Understanding COVID-19

REPORT BY THE COVID-19 ADVISORY TEAM
TO THE PRESIDENT OF THE POLISH ACADEMY OF SCIENCES

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Table of Contents

About the authors 4

Executive summary 6

1. Introduction 7

2. Basic facts and figures 12
   2.1 Mechanism underlying the emergence of new infectious diseases 12
   2.2 The COVID-19 epidemic 13
      2.2.1 The initial phase 13
      2.2.2 Seasonal cycles and multiannual regional correlations 16
      2.2.3 Transmission routes 21
   2.3 Pathogenesis and clinical course of COVID-19 21
   2.4 Extrapulmonary manifestations of the disease 22
   2.5 Long-term consequences of COVID-19 22

3. The current state of affairs 23
   3.1 Prevention 23
      3.1.1 Methods of preventing and containing transmission 23
         Contact tracing apps 23
      3.1.2 Vaccines 24
         Types of vaccines under development 24
         Efficacy 24
         Safety and potential risks 25
      3.1.3 Immunity 25
         Does immunity wane over time? 25
         The role of IgG, IgA, T-cells in mucous membrane diseases 25
         Is anyone naturally immune to infection? Genetics vs. COVID-19 26
   3.2 Treatment 26
      3.2.1 Antiviral drugs 26
         Drugs with proven efficacy 26
         Drugs with unproven efficacy 27
         Development of new drugs 27
      3.2.2 Immunomodulatory drugs 27
         Steroids 27
         Modulation of immune response 27
         Tuberculosis vaccine? 28
      3.2.3 Assisted breathing, mechanical ventilation and intensive care 28
   3.3 Polish society in times of pandemic 28
      3.3.1 Psychological consequences of COVID-19 33
      3.3.2 Economic consequences of the COVID-19 epidemic in Poland 35

TABLE OF CONTENTS

4. Forecasts and recommendations 36
4.1 The autumn-winter season 36
Virus transmission, temperature and humidity 37
General state of health and respiratory condition 37
Co-infections 38
Air pollution 38
Possible scenarios 38
4.2 Preparing for the autumn-winter season 39
Threats in the autumn-winter season 39
Opening up schools and universities 40
Flu vaccines 40
Cooperation – Europe 41
4.3 Society 41
The second wave and easing up: a matter of trust 41
Views and social behavior vs the dynamics of the epidemic: implications for recommendations 43
4.4 Summary and recommendations 44
4.4.1 What threat does COVID-19 pose to people at various ages? 44
4.4.2 General recommendations for the public 45
4.4.3 The group most at risk: adults 65+ with chronic diseases 49
4.4.4 Preparing for potential SARS-CoV-2 infection on the part of adults 65+. 51
4.4.5 Recommendations for public authorities and the media 51
4.4.6 Concluding remarks 53

5. Acknowledgments 53

6. References 54
Trustworthy websites 54
Selected scientific publications 56

7. Appendices 67
Timeline of the epidemic in Poland 67
Global timeline of the epidemic 73
Decision no. 27/2020 of the President of the Polish Academy of Sciences dated 30 June 2020 on Establishing an Interdisciplinary COVID-19 Advisory Team to the President of the Polish Academy of Sciences 75
Position Statement no. 1 of the COVID-19 Advisory Team to the President of the Polish Academy of Sciences 76
Position Statement no. 2 of the COVID-19 Advisory Team to the President of the Polish Academy of Sciences 76

List of figures 78

List of tables 78

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Executive summary

We resolved to put together this present Report, as a compendium of knowledge about the SARS-CoV-2 virus and the disease it causes – COVID-19 – in view of the following considerations:

1. We wished to systematize the information on COVID-19 that has accumulated during the months since the new disease's emergence in December 2019. Scientific publications on this subject are now running into the thousands (to be exact, 55,932 such works had been published as of 7 September 2020). Their number increased by 12,972 in July alone, which translates into 418 new scientific works dealing with COVID-19 or SARS-CoV-2 being published every day. On top of this, we should note the tens of thousands of press releases and millions of posts on social media. Barraged by such a plethora of often conflicting information, the public at large has unfortunately become more and more disoriented and therefore increasingly prone to succumbing to nonsensical, fallacious views on the COVID-19 epidemic. Irrational attitudes started to emerge in society, seriously hampering the management of the COVID-19 epidemic – a fight which will nevertheless need to be managed rationally if it is to be won.
2. By means of this Report, we wish to set the public discourse onto a rational track. Herein we review how scientists have been responding to the pandemic situation and demonstrate how the wholly novel phenomenon of COVID-19 is becoming better and better understood. We point out that every scientifically-backed assertion is underpinned by robust research findings, documented by scientific publications in reputable scientific journals. We also indicate that in moments of rapid progress in science, many scientific opinions end up getting challenged or reconsidered, which is only legitimate and natural.
3. Our aim is also to partake more broadly in international cooperation, to draw on the experiences gained by other countries and offer our own experiences in fighting the COVID-19 epidemic to date, to be shared with the international scientific community. Hereby we would like to provide our foreign partners with a broad overview of the Polish context of the COVID-19 pandemic; we hope this Report will make it easy for them to grasp the Polish situation.
4. We are of the opinion that Poland needs a team of experts who are competent and knowledgeable about how to manage the crisis caused by the COVID-19 epidemic. Such a team should develop an understanding of the COVID-19 epidemic and document its course. Should a future challenge appear which will be similar to the present COVID-19 epidemic, it will be possible to draw on the reports of our team, rather than having to start from scratch.

These are the motives that prompted us to prepare the present Report, which strives to describe in straightforward terms the initial period of the COVID-19 epidemic in Poland (i.e. March-September 2020). Herein we summarize how the epidemic spread in Poland's neighboring countries and worldwide. We present the current body of knowledge about the biology of the SARS-CoV-2 virus and the physiology of the COVID-19 infection, accumulated over the past eight months. We describe the methods for testing the presence of SARS-CoV-2 in infected people and available methods of treatment. We discuss the ways in which the spread of the epidemic could be contained, focusing on the mechanisms by which the virus is contracted and methods for minimizing the probability of that happening. We examine recommended public health measures appropriate in the time of epidemic and explain how and to what extent they could mitigate its spread. We highlight the economic, psychological and social consequences of the COVID-19 epidemic and outline different scenarios of how the epidemic situation could evolve in the coming months, especially during the coming autumn and winter, a season which raises our concern.

1. Introduction

The appearance in December 2019 of several cases of an atypical form of severe pneumonia surprised healthcare providers first in Wuhan, a city of 9 million in China's Hubei province, and soon thereafter across the entire province with a population of 58.4 million. A frantic race began among scientists, struggling to find the factor causing the mysterious illness and the right methods to treat it, as the epidemic spread to more and more countries. As early as 11 February 2020 the disease was named COVID-19, and three days later the pathogen (virus) that caused it was labeled SARS-CoV-2.

The intensity of the vast research effort that has been leveled against the disease is perhaps best demonstrated by the number of scientific publications which had the phrase COVID-19 or SARS-CoV-2 in their titles or abstracts (Fig. 1). In the period from 1 January through 1 September 2020, a total of 55,932 such works were published. Their number grew by 12,972 in July alone, which translates into 418 new scientific works on COVID-19 or SARS-CoV-2 being published daily. Such intense research dedicated to a single issue has no precedent. Over these months, science has made huge progress in understanding both the disease and the virus causing it.

Initially, the virus had the upper hand, being identified in 84 countries across the globe by 5 March 2020. The first COVID-19 case in Poland was confirmed on 4 March 2020, and the first death from the coronavirus disease was reported on 12 March, a day after the World Health Organization (WHO) had declared a pandemic, i.e. a worldwide epidemic. As of 5 September, cases of COVID-19 have been reported in every country around the world, with 27,075,418 total registered cases (Worldometer data), ending in 883,846 deaths globally. According to European Centre for Disease Prevention and

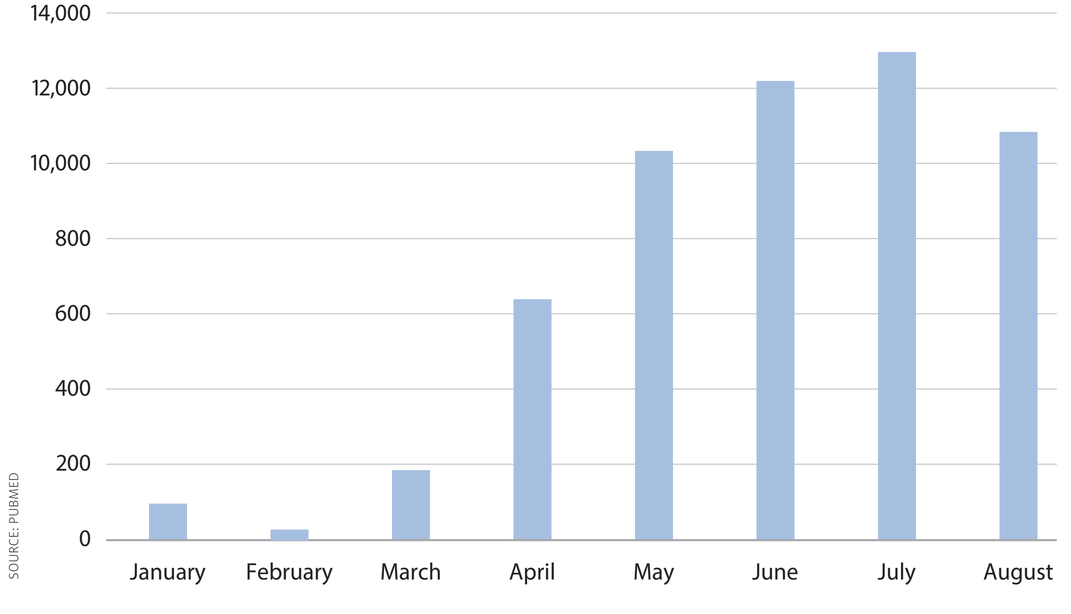


Fig. 1
Number of research publications listed in the PubMed database (as of 7 September 2020), containing the search terms COVID-19 or SARS-CoV-2 in the title or abstract

Control (ECDC) data, 69,820 COVID-19 cases and 2,100 deaths have been reported in Poland to date.

Since its very onset, the pandemic has been closely watched by governments around the world. Analyses published by A. Meijer and C.W.R. Webster show that governments are employing various information policies, depending on the level of centralization and perceived reliability. There are countries where official information policies are often contested as unreliable (the U.S., Brazil, Mexico); in others deviance from official information policies has not been tolerated due to institutional dominance (Singapore, South Korea, China); elsewhere patterns of democratic information policies have prevailed and have been largely accepted, although some specific measures have been contested (mostly in European countries and Canada).

There are many considerations suggesting that individual policies should be analyzed as elements of broader measures having political and symbolic significance. Furthermore, research indicates that, essentially, there is no single most reliable policy. For instance, decentralization does not always entail reliability, whereas centralization of information policies may sometimes go hand in hand with high perceived reliability (as is the case with Singapore, for instance). It can be said, therefore, that the reliability of information policies pursued by individual governments largely depends on the historical and cultural traditions prevalent in a given country.

A whole gamut of measures have been put in place to deal with COVID-19 (such as special mobile apps), which should be analyzed to find out whether they are reaching all sectors of society, in particular the most vulnerable groups. It is still too early to attempt to draw conclusions on the effectiveness of policies employed by individual governments, especially because any government is just one of the actors present on the "information market," not necessarily the strongest. There exist many sources of less official information, disseminated via social media. These include certain circles which contest the very existence of the pandemic or downplay its significance, which are not meagre in number and are becoming increasingly institutionalized. This intricate network of generating and exchanging information must be taken into account by all official agencies that attempt to manage information about the pandemic in such a way so as to increase the level of rationality in public discourse.

The COVID-19 pandemic has also caught the attention of the public in many countries. It offers a sneak peek into the inner workings of science, making many of us realize that we are in the midst of a dynamic process whereby a new phenomenon is studied, with scientists often making a breakthrough one day that nevertheless ends up being debunked the next day. This is how science actually works. The pandemic is a medical, social and economic disaster, but also a lesson for us all to learn. It is to be hoped that observing how science originates and what impact it has on everyday life will enhance rationality in the life of society and foster broader acceptance among the public at large for evidence-based inquiry.

Nonetheless, we can also see that resistance to rationality and reason is gaining more and more traction. Circles which propagate irrational views or even challenge the very existence of the pandemic are becoming increasingly active. A large portion of the public stands poised between these two standpoints, rational and irrational, slightly disoriented, burdened by the excess of conflicting information (which has been described as an "infodemic").

The role of scientists and the media is to expose the irrational and draw a clear distinction between it and evolving opinions or the clash of opposing hypotheses, both of which are inevitable aspects of scientific progress.

