF Editorial Team. 2020 Oct 11, https://www.idf.il/en/mini-sites/idf-s-response-to-covid-19/idf-efforts-to-help-civilians-during-covid-19/
22. Blood donation saves lives and so does the IDF *Internet* IDF Editorial Team. 2023 Jun 14, https://www.idf.il/en/articles/2023/blood-donation-saves-lives-and-so-does-the-idf/#:~:text=The%20IDF%20decided%20to%20create,medical%20and%20blood%20services%20organization.
23. Alvarez MM, González-González E and Trujillo-de Santiago G. Modeling COVID-19 epidemics in an Excel spreadsheet to enable first-hand accurate predictions of the pandemic evolution in urban areas. *Sci Rep Internet* 2021; 11. http://dx.doi.org/10.1038/s41598-021-83697-w.
24. Barreto H. Why excel? *J Econ Educ Internet* 2015; 46: 300–309. http://www.jstor.org/stable/43610486
25. Mondal H and Mondal S. Sample size calculation to data analysis of a correlation study in Microsoft Excel®: a hands-on guide with example. *Int J Clin Exp Physiol* 2016; 3: 180–189.
26. Palocsay SW, Markham IS and Markham SE. Utilizing and teaching data tools in Excel for exploratory analysis. *Journal of Business Research Internet* 2010; 63: 191–206. https://ideas.repec.org/a/eee/jbrese/v63y2010i2p191-206.html
27. Reed DD and Dixon M. Using Microsoft Office Excel® 2007 to conduct generalized matching analyses. *J Appl Behav Anal Internet* 2009; 42: 867–875.
28. Scott RW. Taking data apart: tools are proliferating as businesses strive to turn their data into information they can act on. *Account Technol* 2006; 22: 18.
29. Obiri-Yeboah J. Job satisfaction level for proactive management: a case study at Jovay Mine Ghana Limited. *J Hum Resour Manag Internet* 2020; 8: 76.
30. Musa SS, Zhao S, Wang MH, et al. Estimation of exponential growth rate and basic reproduction number of the coronavirus disease 2019 (COVID-19) in Africa. *Infect Dis Poverty Internet* 2020; 9. http://dx.doi.org/10.1186/s40249-020-00718-y.
31. Sharma VK and Nigam U. Modeling and forecasting of COVID-19 growth curve in India. *Trans Indian Natl Acad Eng Internet* 2020; 5: 697–710.
32. Komarova NL, Schang LM and Wodarz D. Patterns of the COVID19 pandemic spread around the world: exponential vs power laws *Internet*. bioRxiv. 2020. http://dx.doi.org/10.1101/2020.03.30.20047274
33. Lucijanić M. Survival analysis in clinical practice: analyze your own data using an Excel workbook. *Croat Med J Internet* 2016; 57: 77–79.
34. Lucijanić M. An update to the custom-made MS Excel workbook performing the log-rank test with extended functionality and a new original COVID-19 training data set. *Croat Med J Internet* 2021; 62: 531–533.
35. Junior ADN, da Silva BA, Dal-Pizzol F, et al. A two-wave epidemiological model of COVID-19 outbreaks using MS-Excel®. *Arch Clin Biomed Res* 2021; 5: 298–312.
36. Alvarez MM, González-González E and Trujillo-de Santiago G. Modeling COVID-19 epidemics in an Excel spreadsheet to enable first-hand accurate predictions of the pandemic evolution in urban areas. *Sci Rep Internet* 2021; 11. http://dx.doi.org/10.1038/s41598-021-83697-w.

Appendix

Date	Verified cases	Light condition	Mild condition	Serious condition	Life-support condition	Deaths
03-03-2020	12					
04-03-2020	15					
05-03-2020	17					
06-03-2020	21					
07-03-2020	25					
08-03-2020	39					
09-03-2020	50					
10-03-2020	58					
11-03-2020	82					
12-03-2020	109	109				
13-03-2020	126	126				
14-03-2020	154	154				
15-03-2020	195	195				
16-03-2020	254	254				
17-03-2020	324	324				
18-03-2020	433	433				
19-03-2020	677	644	13	6	6	
20-03-2020	705	662	17	10	10	1
21-03-2020	883	810	21	15	15	1
22-03-2020	1071	984	25	24	15	1
23-03-2020	1442	1339	32	29	29	1
24-03-2020	1930	1790	47	37	31	4
25-03-2020	2369	2213	54	39	34	5
26-03-2020	2693	2503	68	46	37	8
27-03-2020	3035	2885	60	49	38	12
28-03-2020	3619	3383	81	54	43	12
29-03-2020	4247	3952	82	74	54	15

(continued)

Appendix Continued.

Date	Verified cases	Light condition	Mild condition	Serious condition	Life-support condition	Deaths
30-03-2020	4695	4349	90	79	66	16
31-03-2020	5358	4916	105	94	76	20
01-04-2020	6092	5602	129	95	81	26
02-04-2020	6857	6252	126	108	87	34
03-04-2020	7428	6718	155	113	96	39
04-04-2020	7851	7059	165	126	108	43
05-04-2020	8430	7594	182	139	106	49
06-04-2020	8904	7841	197	140	109	57
07-04-2020	9248	8075	189	149	117	65
08-04-2020	9404	8186	199	147	122	71
09-04-2020	9968	8522	171	166	121	86
10-04-2020	10,408	8790	173	167	124	95
11-04-2020	10,743	8972	154	175	129	101
12-04-2020	11,145	9077	155	183	131	103