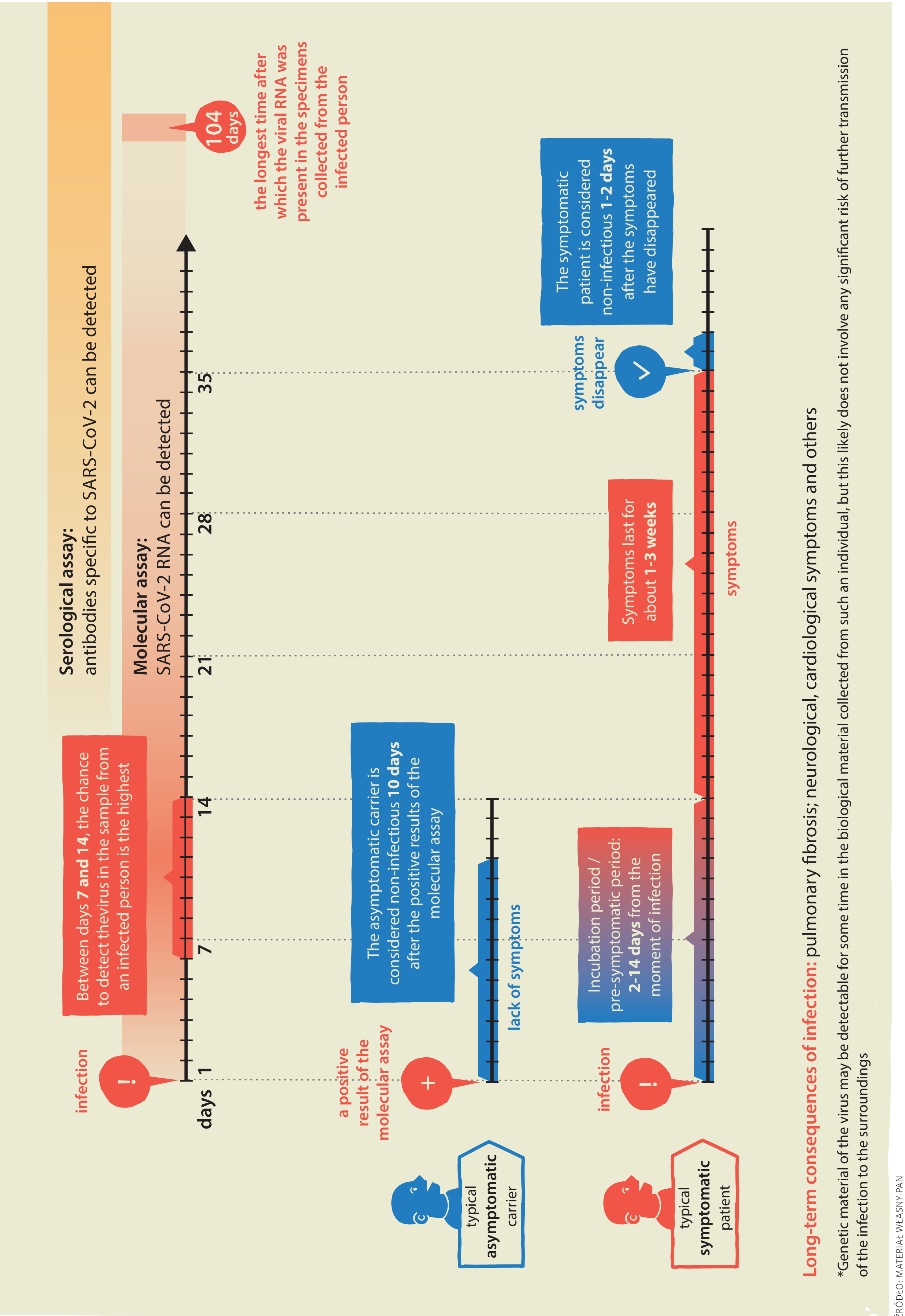


Fig. 2
Okresy miarodajności testów: molekularnego i serologicznego, w wykrywaniu zakażenia wirusem SARS-CoV-2. Na liniach dolnych przedstawiony jest przebieg u typowych pacjentów: bezobjawowej postaci choroby i objawowej postaci choroby COVID-19

Public opinion has never been so "close" to the process of scientific research with all its twists and turns, breakthroughs, and successes. Successes in the sphere of public health can only be made based on evidence-based medicine. A certain useful comparison may give a glimpse of the magnitude of the revolution currently taking place in the fight against infectious diseases and how the process of expanding our knowledge is rapidly accelerating. Namely, let us compare today's situation with 1981, the year which saw the first reports of a new disease, nowadays known as AIDS. Reliable tests detecting AIDS (all of them serological at the time) were not available until 1986–1987, whereas the debate whether the HIV virus is the real cause of AIDS continued until 1994.

In comparison, the severe acute respiratory syndrome, or SARS disease, was first recorded in 2002, while the identification of the pathogen causing it, the SARS-CoV virus, and the development of reliable tests only took several months. A revolution in molecular biology had then taken place, which notably produced the polymerase chain reaction technique (nowadays commonly known as PCR) as a basic diagnostic tool. Further honing of that technique allowed SARS-CoV-2 to be identified as causing COVID-19 roughly within a fortnight – between December 2019 and January 2020 (the first known case was identified *ex post* on 1 December 2019; on 31 December 2019 China formally declared that there were cases of a new type of pneumonia; on 10 January 2020 Australian scientists made the first sequences of the virus genome public, and as early as 13 January 2020 the Charité Hospital in Berlin made a SARS-CoV-2 test publicly available).

And so, what took researchers several years in the case of AIDS, and several months in the case of SARS, required fewer than 20 days when COVID-19 emerged. This represents colossal progress in science.

Such time pressure is quite understandable in today's increasingly globalized world, entangled in a web of immediate communications, where nearly everything can happen "right away." This has a bearing on the very process of scientific research; with a snowballing number of publications on COVID-19, in some cases editors will relax the publishing acceptance criteria so as to allow different hypotheses to be open for discussion in the shortest possible time. Such a diversity of hypotheses, if formulated via the scientific method and carefully verified and compared on the basis of data, typically characterizes the process of scientific progress. What raises concern is that the general public is not always ready to accept this fact.

While it is rather easy to expose the irrationality of patently ridiculous stereotypes not founded on any scientific method, it is much more challenging to prepare the public for the kind of differences of opinion that are natural among researchers, especially at pivotal moments for science. Some may think something along the lines of: "Hey, wait a minute, if one researcher claims one thing, and another claims the opposite, then neither of them can be trusted!" As a result, the group ready to accept irrational views may expand because confidence in science is undermined.

And this is where the media and science communicators can step in. They have a great role to play, emphasizing the difference between irrationality on the one hand and justified diversity of scientific hypotheses on the other, which is a daunting yet necessary task. Science, which is based on continually challenging the existing state of scientific knowledge, also needs public trust.

Our overarching intention in this Report is to present the current (as of early September 2020) state of knowledge regarding SARS-CoV-2 and COVID-19. We would also like to emphasize to readers that, just like every claim posited by science, every piece of information included in the Report is backed by robust scientific inquiry; on this basis we have formulated the most rational course of action, presented in our suggestions and recommendations. Be that as it may, we are well aware that some of these suggestions and recommendations could become obsolete in a month or so, to be replaced by new ones formulated on the basis of more precise studies using more advanced research techniques.

There is yet another serious consideration that prompted us to undertake work on this Report. Namely, the epidemic situation associated with COVID-19 can reasonably be expected to deteriorate in the coming autumn and winter. Grounds for recognizing this a likely course of events are provided by the following premises:

1. The demands on the healthcare system show seasonal variation, and typically peak in winter.
2. Given that adherence to public-health precautions is likely to have relaxed over the summer months, we can expect a significant increase in COVID-19 cases with local and even regional hotspots.
3. The demand on medical professionals to focus on COVID-19 hampers their ability to care for patients with other health problems. This is likely to result in an increased number of cases of chronic or undiagnosed illnesses. Additionally, the difficulty in distinguishing between infection with SARS-CoV-2 and other viruses means that many people will be completely unable to access basic medical care. Research shows clearly that patients with comorbidities experience more severe symptoms of COVID-19, which leads to an increased number of patients requiring intensive care.
4. It is likely that seasonal influenza epidemics, typical in our region, and high rates of other viral and bacterial infections in autumn and winter (the co-infection effect), combined with other factors such as lowered immunity and increased air pollution, will make the course of the disease more severe in many patients.

It is our hope that this Report will help elucidate how dangerous the enemy we have to face this autumn and winter truly is (in other words, the COVID-19 epidemic and those who deny its existence), and to help ensure that appropriate public-health requirements are complied with by society at large.

By 13 September 2020 – within six months from the first recorded death caused by COVID-19 in Poland – a total of 2182 deaths were reported (ECDC data), which is a relatively small number compared to the deaths caused by other diseases. Suffice it to say that, in Poland, about 170,000 people die every year of cardiovascular diseases, 110,000 of cancer, 30,000 of dementia, 17,000 of digestive diseases, and 7,000 of diabetes. In other words, in the last six months 39 times more people died of cardiovascular diseases, 25 times more of cancer, 7 times more of dementia, 3.9 times more of digestive diseases, and 1.6 times more people died of diabetes than the numbers who died of COVID-19. This is the reason why there is a prevalent belief in some quarters that the government and the media response to COVID-19 has been exaggerated, to say the least. Not to mention those who claim outright that it is nothing but a conspiracy.

Considerable evidence suggests that the relatively low rate of COVID-19 deaths has been due to the severe restrictions imposed on the general public and the broad lockdown of the economy introduced in Poland at an early stage of the pandemic. These drastic measures suppressed the epidemic but did not quash it completely. One bad decision, such as permitting a sporting match to be organized at an arena with a large audience of fans in attendance, or failure to make wearing of masks mandatory indoors during public gatherings, could be enough for the epidemic to fiercely break out in Poland anew.

Let us hope that science, now so extensively engaged in COVID-19 research, will soon make new breakthroughs that will help us better understand the biology of the

SARS-CoV-2 virus, the mechanisms of the COVID-19 disease, and successful methods of its treatment. We are waiting for such breakthroughs. We plan to continue to convey how our body of knowledge and COVID-19 itself change in the coming months. The present Report will act as a frame of reference for the planned next Report. By producing them, we intend to guide readers through the twists and turns of scientific knowledge on COVID-19 until effective treatments for the disease and bringing the pandemic to an end are ultimately developed.

2. Basic facts and figures

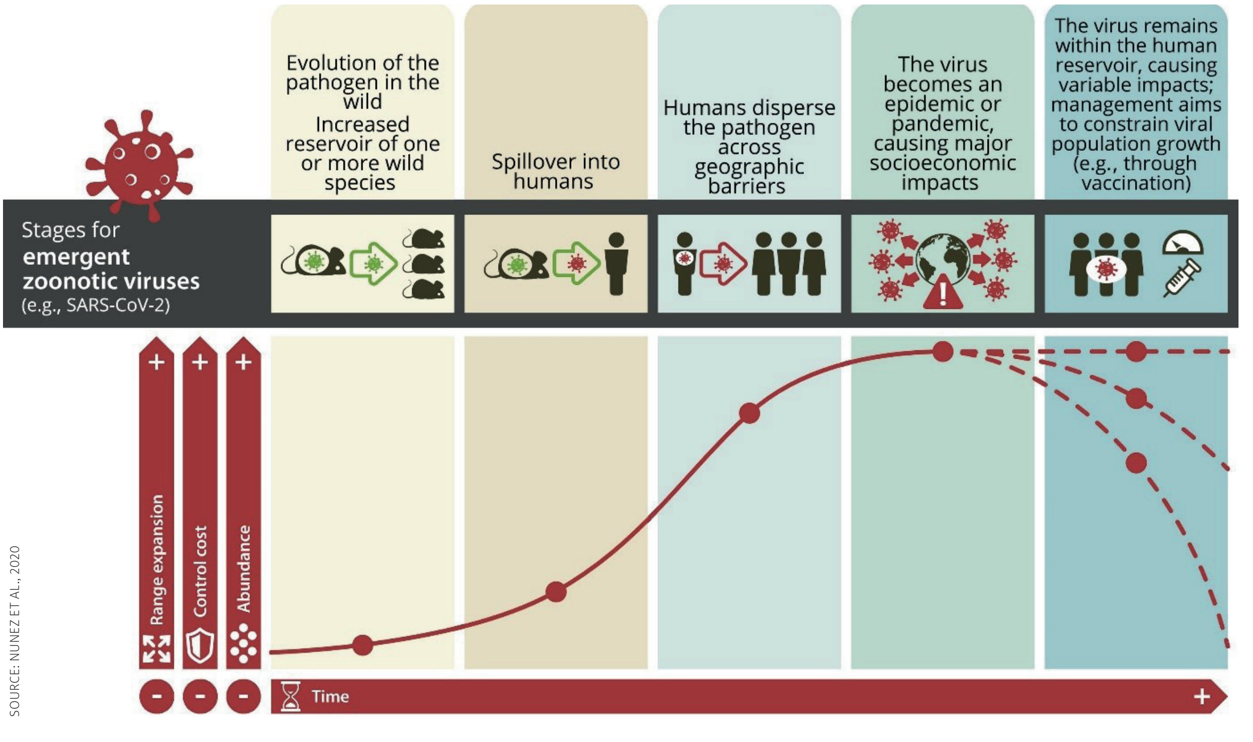
2.1 Mechanism underlying the emergence of new infectious diseases

SARS-COV-2 is a typical virus of animal origin; it causes the COVID-19 disease, classified as a zoonosis. A prevailing majority of human diseases belong to this group. Pathogen transmission between animals and humans (but also between humans and animals) takes place as part of a natural biological cycle.

Over the last seven decades, the whole world has come under increasing and accelerating anthropopressure. The natural environment is being transformed massively and broadly, which creates new conditions for pathogen circulation (viruses, bacteria, parasites) in socio-ecological niches. As a result, a wholly new ecosystem comes into being, the attributes and composition of which bring about close and frequent contacts between wild animals, domesticated animals and humans. In such surroundings, the circulation of pathogens accelerates, leading to the emergence of new diseases in conditions which are unfavorable for humans.

The crossing of the interspecies barrier and colonization of the human population by pathogens is typically modelled in terms of five stages in the lifecycle of "new" animal pathogens (Fig. 3):

Fig. 3
Stages in the development of a new epidemic



SOURCE: NUNEZ ET AL., 2020

1. The first stage takes place in the animal community, where the virus proliferates to reach critical representativeness (widespread prevalence in the environment of a given region).
2. At the second stage, the interspecies barrier between animals and humans is crossed, and a given community is colonized by the new pathogen (spillover); this is the stage when the new illness is endemic and remains undetected by public health authorities.
3. The third stage involves propagation within the human population; the disease is transmitted between humans and is discovered in communities outside of its place of origin; this is the stage at which COVID-19 was first detected in Wuhan.
4. The fourth stage encompasses the continental, and then global dissemination of the new disease and efforts to develop medical and non-medical countermeasures; after it moves to a new place, the disease spreads fast in local communities and is transmitted onward to neighboring communities through population mobility (air and road transport, social visits, professional activity).
5. At the fifth stage, a drug and/or vaccine is developed, which as a rule does not fully eradicate the pathogen from the human community, but does bring it under control.

The amount of time that passes between the subsequent stages of the model can substantially differ depending on the type of the pathogen, the way it propagates (i.e. via face-to-face contacts or by food), as well as the intensity of human interactions. Simplifying things somewhat, we can say that the same laws apply to the emergence of the SARS-CoV-2 virus, with one major difference relating to stage 4, i.e. the rate of propagation around the world. A mere six months have passed since the first COVID-19 case was recorded in Poland, and yet the number of medically confirmed cases is now in excess of 60,000 nationwide. This unprecedented speed of this process, never before observed on the scale of all of humankind, is a direct consequence of globalization, especially the mass movement of people across long distances over a short period of time.

SARS-CoV-2 is yet another virus that, like SARS and Zika, has rapidly migrated from its primary ecological niche; the difference, however, lies in the severity of the health implications of such a rapid global outbreak of the new disease. Importantly, the research findings to date indicate that COVID-19 can be transmitted between humans in all known geographical conditions.

2.2 The COVID-19 epidemic

2.2.1 The initial phase. The first reports of a new disease appeared in December 2019, when a number of severe pneumonia cases were identified in the city of Wuhan in the Hubei province. The discovery was made possible by a system alerting about unusual pneumonia cases, which had been put in place in China in the wake of the previous epidemics: SARS, MERS and influenza. The World Health Organization (WHO) was notified on 31 December 2019 when 44 cases were detected, and on 9 January 2020 the world was informed for the first time that the disease was caused by a new coronavirus, related to SARS-CoV. Since initially all cases were linked to live animals and seafood, the virus was expected to be an animal pathogen. Specialists became even more concerned once human-to-human transmission was confirmed. Even though by 23 January 2020 fewer than 400 cases had been identified, the urgent construction of a hospital for 1000 patients was commenced. On 23 January 2020 the city of Wuhan and the whole Hubei province were placed under lockdown, with partial freezing of the economy, a ban on people leaving their homes and imposition of a cordon sanitaire. Other governments around the world imposed restrictions for travelers returning from China. Initially, it was hoped that the disease would be contained within South-East Asia, or would expire with the onset of spring. However, the first cases started to be reported in Europe as early as the end of January. The initial introductions in Germany, France, Finland and the UK were effectively brought under control. The epidemic ran out of control first in Italy, followed by Spain and France, and in March 2020 Western Europe became the epicenter of the pandemic. The transmission of the virus was considerably accelerated in many countries as a result of events attracting large audiences such as festivals, sports matches, and elections. The virus reached Central and Eastern Europe with a delay, and many countries in the region imposed restrictions immediately after the first cases had been identified (Fig. 4).

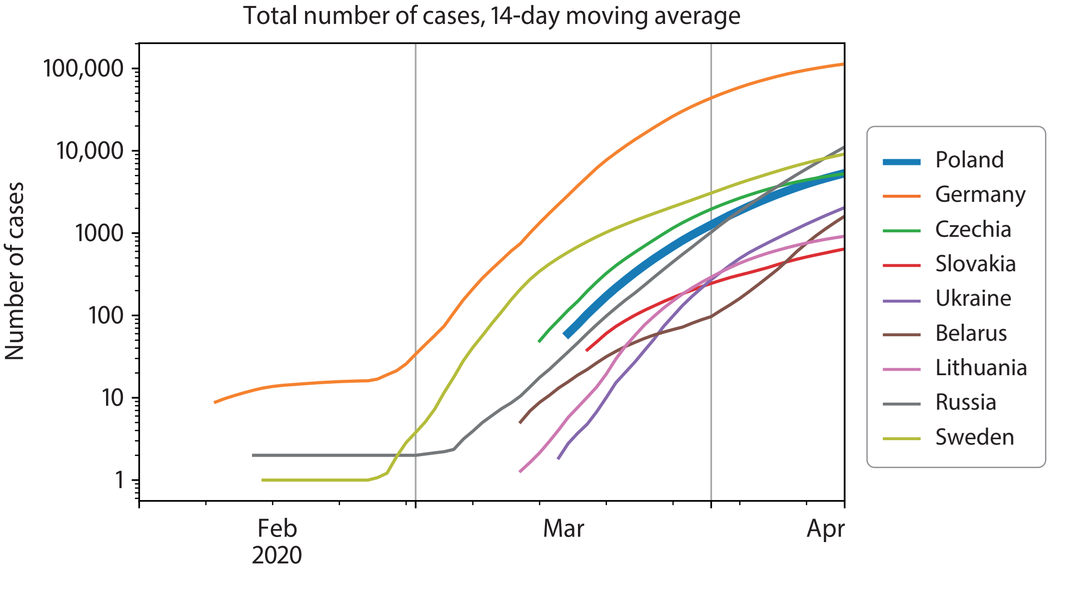
The chronology of events, lower population densities and mobilities, as well as differences in the approach taken to diagnostics are the most likely explanations for the lower overall number of cases in these countries.

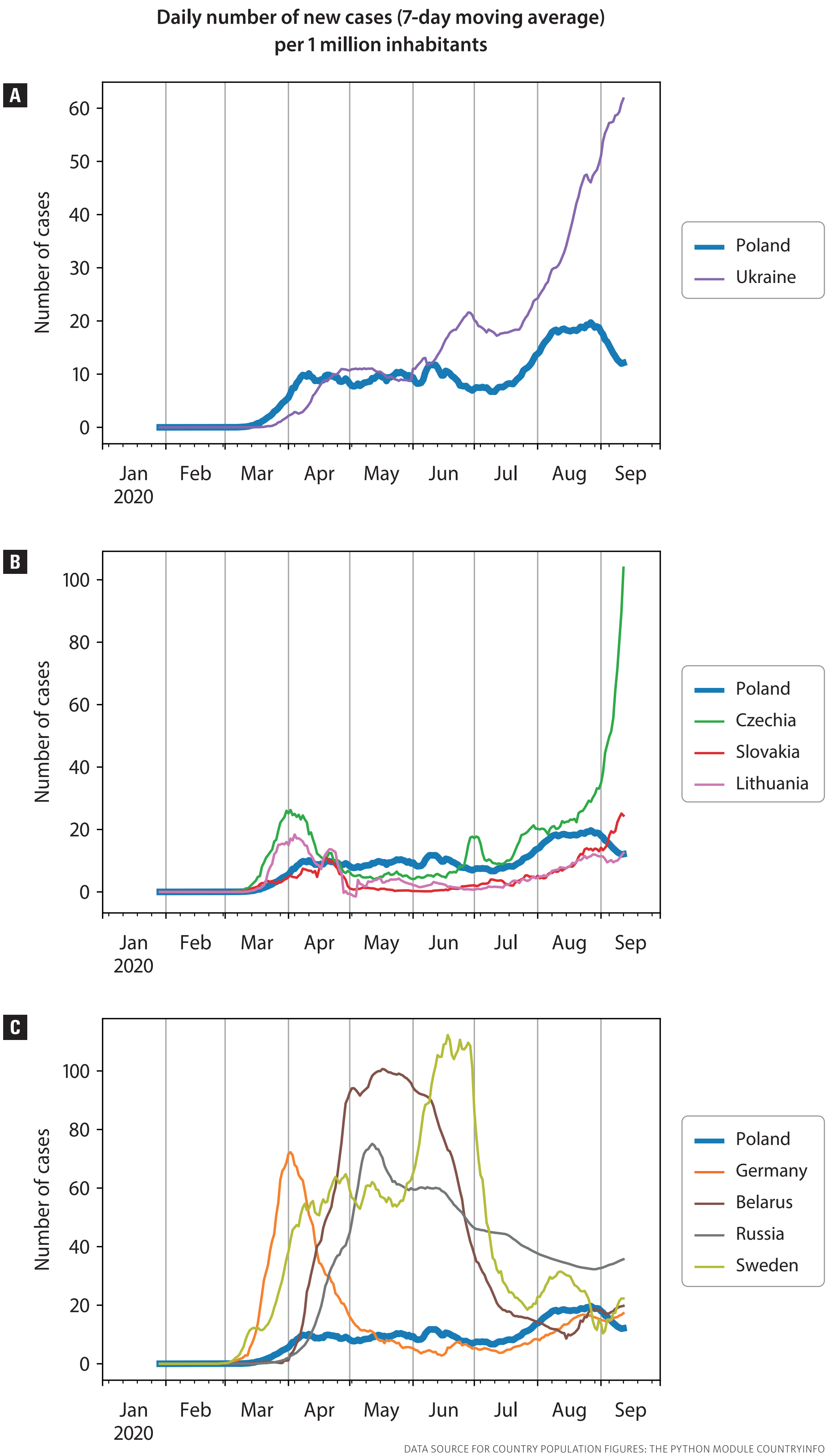
The virus quickly spread to other continents. By 5 March 2020 positive cases had been confirmed in 84 countries, and on 11 March 2020 the WHO declared the coronavirus outbreak a pandemic. A wave of infections broke out in the United States, and then in Latin American countries. The onset of winter in the southern hemisphere concurred with a drastic worsening of the situation in that region, where some stabilization could be observed as late as mid-August 2020. The infection rate is growing in Asia, notably India, and in Europe, following a relaxation of the social restrictions.

The first case in Poland was diagnosed on 4 March 2020 in a patient who had travelled from Germany. The situation that developed in Poland could largely be attributed to numerous infected travelers who came back from various European countries, mostly as part of the #LOTdoDOMU [Flight Home] campaign, when LOT Polish Airlines organized 400 flights from 70 cities on five continents within a very short period of three weeks. By mid-March 2020, about 30% of all cases were people who had contracted the disease abroad. This percentage fell to about 15% in the second half of March 2020, and to about 2–3% currently (data from the Chief Sanitary Inspectorate and the National Institute of Public Health – National Institute of Hygiene NIZP-PZH). In March 2020, most infected cases originated from the following countries: Austria (16.1%), France (13.7%), United Kingdom (13.7%), Germany (9.4%), Spain (9.1%), and Italy (7%).

Fig. 4
Cumulative number of COVID-19 cases detected in countries neighboring on Poland, 14-day moving average, for the initial period of the epidemic, from 01 February 2020 to 15 April 2020

SOURCE: COVID-19 DATA REPOSITORY BY THE CENTER FOR SYSTEMS SCIENCE AND ENGINEERING (CSSE) AT JOHNS HOPKINS UNIVERSITY, HTTPS://GITHUB.COM/CSSEGISANDDATA/COVID-19





DATA SOURCE FOR COUNTRY POPULATION FIGURES: THE PYTHON MODULE COUNTRYINFO

Fig. 5
Countries neighboring on Poland can be divided into three groups in terms of the occurrence of a "first wave" of the epidemic, understood as a surge and then a decline in the daily number of COVID-19 cases. The daily number of new cases (7-day moving average) is plotted here as a ratio, per 1 million inhabitants

A: Countries in which there was no "first wave" of the epidemic: Poland and Ukraine. In both of these countries, the daily number of new cases remained on the same level for a certain period of time. In Ukraine, however, it began to rise in June. Poland, on the other hand, maintained its daily new case numbers on a stable level all the way until mid-July, and the subsequent surge was weaker than that seen in Ukraine.

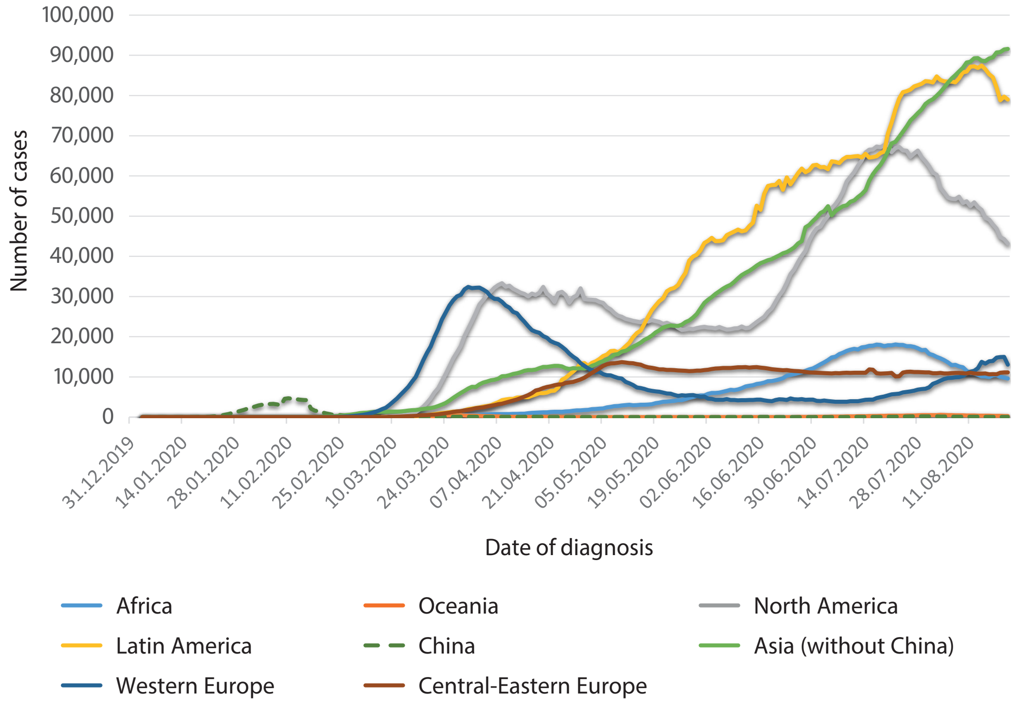
B: Countries where the "first wave" of the epidemic was small (Poland also shown for comparison).

C: Countries where the "first wave" of the epidemic was large (Poland also shown for comparison). Sweden is visibly distinctive, because in April and May it experienced a high but flat wave of new cases. In June, however, the number of new cases in Sweden suddenly surged, to drop again in July.

In all the countries, the appearance of a "second wave" is visible at the end of the summer. Sweden is a special case, where the "second wave" rose and strongly declined in August, during the course of one month. Also visible is a decline in the "second wave" in Poland in September.

Source of epidemiological data: COVID-19 Data Repository by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University, https://github.com/CSSEGISandData/COVID-19.

Fig. 6
Number of cases (7-day moving average) of SARS-CoV-2 in the world, by geographical region



SOURCE: ECDC DATA
HTTPS://WWW.ECDC.EUROPA.EU/EN/GEOGRAPHICAL-DISTRIBUTION-2019-NCOV-CASES

2.2.2 Seasonal cycles and multiannual regional correlations. The incidence of infectious diseases often shows seasonal variation. The best-known examples include epidemics of influenza, the so-called seasonal flu, but other diseases such as gastrointestinal infections or tick-borne diseases are also seasonal in nature. The seasonality of infectious diseases may stem from: (a) activity of the infection vectors, e.g. ticks; (b) seasonal behavior patterns of animals which are pathogen reservoirs; (c) weather (temperature, humidity), which determines pathogen survival and human activity; (d) other environmental factors (e.g. water salinity, presence of algae); (e) co-infections with other pathogens that show seasonal variations; (f) seasonal variability of human behavior, frequency and type of interactions; (g) variability of the immune system operation; (h) pathogen variability. The potential seasonality of SARS-CoV-2 infections has no explanation to date, and observations are presently cumbersome due to the intensive anti-epidemic measures being taken. In addition to seasonal cycles, multiannual cycles are frequently observed, with the natural spreading of infections. During an epidemic a large portion of the population contracts the disease and as a consequence builds natural immunity, which ultimately leads to the termination of the epidemic. After a lapse of several years a new generation emerges which has no immunity against the disease; additionally, the acquired immunity may wane or the pathogen may mutate. This leads to a growth in the number of susceptible individuals in the population, and in consequence makes a new outbreak of the epidemic possible.

Epidemics transmitted by droplets typically spread faster in locations with high population density. In the usual course of the epidemic, the incidence rate increases first in large agglomerations and only later sprawls out to smaller towns and villages. A similar pattern can also be observed in SARS-CoV-2 infections, showing considerable geographical differences.

In the early phase of the epidemic, the first identified cases were randomly spread all over Poland, although new cases were soon concentrated in large cities and agglomerations (Warsaw, Kraków, Poznań, Łódź). The initial rapid increase in confirmed cases could be attributed to a number of factors: (1) individuals returning from abroad during the period of school winter holidays, (2) numerous individuals returning from other countries after 11 March 2020, i.e. after Poland's borders were closed, (3) initial intensive movement of workers and students beyond their usual place of residence. Stabilization of the partial lockdown rules and curbing mobility (by the closure of schools and universities, organization of remote work, heavy fines for breaking sanitary rules) considerably restricted the possibilities for COVID-19 transmission, a move which as of the end of April 2020 produced the following epidemic situation (Fig. 7):

1. The greatest number of cases and a lack of stable conditions for the transmission of COVID-19 was visible in districts (*powiats*) with the highest population density and, unfortunately, in those districts where the virus had been introduced to nursing homes.
2. Controlling the mobility of the population resulted in the spatial containment of the outbreak, with 13 districts being entirely infection-free and a majority having no more than five confirmed cases.
3. The highest absolute number of cases has characterized (and still does characterize) agglomerations with a large number of residents and a high population density, which is a reasonable finding given droplet transmission (the greater the number of potential human interactions, the higher the number of infections).

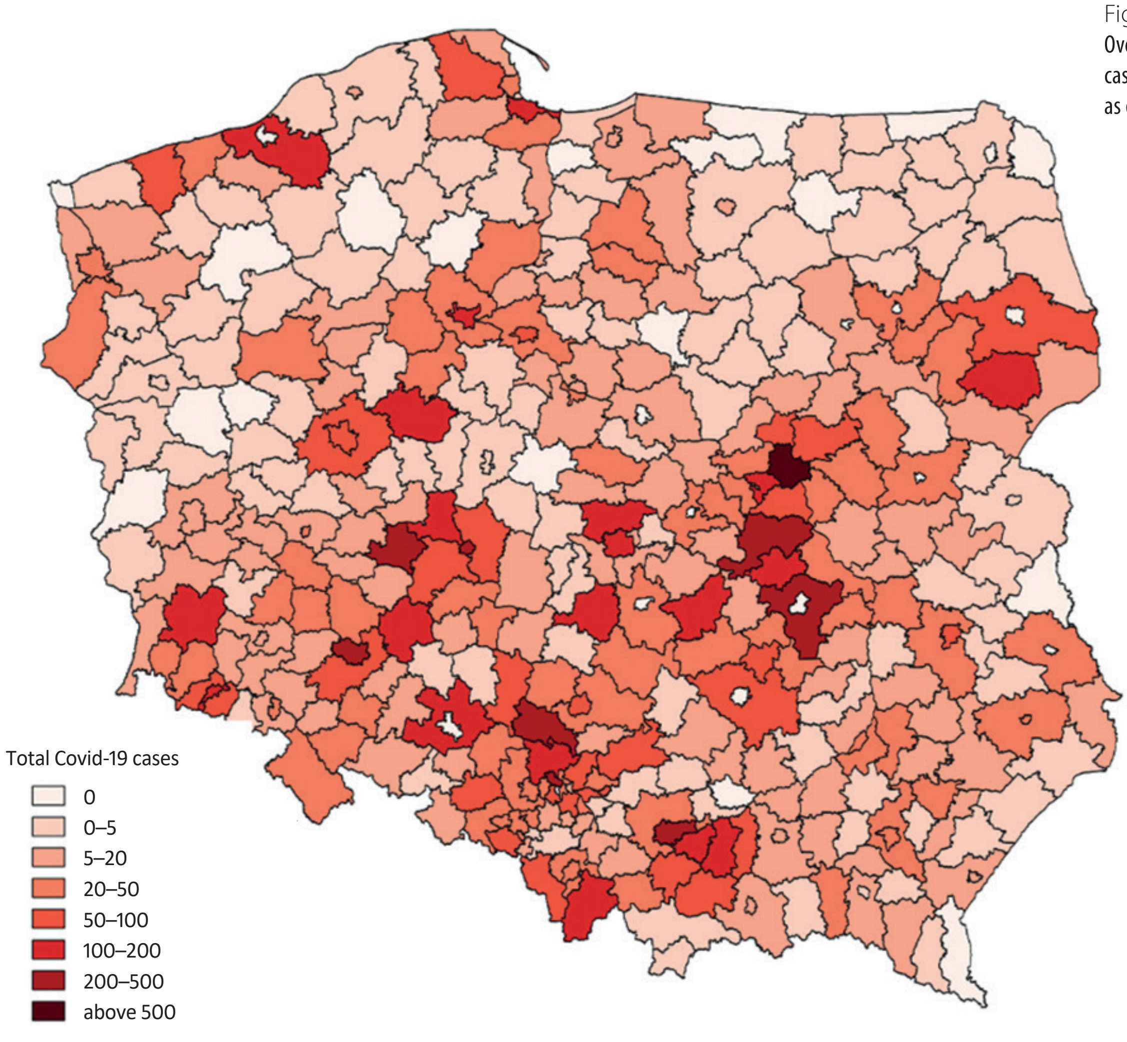


Fig. 7
Overall number of COVID-19 cases by district (*powiat*), as of 27 April 2020

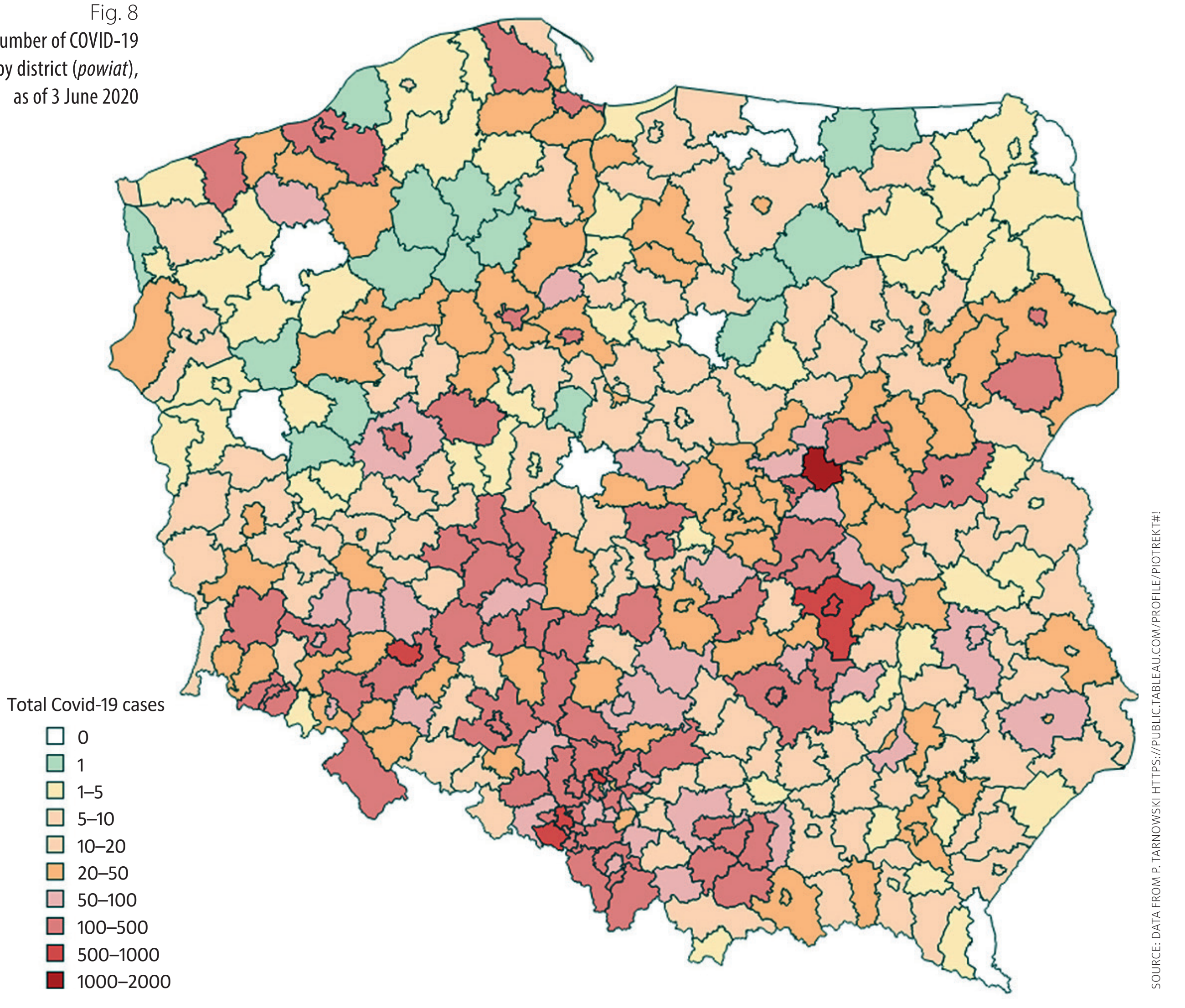
SOURCE: BY A. AFELT, ICM UW, BASED ON PUBLIC DATA

Overall, the end of the restrictive imposition of sanitary precautions resulted in the circulation of the virus being maintained only in high-risk areas (high population density) and its gradual limitation in high-risk institutions (nursing homes). Importantly, new cases were consistently recorded nationwide, but starting from mid-April the number of recovered cases began to increase at a fast rate.

The relaxation of sanitary rules as of 4 May 2020 had the following effects within about 40 days (Fig. 8):

1. The overall number of cases doubled (from 13,000 up to 27,000), with a steady daily increase in new cases, oscillating between 250 and 400.
2. Visible clustering (concentration) of new hotspots, which included coalmines in Upper Silesia, other large workplaces, and other large social gatherings such as first communions or weddings.
3. The epidemic started to spill out across the country, whereby the number of coronavirus-free districts decreased by half and the number of districts with the largest weekly numbers of new cases started to increase rapidly.
4. Unfortunately, a dangerous process began at that time, involving a disturbed equilibrium between the numbers of active and recovered cases.

Fig. 8
Overall number of COVID-19 cases by district (*powiat*), as of 3 June 2020



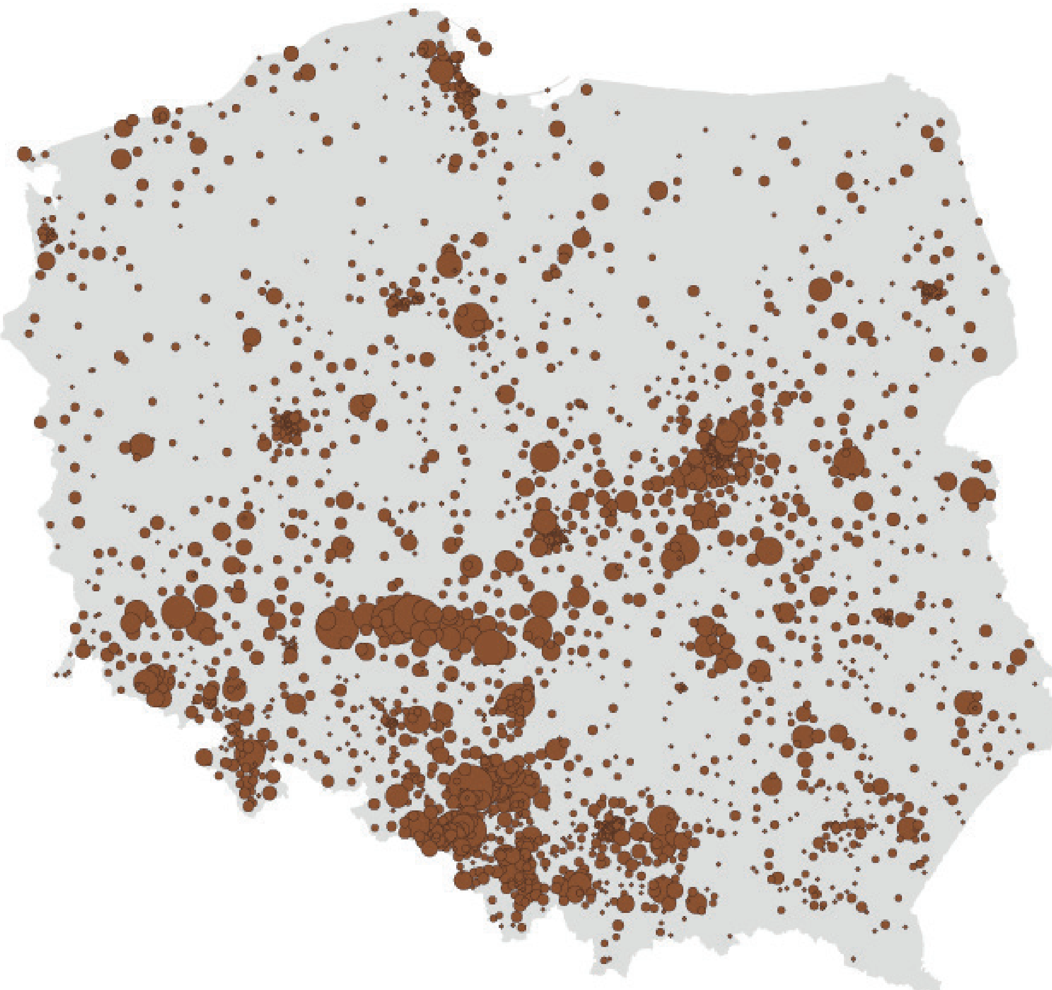


Fig. 9
Spatial concentration of confirmed COVID-19 cases, as of June 2020 with 19,000 diagnosed cases

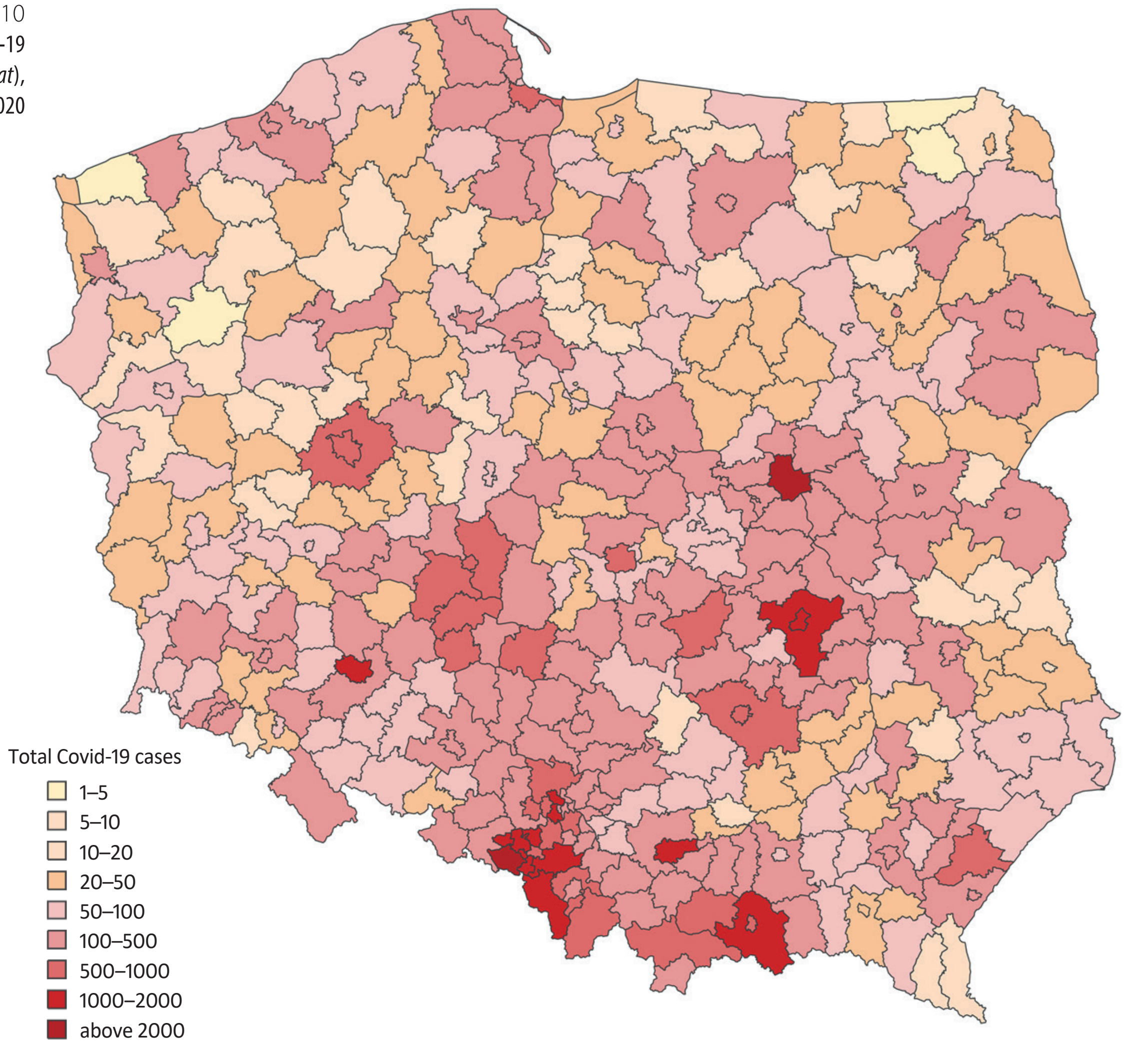
SOURCE: BASED ON DATA FROM PZH-PIB, M. KURSA, A. AFELT, ICM UW

Such a district-level spatial analysis suggests that the presence of COVID-19 appears within the community of a given administrative unit as a spatially homogeneous spillover of infections. However, a closer look at the data indicates that the virus actually spreads spatially in clusters. This means that a carrier of the virus (vector) is a source of infection for people he or she has been in contact with (at home, at work, in a social meeting, on public transport) without sufficient concern for abiding by simple yet effective sanitary recommendations. The result is a clearly local concentration of confirmed COVID-19 cases within the country (Fig. 9).

This picture is consistent with the spatial distribution of the population concentration nationwide, and generally reflects the spatial distribution of agglomerations. It also offers an indirect view of the spatial mobility of Poles during the period of the epidemic preceding the summer holiday season.

What difference did the summer holidays bring? Constraints on international mobility in the form of national restrictions imposed on land transit and sanitary requirements changed people's summer holiday plans. In consequence, this year's summer holiday season largely meant domestic tourism. Unfortunately, the country's current epidemic situation, combined with laxer sanitary rules and a policy of soft recommendations and guidelines pursued by national institutions, does not seem favorable on the eve of autumn and the expected onset of seasonal infections, as is the case every year. As of 12

Fig. 10
Total number of COVID-19 cases by district (*powiat*), as 12 September 2020



SOURCE: DATA FROM P.TARNOWSKI HTTPS://PUBLIC.TABLEAU.COM/PROFILE/PIOTREKT#!

September 2020, six months after sanitary restrictions had been imposed and in accordance with the timeline of changes in sanitary policy in the last three months, 73,650 active cases, 59,725 recovered cases, and 2182 deaths were recorded in Poland. At the end of the holiday season and start of the 2020/2021 school year, the presence of COVID-19 had been noted in all of the country's 380 districts (Fig. 9). The numbers of cases in the districts that had so far had the highest numbers of infections continued to rise. Above all, however, the number of districts with numerous coronavirus hotspots detected in recent weeks had grown rapidly (districts with five to 20 cases). A strong epidemiologic threat is posed by the number of personal interactions of infected people, which has been increasing rapidly since the end of April 2020. According to the Central Statistical Office (GUS) data, an average household in Poland has 2.6 members. At the end of April 2020, the average number of people that one COVID-19 infected individual had come into contact with was 2.7 (PZH-PIB data). That meant that the number of out-of-family interactions was effectively restrained during the lockdown. Unfortunately, once the sanitary restrictions were lifted, as of 4 May 2020, the number of people coming into so-called "sanitary contact" started to surge at a fast rate. By mid-August 2020, this number had statistically increased to eight! This means creating extremely conducive conditions for the continued rapid development of the epidemic.

2.2.3 Transmission routes. The SARS-CoV-2 virus is an enveloped virus for which the respiratory system is the main pathway of infection. Transmission of the virus between people most often occurs via droplets – by escaping from our respiratory system together with smaller or larger droplets of respiratory secretions and saliva, the virus can manage to enter the respiratory system of a healthy person, where (if it happens upon a susceptible cell) it can cause infection. Droplets are particles 5–10 μm in diameter, which are unable to float in the air. Hence, the probability of infection increases with decreasing distance and increasing duration of exposure. Empirical data show that the risk is greatest when the virus carrier is situated less than 2 meters away. Poor ventilation and confined spaces increase this risk. Although the virus can persist in the air for long periods under laboratory conditions and travel long distances, it requires the generation of an aerosol, with particles <5 μm in diameter containing the virus. In practice, apart from specialized hospital procedures, this happens rarely, and analysis of real cases of infection has indicated that this pathway is of marginal importance.

A second very important (although less frequent) route of infection involves the transmission of the virus via physical objects. If contagious drops of our saliva settle on everyday objects and another person transfers them to their face, infection may occur. As with direct transmission, the virus remains contagious for long periods under laboratory conditions. However, in the real world, which is relatively hostile to sensitive enveloped viruses, this tends to be much shorter and depends on temperature, on whether cleaning agents are present, and on humidity.

Although the virus is excreted from the digestive system in the feces, the fecal-oral pathway has not been shown to be an important channel of transmission, mainly due to the degradation of the virus by enzymes in our intestines. It has also not been demonstrated that transmission of the virus is possible through the skin or through blood or blood products.

Due to the way the virus spreads, before an infected person is diagnosed and isolated, it is the other members of their household who are most vulnerable. Preventing transmission within the home is practically impossible, so as a rule, household infections constitute a significant percentage of all cases, amounting to 30–40% in Poland (data from the National Institute of Public Health – National Institute of Hygiene). When household infections are set aside, in April, when there were significant restrictions on social contacts, the most dominant transmission route was related to the health service and elderly care facilities. About 30% of all cases were related to healthcare personnel, due to the reported shortages of personal protective equipment, and another 10% were infections of patients. Then, in May, with the gradual easing up of restrictions, about 40% of cases were infections that occurred at workplaces, most often in clusters, the largest of which occurred at mines in Silesia.

Work-related infections were still observed in June and during the summer months, but a large share of cases involved people becoming infected in public spaces or during social contacts. There is also a notable increase in the percentage of infections for which no epidemiological link could be established: in the summer months, this was true for more than one in every four diagnoses. Unlinked infections signal the emergence of uncontrolled chains of infections.

Further reading (2.2.3):

WHO. *Transmission of SARS-CoV-2: implications for infection prevention precautions. Scientific Brief*, 9 July 2020. https://www.who.int/news-room/commentaries/detail/transmission-of-sars-cov-2-implications-for-infection-prevention-precautions

Jones DL, Baluja MQ, Graham DW, et al. Shedding of SARS-CoV-2 in feces and urine and its potential role in person-to-person transmission and the environment-based spread of COVID-19 [published online ahead of print, 2020 Jul 31]. *Sci Total Environ*. 2020;749:141364. doi:10.1016/j.scitotenv.2020.141364.

Xiao S, Li Y, Wong TW, Hui DSC. Role of fomites in SARS transmission during the largest hospital outbreak in Hong Kong. *PLoS One*. 2017;12(7):e0181558. Published 2017 Jul 20. doi:10.1371/journal.pone.0181558

Aboubakr HA, Sharafeldin TA, Goyal SM. Stability of SARS-CoV-2 and other coronaviruses in the environment and on common touch surfaces and the influence of climatic conditions: A review [published online ahead of print, 2020 Jun 30]. *Transbound Emerg Dis*. 2020;10.1111/tbed.13707. doi:10.1111/tbed.13707

Cho HJ, Koo JW, Roh SK, et al. COVID-19 transmission and blood transfusion: A case report [published online ahead of print, 2020 May 13]. *J Infect Public Health*. 2020;10.1016/j.jiph.2020.05.001.

2.3 Pathogenesis and clinical course of COVID-19

The SARS-CoV-2 coronavirus permeates into cells through an interaction between the spike S protein and angiotensin converting enzyme 2 (ACE2) in a process that also employs transmembrane serine protease 2 (TMPRSS2). The presence of these proteins on the cells' surface determines their susceptibility to the entry of the virus. They are found in large quantities on respiratory epithelial cells (and in even larger quantities on the surface of the cells in the nasopharyngeal cavity) and on the endothelial cells of pulmonary vessels.

In some patients, infection of cells in the lower respiratory tract (mainly type II pneumocytes) causes increased damage of the alveoli due to the damage to the alveolo-capillary barrier and pulmonary capillaries, exudate formation and neutrophil infiltrates. The patient's immune system takes part in the process: complement components and released pro-inflammatory cytokines (in most acute forms of the disease involving multiorgan failure, an uncontrolled cytokine release can be observed, called a "cytokine storm").

The presence of ACE2 on the surface of vascular endothelial cells and their infection by the virus causes damage to endothelial cells and intravascular coagulation. The accompanying lack of blood flow causes hypoxia and irreversible organ damage. Due to the fact that the proteins enabling cell entry of SARS-CoV-2 are present in various tissues, the virus can also cause damage outside of the respiratory system, which is exacerbated even further by hypoxia resulting from acute respiratory failure and hypoxemia.

2.4 Extrapulmonary manifestations of the disease

Due to the presence of the ACE2 enzyme in many tissues, SARS-CoV-2 can infect and damage tissues of more than just the respiratory system. Direct damage caused to tissues by the virus plays an important role in symptoms manifested by other organs. Other mechanisms can also be observed in that regard, such as damage caused by hypoxia, dysregulated immune response, or damage from blood flow disorders in the microcirculation, which are secondary to vascular endothelial damage and intravascular thrombosis. The latter mechanism has recently garnered considerable attention, especially in view of the fact that a large percentage of patients die from thromboembolic events.

Extrapulmonary manifestations of COVID-19 include cardiovascular symptoms (features of myocarditis, heart arrhythmia, acute coronary syndromes, takotsubo cardiomyopathy, acute pulmonary heart disorder), central nervous system (e.g. delirium, headache, cerebral stroke), blood coagulation disorders and vascular changes, kidney and liver damage, gastrointestinal symptoms (diarrhea, nausea and vomiting, loss of appetite), eye symptoms and skin lesions.

2.5 Long-term consequences of COVID-19

The question of the long-term negative effects of COVID-19 on humans is recurring yet remains unanswered. However, in view of the reports that in some patients effects of the disease on the respiratory system persist after recovery, and given the fact that SARS-CoV convalescents back in 2003 reported such manifestations as impaired lung function, such long-term effects do appear likely. No consensus has yet emerged regarding how persistent such changes are or what their impact is on individual organs such as the heart, nervous system, kidneys or blood vessels. The potential, most frequently listed consequences of the disease include pulmonary fibrosis, pulmonary and systemic vessels, bronchiectasis, chronic fatigue, sarcopenia and neurological disorders. Some countries have already launched platforms (e.g. https://covid.joinzoe.com/post/covid-long-term) whereby such disorders may be reported, which should facilitate their treatment and prevention.

At the present stage, it remains an open possibility that those COVID-19 patients who were asymptomatic or only manifested mild symptoms will not suffer long-term consequences of the disease. However, it should be noted that the absence of distinct symptoms does not necessarily mean the absence of changes in the body. Abnormalities in lung or blood parameters have been observed in many asymptomatic or mildly symptomatic patients. Retrospective research indicates that such changes may continue for a long time; about 10% of patients with a mild course of the disease have reported persistent loss of smell and taste.

3. The current state of affairs

3.1 Prevention

3.1.1 Methods of preventing and containing transmission. There are three major approaches to preventing infection:

1) eliminating the source of infection – in the case of SARS CoV-2, this means isolating an infected person before they start to infect others. Isolation of patients is only possible with a robust testing strategy, efficient identification and quarantine for contacts.
2) cutting off transmission routes – this involves reduction of human-to-human contacts by restricting gatherings, closing establishments, working remotely, etc., and reducing the probability of infection during contact by maintaining social distancing, wearing masks, practicing respiratory and hand hygiene (using disposable handkerchiefs while coughing and sneezing), sanitizing surfaces.
3) immunizing the population by vaccination – an epidemic terminates when sufficiently large share of the population becomes immunized through vaccination or naturally through contact with the disease. The minimum percentage of immune persons required for this is known as the herd immunity threshold.

Strategies to quash the epidemic may differ in terms of their adopted goal, which kinds of interventions they focus on, and to what extent vary at the local level. Initially, some countries, including Poland, focused on reducing social contacts and reducing mobility, particularly international travel, on the assumption that the epidemic could be fully contained and terminated. Even though a speedy eradication of the virus proved impossible, such a strategy won the time needed to organize other activities and prepare the healthcare services for dealing with increased numbers of COVID-19 patients. Currently, the adopted goal is for the infection rate to remain at a safe level while minimizing the disruptions to the life of society. The necessary measures include testing and isolating patients, identification and quarantining of contacts, as well as maintaining social distancing and practicing good hygiene. Restrictions to social life and mobility should cover those areas where the epidemic is still spreading despite the measures already taken there. Originally, a strategy of striving to achieve herd immunity by allowing the disease to spread was contemplated. However, such a strategy would imply excessively high infection and death rates, due to the practical impossibility of protecting vulnerable people likely to suffer severe symptoms. Furthermore, there are doubts about whether the natural immunological response offers long-term protection. Looking to the future, vaccinations will probably be the key tool in dealing with COVID-19.

Contact tracing apps

To ensure the effectiveness of contact tracing in COVID-19, the period between the appearance of the first symptoms in a patient and the quarantining of his or her contacts should be shorter than three days. Since this is hardly achievable with manual contact tracing, a concept has been developed to employ specially developed tracing apps installed on mobile phones. If two people having an active app remain at a close distance for a sufficiently long time, their coming into contact will be registered in their apps via Bluetooth. Then, if one of them subsequently falls ill and enters the information into the app, the other will be alerted. Another option would be to establish a central contact database, but such a solution is not viable due to privacy protection regulations. Currently, most apps employ a decentralized solution developed jointly by Google and Apple, including ProteGo Safe, an app implemented in Poland. It is estimated that for a tracing app to be fully effective, it should be installed by at least 60% of the population, although its impact may be visible with as few as 30% to 40% users.

This issue calls for further study and will be discussed at greater length in our next Report.

3.1.2 Vaccines

Types of vaccines under development

An antiviral vaccine is a medical preparation containing a weakened virus or viral particles, which do not induce illness in humans but do present patterns typical of a given pathogen to the human immune system. As a result, when infected with the active virus, the immune system can respond quickly through the proliferation and mobilization of lymphocytes and production of specific antibodies, which helps mitigate the infection and alleviate the symptoms of the disease.

Work on developing a SARS-CoV-2 vaccine is currently underway at nearly 200 academic and commercial centers. Specific solutions have one aim in common – to supply viral fragments – but differ in their concepts for how this is to be done. Various approaches are being adopted: applying a dead or weakened virus, viral proteins forming virus particles that devoid of genetic material (*virus-like particles*, VLP), single viral (protein) fragments, other viruses which are harmless to humans but have SARS-CoV-2 proteins on their surface, or nucleic acids (RNA and DNA) that enable our system to produce and identify viral proteins when they enter human cells. Each of these vaccine platforms has its advantages and disadvantages. It is too early to say which of these approaches is the optimal one.

Efficacy

Work is now underway on a whole series of solutions intended to teach the immunological system how to defend itself from the SARS-CoV-2 virus. However, it is currently unknown whether these efforts will be successful. Viruses mutate at a rapid pace and have an extensive set of tools to neutralize human defense systems. In some cases, such as the HIV virus, development of an efficacious vaccine has not proved possible. To date, no effective vaccine has been developed for any human coronaviruses. Even if the efficacy of a vaccine is successfully confirmed within the coming year, the process of its registration, production and distribution is still bound to take a long time, making the chance of vaccinations in the 2020/2021 winter season rather slim.

If a vaccine is eventually developed, in all likelihood it will not be 100% effective and will protect only part of the population against infection – due to the nature of the vaccine itself and to the fact that the immune system behaves differently or is weaker in some individuals. For this reason it will be necessary for vaccinations to be done on a mass scale, in order to achieve the so-called herd immunity.

Safety and potential risks

As any other substance, a vaccine can potentially be harmful, e.g. by provoking an allergic effect or an unfavorable immunological response. This is a matter of grave significance, because in coronaviral infections it is necessary to verify that the human system's response to a vaccine will not actually exacerbate the illness (ADE, or *antibody-dependent enhancement*). Therefore, before being granted a marketing authorization every single vaccine must undergo an extensive series first of laboratory tests, then animal and human trials, when it is tested on a small, and subsequently on larger groups. For this reason it is crucial for the whole process to be transparent, and for the findings from all tests and trials to be examined by independent experts. The attempts being made in certain countries to cut corners in this regard may be extremely dangerous. In Europe, monitoring of vaccine safety and oversight over the process rest with national organizations and the European Medicines Agency (EMA).

3.1.3 Immunity

Does immunity wane over time?

There are no direct data as to whether immunity to the SARS-CoV-2 virus can last for months, let alone years, because the virus itself has only been known for several months. Nevertheless, the human immunological system behaves similarly in relation to this particular microorganism as it does in relation to other viruses. First, it forms IgM antibodies (humoral immunity) which bear little affinity to the virus antigens and live in the system for a relatively short time; IgA and IgG antibodies are subsequently produced. They show much greater affinity to the virus antigens, and the cells that produce them (memory B cells) may survive for decades after the initial infection. On secondary contact with the same microorganism (or after a successful vaccination) the humoral response manifests rapidly, thus preventing infection or mitigating its severity. The antibodies that bind the viruses and prevent their entry into cells, called neutralizing antibodies, represent only a certain fraction of the total pool of antibodies. Cell-mediated immunity is the second pillar of our defense systems, which enables identification and destruction of cells already infected with the virus through T lymphocytes. On the basis of what we know from the study of other infections, such an immune response, once produced, may persist for many years. We know that for SARS-CoV-2, like in the case of other coronaviruses, IgG antibodies survive for a relatively short time and start to disappear after several months. It appears that the combined response by IgA antibodies, lymphocytes and the new IgG antibodies may lead to a milder presentation of the disease.

The role of IgG, IgA, T-cells in mucous membrane diseases

SARS-CoV-2 belongs to the group of respiratory viruses which enter the system via the respiratory tract. The basic mechanism protecting against such entry of microorganisms is the secretion of mucus and its gradual removal from the respiratory tract through the ciliary epithelium lining it. Mucus as a viscous substance captures various particles (including viruses) from the inhaled air, and then is moved upward towards the upper airways and throat, where it is removed from the respiratory system. IgA is the main antibody secreted to the surface of the mucous membrane, which binds the virus thus hampering its further penetration, and is similarly removed from the respiratory tract together with mucus. IgA antibodies may play a key role in mitigating SARS-CoV-2 infection – much greater than that of IgG antibodies, for instance. For this reason, it cannot be said that an absence or loss of neutralizing antibodies in the blood renders us completely defenseless.

Is anyone naturally immune to infection? Genetics vs. COVID-19
As a result of human genetic diversity, there are typically certain individuals among the population who are naturally immune to various infections. Viruses infect cells by binding to specific particles on the cells' surface, which in this way become receptors for the virus. For instance, a protein called CCR5 acts as a receptor for HIV, and individuals who have a mutated form of the protein (which is not recognized by the virus) turn out to be partly resistant to HIV infection. In the case of SARS-CoV-2, a protein known as angiotensin converting enzyme 2 (ACE2) is the receptor. Although many different variants of this protein can be found in humans, no evidence has been reported as to whether any of these variants might either stimulate or inhibit infection. As is the case with other human proteins, there are no grounds to claim that any nation or group is "genetically" more susceptible to SARS-CoV-2 or to a more severe presentation of the disease. Similarly, there is no evidence confirming that there are individuals who are wholly or partly immune to infection. However, it cannot be ruled out that such evidence might be discovered in the future.

3.2 Treatment

The treatment of COVID-19 depends on the severity of its clinical manifestations: patients with mild symptoms receive symptomatic treatment. Patients with pneumonia and imminent respiratory failure are administered antiviral and/or immunomodulatory drugs in hospital, whereas patients with respiratory failure require breathing support in intensive care units.

3.2.1 Antiviral drugs

Drugs with proven efficacy
Antiviral drugs act by inhibiting virus replication in the patient, thus secondarily preventing an inflammatory response. At present, the greatest hopes are pinned on well-known and long-used medications which could potentially be repurposed to treat COVID-19. Remdesivir, a drug also available in Poland, can serve as an example; it was originally developed in the United States to treat Ebola infections and has shown considerable efficacy in inhibiting the replication of coronaviruses, including SARS-CoV-2. It interferes with the action of the viral polymerase to inhibit its proliferation. One limitation is that it has a rather narrow time window: the effectiveness of remdesivir was analyzed for patients suffering from pneumonia and imminent respiratory failure. Its use in COVID-19 patients showing mild symptoms is not justified, whereas its application too late, when the patient already requires mechanical ventilation, is not effective. At the same time, the findings from clinical trials do not unequivocally confirm positive effects of remdesivir and, given the incidence of serious adverse events, the debate on the rationale of its use remains open. Some hopes are being raised by favipiravir, a preparation with a similar mechanism of action to remdesivir, designed and registered in Japan to treat future influenza pandemics, which is known to be active in relation to certain RNA viruses. The initial findings are promising, but its effectiveness in treating patients with a severe form of the disease has not yet been demonstrated, and several reports have suggested its serious adverse events. Tests are currently underway to evaluate its clinical suitability, which in the future may enable its registration and

sale in the European Union. There have been some reports suggesting the effectiveness of treatment using convalescent plasma, without any serious adverse events. Effective treatment requires the presence of antibodies neutralizing the virus, which presents some technical difficulties.

Drugs with unproven efficacy

Many preparations have not fulfilled the hopes that were pinned on them (e.g. lopinavir boosted with ritonavir, darunavir, azithromycin) even if they showed high activity that inhibited SARS-CoV-2 replication in vitro (e.g. chloroquine/hydroxy chloroquine, ribavirin). Furthermore, hydroxychloroquine and azithromycin, especially when used jointly and in high doses, presented considerable cardiac toxicity, increasing the risk of the patient's death from heart arrhythmia. Similarly, a preventive effect of hydroxychloroquine administered orally has not been confirmed. Research on the clinical efficacy of IFN-β is underway. Ribarivin, a drug involving a considerable risk of hemolysis, has not been used in practice.

Development of new drugs

Attempts are currently being made around the world to identify drugs already approved for human use which are active in fighting SARS-CoV-2. Even though chances of finding a fully effective drug are small, combined therapy with the use of several medications whose effectiveness is similar to that of remdesivir may enable successful treatment.

Introduction of a drug inhibiting SARS-CoV-2 replication developed *de novo* may take many years. There are currently dozens of potential candidates.

3.2.2 Immunomodulatory drugs. Drugs which modulate the inflammatory response to the SARS-CoV-2 infection have no effect on virus replication and do not reduce the length of the contagious period. Rather, their task is to alter the system's inflammatory response to the SARS-CoV-2 infection in order to alleviate its symptoms, for instance to prevent destruction of the lung tissue.

Steroids

Initially the use of steroids was avoided in COVID-19 patients because such therapy had been found in the case of the SARS-CoV virus in 2003 to worsen the prognosis for the illness. However, clinical data suggest that the use of small 6 mg doses of dexamethasone (orally or intravenously) considerably reduces the risk of death (by 30%), and this beneficial effect was recorded in the short period of imminent respiratory failure. However, use of this medication, cheap and well-known for years, is not justified in mild or asymptomatic presentations of the disease, and is not effective in cases involving damage to the lung tissue and respiratory failure. It should also continually be borne in mind that using steroids in SARS-CoV patients in 2003 provoked serious, long-term adverse events.

Modulation of immune response

Clinical trials on tocilizumab (monoclonal antibodies against the IL-6 receptor) demonstrated certain effectiveness of the preparation in a similarly narrow time window, in patients with imminent but not actual respiratory failure. It should be borne in mind, however, that this is a long-acting intravenous drug for which an infection is the main contraindication, and the potential risks include reactivation of either tuberculosis or latent HBV infection, the later one being common among elderly people in Poland.

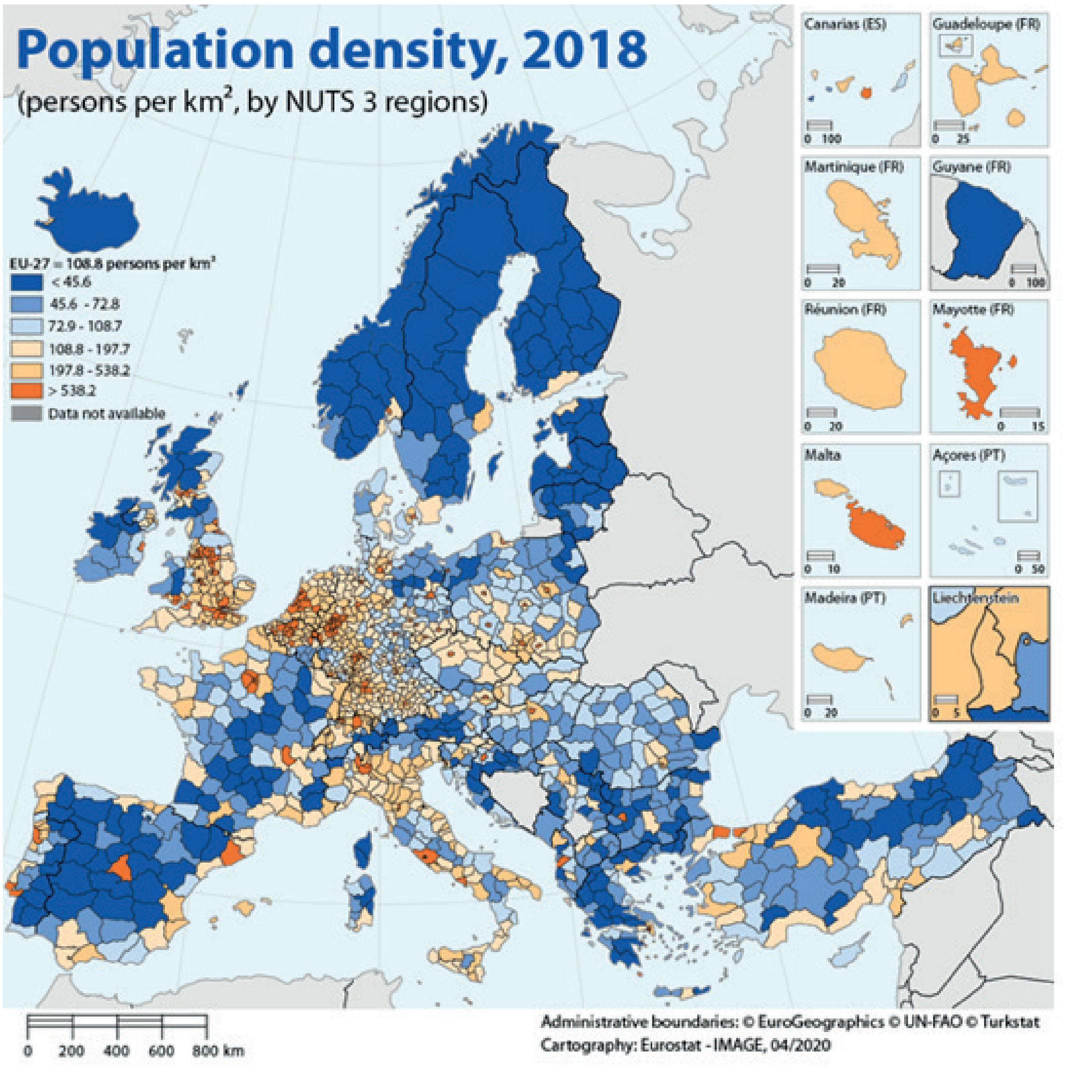
Anti-inflammatory action has also been attributed to chloroquine/hydroxychloroquine but, as mentioned above, the effectiveness of this drug in COVID-19 therapy has not been demonstrated.

Tuberculosis vaccine?
Small-scale observational studies suggest a non-specific effect of the BCG vaccine on reducing the frequency of upper respiratory tract infections and sepsis in vaccinated children and adults. Non-specific immunomodulatory effect most likely underpins the use of this drug in the treatment of bladder cancer. The suggested mitigating effect of the BCG vaccine on the clinical manifestations of COVID-19 was not confirmed in a large-scale analysis conducted in Israel. Furthermore, studies on the effect of BCG vaccination in childhood do not suggest a reduced infection or mortality rate of elderly patients. Clinical trials aimed to investigate in depth the impact of the BCG vaccine on the clinical presentation of the SARS-CoV-2 infection are underway in the Netherlands and Australia.

3.2.3 Assisted breathing, mechanical ventilation and intensive care. The most recent findings from epidemiological research indicate that most (80%) of SARS-CoV-2 infections are characterized by mild symptoms. In the remaining cases patients may require hospitalization, especially if they have symptoms of respiratory failure. The applicable recommendations for such a situation stipulate instant measurement of the oxygen saturation of arterial hemoglobin (SpO_2) using pulse oximetry. If the SpO_2 values fall below 90–92%, passive oxygen therapy should instantly be delivered to maintain the SpO_2 values within the 92–96% range. The proposed procedure may be successfully applied in isolation wards since it does not require specialized equipment or professional skills of physicians specializing in anesthesiology and intensive care. In those patients who have continued hypoxemia (oxygen deficiency in arterial blood) despite the use of passive oxygen therapy, mechanical ventilation must be performed in an intensive care unit (ICU) while observing the principles of protective lung ventilation. If there is no improvement in the gas exchange in the lungs, in some cases the use of veno-venous extracorporeal membrane oxygenation (VV-ECMO) may be recommended. When making the decision to apply VV-ECMO therapy, the fact that it is labor-intensive and employs the ICU personnel to a greater extent than the remaining methods improving the gas exchange needs to be taken into account. As of now, it appears that the group of patients suffering from severe respiratory failure in COVID-19 and with indications for VV-ECMO therapy will be small, especially if the principles of protective lung ventilation are adhered to, skeletal muscle relaxants are administered, the patients are ventilated while lying face down, and alveolar recruitment is sustained with the use of high PEEP levels.

3.3 Polish society in times of pandemic
In this section we present a brief profile of Polish society, highlighting in particular those factors which might influence the spread of infectious diseases. We will consider two types of characteristics: static and stable features (population density) as well as dynamic features (physical mobility patterns, density and types of activity involving social interactions).

In the "physical" dimension, Polish society is generally characterized by average population density (123 persons per km^2). By comparison, the population density is nearly 17,000 per km^2 in Monaco, 1297 in Malta, 399 in the Netherlands, 326 in Belgium,



SOURCE: EC.EUROPA.EU/EUROSTAT

Fig. 11
Population density in Europe in 2018, based on Eurostat's NUTS 3 classification (Nomenclature of Territorial Units for Statistics) – in Poland, each such unit groups together several districts (*powiats*)

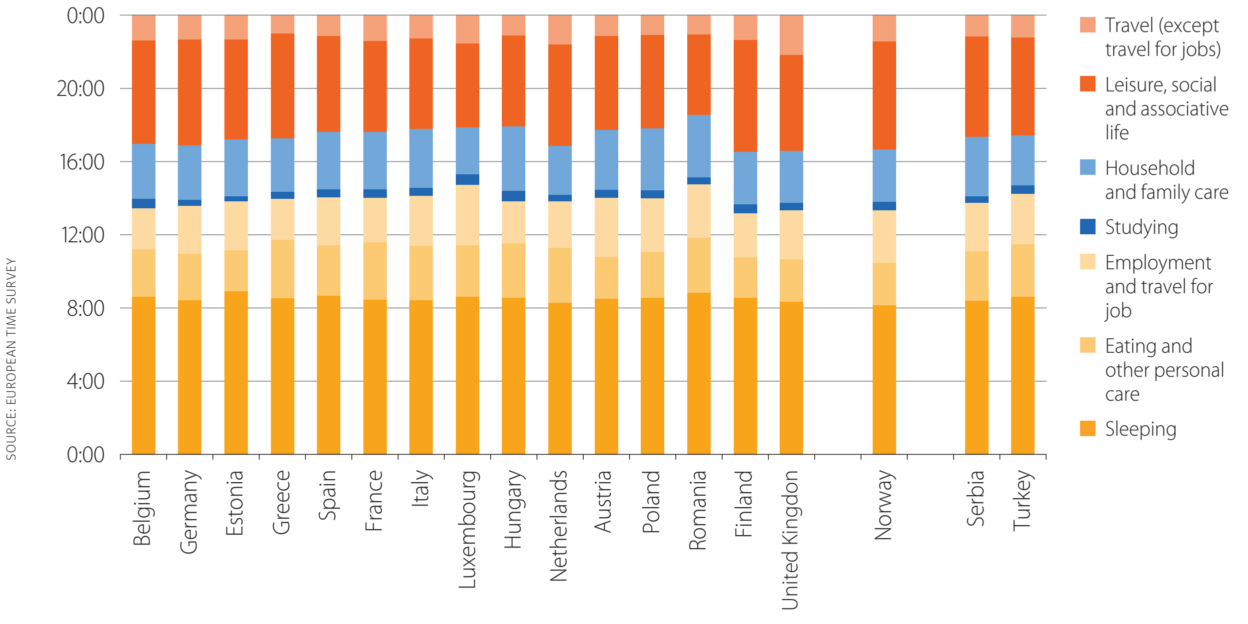
254 in the United Kingdom and 229 in Germany; the Nordic countries are at the other extreme of the spectrum, with Iceland being the least populated European country (3 persons per km^2). The map below shows the population density for NUTS 3 regions, which clearly highlights areas of concentration (cities).

As one can easily notice, population density is strongly correlated with the degree of urbanization, understood as the number and size of cities. There are no large agglomerations in Poland save for Warsaw, the only city with a population in excess of 1 million (indeed, close to 2 million if visitors and temporary residents are taken into account). Most of the country's cities are small; only 4% cities have over 100,000 residents, 20% have between 100,000 and 200,000, and 76% are cities with a population under 20,000.

In terms of mobility, Polish society can be described as stationary: we stay at work or at home most of the time. According to the European Time Survey (Fig. 12), Poland is among the countries whose residents devote relatively less time to leisure and social life, and distinctively less to travel (except commuting to work).

Poles tend to spend most of our time at home, at work, university or school; additionally, we quite commonly to work outside of our municipality (*gmina*) of residence,

Fig. 12
Time devoted to daily activities in various European countries



which means having to commute. The 2014 GUS survey findings[1] indicate that 3.1 million employed individuals commute to work, with residents of the Śląskie, Wielkopolskie, Mazowieckie and Małopolskie provinces being the most mobile; this can primarily be attributed to the proximity of a large urban center offering jobs for residents of the neighboring municipalities. A survey has found that the average work commuting time in Poland is 41 minutes (compared to the European average of 42 minutes); 60% commuters travel by private car (mainly because of driving their children to school), and 40% use public transport[2].

Poles also like to spend our leisure time at home: according to CBOS data, we go out to a restaurant, cinema or a concert rather infrequently: in 2019, 26% respondents never went to a restaurant, 47% never went to a cinema, 48% did not go on any holidays, and over 60–70% never went to a concert, sports event or the theater (cf. Table 1).

Table 1
Frequency of spending time outside the home

In the last year, have you:	Yes				No
	Overall	many times	several times	only once	
	in percent				
– been to a restaurant with your family or friends	**74**	19	47	8	**26**
– used the Internet for purposes unrelated to professional work	**73**	68	4	1	**27**
– donated money to charity	**73**	4	48	21	**27**
– held a party for friends, acquaintances	**72**	11	50	11	**28**
– read a book for pleasure	**61**	22	29	10	**39**
– donated things, e.g. clothing or books, to charity	**59**	5	42	12	**41**

[1] Polish National Census of Population and 2011
[2] Survey on performed by PageGroup in 2016 as part of the Commuter Survey in 11 European Countries; responses were taken from nearly 12,500 individuals, including 1072 from Poland

In the last year, have you:	Yes				No
	Overall	many times	several times	only once	
	in percent				
– bought something attractive, unplanned	**56**	8	31	17	**44**
– been to the cinema	**53**	10	31	12	**47**
– travelled away on holiday	**52**	2	24	26	**48**
– attended a concert	**42**	4	21	17	**58**
– gone abroad	**36**	3	17	16	**64**
– been to a sporting event	**35**	7	19	9	**65**
– been to an exhibition, gallery, museum	**33**	3	16	14	**67**
– played the lottery	**33**	7	23	3	**67**
– donated your own labor or services to charity	**23**	3	13	7	**77**
– been to the theatre	**21**	1	11	9	**79**
– taken out a loan from a bank or other financial institution	**14**	0	1	13	**86**
– borrowed money from acquaintances	**10**	1	6	3	**90**
– worked as a volunteer	**7**	1	3	3	**93**
– participated in a strike or demonstration	**6**	1	1	4	**94**
– worked abroad	**6**	1	2	3	**94**

SOURCE: SURVEY BY CBOS

In terms of social contacts (Fig. 13), the Poles are also relatively “closed”: we are focused on our family and interactions with our nearest and dearest:

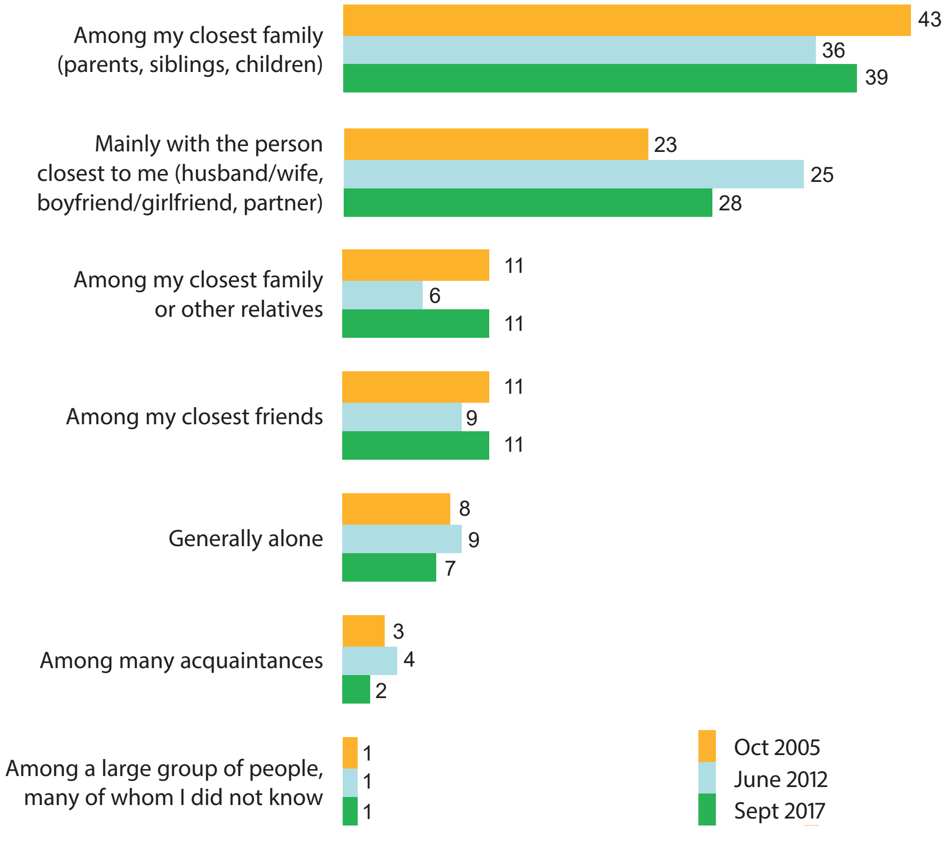


Fig. 13
How have you most often spent your free time over the past 12 months?

SOURCE: CBOS RESEARCH REPORT NO 151/2017 "SOCIAL TIES"

In general terms, Poles demonstrate a home-and-family (stationary) model of society, typified by a low intensity of public sphere interactions, a prevalence of small cities and a relatively low mobility. Arguably, these are factors that may decelerate the spreading of a virus, outside of extremely vulnerable gatherings in workplaces, nursing home facilities and on public transport. On the other hand, however, the share of people aged 65+ who are not in good health is high (18.1%); the data in Table 2 below suggest that they typically suffer from numerous chronic disorders.

Tabela 2
Average number of chronic disorders per individual (ages 15 and up)

Age	Overall	Men	Women	Overall	Men	Women
	per individual			per individual with at least one disorder		
overall	**1.8**	**1.5**	**2.1**	**3.1**	**2.8**	**3.3**
15–19 ages	0.4	0.3	0.5	1.6	1.4	1.8
20–29	0.5	0.4	0.7	1.8	1.5	2.1
30–39	0.8	0.7	1.0	2.0	1.8	2.1
40–49	1.4	1.1	1.6	2.4	2.2	2.6
50–59	2.3	2.0	2.6	3.1	2.9	3.4
60–69	3.1	2.8	3.4	3.7	3.4	3.9
70–79	4.1	3.7	4.4	4.4	4.1	4.6
80 ages and up	4.5	4.3	4.6	4.8	4.6	4.8

SOURCE: CBOS ANNOUNCEMENT NO. 151/2017 "SOCIAL TIES"

The emergent overall picture is that Polish society is rather stable and has an average population density; we Poles do not travel much nor have many interactions which reach beyond their nearest surroundings. As mentioned above, this could be a factor slowing down the spread of infectious diseases. We have mostly focused on the data concerning behavior. They are consistent, however, with the data on attitudes, especially insofar as these indicate low level of social trust. Research has regularly demonstrated that Poles prefer caution over trust in our contacts with others and have relatively little confidence in political institutions and politicians. CBOS survey results (2020) suggest that after a short period in 2008–2010, when the level of trust was slightly higher, the view that "most people cannot be trusted" is shared by 22–23% respondents, the prevalent opinion being that extreme caution is definitely recommended in contacts with others (74–76%). In the institutional dimension, political parties enjoy the highest level of trust (24%). Poles show distinctively more confidence in what is local and close to home: family (98%), friends (95%), but also local authorities (74%).

It can be concluded, therefore, that survey findings regarding public attitudes and "hard" data on the density of the population and interactions are consistent. Polish society emerges as one largely based on micro-bonds and individualism. It resembles to a certain degree the classical diagnosis by Polish sociologist Stefan Nowak involving the notion of a "sociological vacuum," which posits that there are two levels of integration in Polish society, at two extreme scales: the micro scale, which refers to closest family and friends, and the macro scale, when the idea of nation, or Poland as a whole, is invoked. The space in between – Nowak argued – is filled by this "vacuum," evinced by the lack of confidence in institutions situated anywhere between the micro and macro levels. This picture, however, appears to be no longer valid since the "center" now seems to be at least partly filled. This is evidenced by a high level of trust in local authorities and charitable institutions such as the Great Orchestra of Christmas Charity WOŚP (84%) or Caritas (78%).

These findings are crucial for understanding the role that individual social and institutional actors are playing during the pandemic. Given that currently the spread of the disease varies strongly from region to region and is in a sense "decentralized," quite naturally local institutions are increasingly emerging as critical actors in coping with the pandemic. We can see therefore that a high level of trust in local authorities and also the third sector is a potentially major asset in the management of the epidemic situation.

3.3.1 Psychological consequences of COVID-19. As any other health crisis, the COVID-19 pandemic negatively impacts the welfare and well-being of individuals, and by the same token of whole groups and society at large. During a pandemic, people experience a whole gamut of negative emotions, such as a sense of of being under threat, fear, anxiety, frustration or anger. They may feel sad, lonely and disoriented. Such emotions bring suffering, disrupting people's sense of well-being and satisfaction with life; they not only affect the quality of life but can also lead to mental health issues. The major source of fear (and other related psychological states) in such a pandemic is of course the disease itself and its consequences: we fear for our own health and that of our family and loved ones; these feelings are often accompanied by the fear of death. Fear may also be associated with restricted access to medical care and necessary aid, weakened social ties and isolation, loss of work and depleted financial resources, or the infringement of personal liberties (e.g. by imposition of drastic public health protection measures such as isolation, social distancing, travel bans, obligatory face coverings). Fear may be further exacerbated by informational uncertainty, often fueled by ineffective, unnecessary, ill-understood or contradictory actions on the part of public authorities.

Fear (and related affective states) hampers cognitive and social functioning. It aggravates clinical symptoms of phobia, social anxiety, depression, psychosis and other mental disorders. It may trigger such self-destructive behaviors as suicide, self-injury, abuse of alcohol and psychoactive substances, gambling, as well as to behaviors that are detrimental to others, such as aggression or violence. It also fosters social tension and conflicts. Dr David Murphy, president of the British Psychological Society, has identified feelings of fear and threat as the key problems people (policymakers and the public at large) must grapple with during the pandemic. Importantly, however, the psychological consequences of a pandemic outlive the pandemic itself: the fear caused by the disease vanishes, but the fear associated with other pandemic-related stressors will persist. This is why studies on the Ebola pandemic in Africa in 2014–2015 or SARS in 2003, for instance, have demonstrated that the psychological consequences of a pandemic may be much more acute and long-lasting than its medical consequences. For this reason, any mitigating measures should not focus merely on the situation at hand; rather, long-term strategies need to be mapped out in order to better ensure people's welfare and well-being in the future.

Certain groups may be more vulnerable to the psychosocial effects of the pandemic than others. In particular, these include: infected persons, high-risk persons (the elderly, people with reduced immunity, people in nursing homes and similar establishments) and people with pre-existing medical conditions, mental health problems or addictions. The young are especially susceptible: even though they are less exposed to the disease and tend to show less severe symptoms, they may suffer from destabilized family life, isolation from their peers, being forced to change their habits, frequently with no support from their families. The stress associated with the pandemic is exacerbated by the stress associated with developmental issues. That is why young people are in need of special, and frequently professional aid. Healthcare workers are yet another group exposed to increased stress during the pandemic. They face the risk of becoming infected by potential or real contact with the disease itself. This is further compounded by fears of infecting their own families, the insufficient supplies (or even complete lack) of protective personal equipment, as well being having to take part in decision-making about how the insufficient resources that are available should be allocated, a process which is heavily charged both emotionally and ethically. What is more, healthcare workers unfortunately are themselves frequently objects of attacks (verbal and physical) on the part of those who fear infection. Other groups in need of special care include minorities, i.e. stigmatized, socially excluded groups who routinely fall victim to attacks and negative stereotypes on the part of the general public.

Changed lifestyles associated with remote work (or loss of employment), the lack or limitation of social contacts, and the need to organize family life along new lines (home schooling) are forcing people to change the habits that once helped them keep physically and mentally fit, and thereby augmenting fear. However, people differ in their susceptibility to anxiety and insecurity. That is why we see manifestations of a whole range of emotional reactions, ranging from apathy, evasion, denial, to strong fear. These varied responses are what underpin such dissimilar attitudes to health recommendations. Some, out of concern for their own health, will repeatedly take tests, avoid any contact whatsoever with other people (and in many cases even animals), refuse to send their children to school or go to work themselves, and make desperate, ineffective if not harmful attempts to protect themselves and their families (such as drinking chlorine, eating ginger and garlic, sanitizing banknotes in a microwave oven). Others in turn will defy all recommendations, in effect risking their own and their families' health. The underlying psychological characteristics that determine these differences include temperament and personality traits (e.g. impulsiveness, excitement-seeking, openness to new experiences and extroversion, neuroticism and readiness to compromise, tolerance of insecurity, anxiety or susceptibility to anxiety, i.e. being afraid of bodily sensations associated with excitement or fear) and cognitive styles (e.g. a propensity to persistently seek out signs suggesting one's health is at risk, or to avoid threatening information and downplaying its importance; being unrealistically optimistic). Such an extent of possible emotional reactions always needs to be taken into account in order to ensure the success of all kinds of support efforts and psychological interventions.

Given the existence of different risk groups and the wealth of possible individual responses to threats, individualized methods of providing aid and support in the pandemic situation need to be designed. To this end, it is necessary to appropriately identify and monitor: (1) factors that reinforce the effect of stressors associated with COVID-19 (such as exposure to contact with an infected person, having infected family member, losing a loved one, being in quarantine); (2) side effects of pandemic stress such as economic losses or the breakdown of personal relationships; (3) psychosocial impacts such as depression, anxiety, fears for one's health, insomnia, increased use of psychoactive substances, domestic violence, and (4) succeptibility indicators (such as pre-existing physical or psychological conditions increasing sensitivity to stress). Close collaboration is needed between the medical community and researchers in the behavioral and social sciences. In people who cope well with the pandemic, fears are crucially alleviated by communication (see Kossowska et al., 2020) and psychoeducation, i.e. efforts to provide useful tips on how to live during the pandemic and manage stress (cf. the

"You Are Not Alone" project initiated by the Institute of Psychology of the Jagiellonian University in Kraków https://psychologia.uj.edu.pl/kwarantanna/nie-jestes-sam-a). In parallel, vulnerable groups additionally need constant access to specialized care offering both psychological support and relevant therapy. Research demonstrates that remote or digital interventions (telemedicine, telepsychology) can serve as valuable tools in the provision of support to those who need it.

3.3.2 Economic consequences of the COVID-19 epidemic in Poland. The economic crisis triggered by the appearance of a new disease seven months ago has engulfed nearly all the countries of the globe. As such, it is proving to be the gravest and most widespread socioeconomic disaster at least since the Great Depression.

After nearly three decades of uninterrupted economic growth, Poland has also been struck by this crisis. The country's GDP declined by 8–9% in the second quarter of 2020, and is expected to fall by 4.5% year-on-year. These forecasts should be set against those from before the pandemic, which anticipated 3.5% growth – in real terms, therefore, the Polish economy is likely to shrink by about 8%. The forecasts for 2021 are calling for 4.2% growth, which means that Poland is not expected to return to its former fast pace of growth anytime soon. This is in line with the predictions published in April 2020 by Paweł Bukowski and Wojciech Paczos, economists from the PAS Institute of Economic Sciences:

> "[M]echanical losses from a one-month hibernation period will amount to no less than 1.4% of the annual GDP. The longer the freezing, the more acute the losses – other than straightforward cumulation, there will also be additional effects related to insecurity and the need to economize on the one hand, and on the other to the domino effect (losses in other sectors), bankruptcies and unemployment. With a three-month hibernation, the losses may even reach a staggering 10% of the annual GDP."

These forecasts, labor market data and the condition of the state budget all suggest that the present situation may merely herald a deeper economic downturn in the coming months or even years.

It should be emphasized that these economic growth forecasts are based on an optimistic scenario, assuming that the negative influence of the pandemic on the economy ceases as of July 2020. As such, they do not factor in the impact of the uncertainty, social distancing and possible second wave of the pandemic in the second half of the year.

In the early phase of the COVID-19 epidemic in Poland (mid-March 2020), radical measures were put in place: a complete lockdown of practically the entire economy, which considerably halted the spread of the epidemic. The experiences gained during the spring freezing of the economy suggest that, should a second wave appear in the autumn, such a lockdown should probably be imposed only in certain areas and sectors, given that the extent of the epidemic in Poland has varied, and still does vary, from region to region. However, local lockdowns are only possible when public health authorities have the capacity to test the population on a mass and representative scale.

The freezing of the economy entailed the risk of a wave of bankruptcies and unemployment, which could usher in a long-term recession. This prompted the Polish public administration to step in, initiating a set of measures known as successive "Anti-Crisis Shields," which were costly but necessary interventions and were in tune with how other developed countries had responded to the crisis. These aid measures are funded not only from the budget deficit, but also by the Polish Development Fund (PFR) and the state development bank BGK (both of which form part of the public-finance sector but are not calculated into the official budget deficit). In its budget amendment bill, the Government announced that the 2020 budget deficit would come to PLN 109 billion. This amount should be augmented by the PLN 200 billion of debt that may be issued by the end of the year by the PFR and BGK. Public debt calculated using the European methodology (comprising the entire public sector) is estimated at 62% of the GDP this year, and 65% next year, which means that it will exceed the constitutional threshold of 60%. If there is no second wave of the pandemic and hence no need to further boost public spending, and considering the fact that the credit risk of the Polish debt has not increased, these are values that the financial market still considers stable.

The data coming in from the labor market are unclear. The official rate of unemployment published by the Central Statistical Office (GUS) was 6.1% in July 2020 [5]. However, the rate of unemployment as gauged by the Labor Force Survey, a questionnaire survey adopting a definition based on the methodology of the International Labour Organization (ILO), was "merely" 3.1%. One important consideration here is that many people who have lost a job during the pandemic have not as yet been looking for another: according to the prevailing definition such persons are not classified as unemployed, but as economically inactive. Similarly, those who had received termination notice but were still in their notice period when the survey was taken are still classified as employed. A much more pessimistic picture of the labor market situation emerges from the "Diagnosis+" survey conducted during the lockdown using the LFS methodology by four independent research centers – it found that the unemployment rate in June 2020 was 5.4%. The IMF forecasts for Poland predict a nearly 10% rate of unemployment for 2020, and 8% at the end of 2021, which suggests a detrimental "jobless recovery" scenario.

A dramatically deteriorating financial situation can be felt across the whole of the public sector, including healthcare, local governments, education, culture, public transport and many other branches. These sectors of Polish economy and social life may soon be faced with a situation that poses a threat to the functioning of the country and its society.

The European Union has resolved to allocate a staggering EUR 750 billion to assist the Member States in managing the current crisis and its consequences. Poland will be able to utilize a large portion of the allocation, provided that the rule-of-law principles and other values enshrined in EU treaties are adhered to.

4. Forecasts and recommendations

4.1 The autumn-winter season

A season is most simply defined as a subdivision of the year, a period when a specific type of activity typically takes place or when there are particularly favorable conditions for such activity. From the standpoint of public health, certain seasons are identified as being particularly conducive to the spread of specific pathogens, frequently combined with changes in the weather conditions. This is directly linked to bioclimatic factors, in other words to the human body's individual reaction to the thermal and humidity conditions of its immediate surroundings. For example, a temperature of −5°C will be felt one way with windless weather and low humidity, but quite differently with strong wind and higher humidity. Our individual perceptions and comfort in terms of temperatures and humidity are also affected by the frequency of fluctuations in weather conditions and the frequency and gradient of temperature and humidity changes, such as when moving between indoor and outdoor locations. Individual adaptations to external thermal conditions are managed by the body's thermoregulatory mechanism.

In Poland's climate, the variability in general bioclimate conditions progresses through seasonal changes at different times of year. Given the country's location within the moderate transitional warm climate zone, a distinction is drawn between 6 times of year, each defined based on thermal criteria: (1) the prevernal (pre-spring) season, with a multiannual average temperature within the range of 0–5°C, (2) the vernal (spring) season, with a multiannual average temperature of 5–15°C, (3) the estival (summer) season, with a multiannual average temperature of above 15°C, (4), the autumnal (fall) season, with a multiannual average temperature of 5–15°C, (5) the prehibernal (pre-winter) season, with a multiannual average temperature of 0–5°C, and (6) the hibernal (winter) season, with a multiannual average temperature of below 0°C. The individual seasons are characterized by different humidity and windiness conditions, which introduce further variability in perceptions of the air temperature. There are additional, human-induced components to weather perceptions in heavily urbanized areas, where high aerosol content in the air is conducive to higher humidity and to the appearance of fogs and hazes that meet the parameters typical of smog.

In terms of human health, weather conditions ensuring moderate air temperature and high humidity are particularly favorable for the development of various "seasonal" types of respiratory infections (e.g. influenza, bronchitis, pneumonia). Pathogens then attain their optimal opportunities for spreading, especially as much of social activity is then transferred to closed and heated indoor spaces. The large thermal and humidity gradient between such indoor spaces and the outdoor conditions favors the dysregulation of the thermoregulation process, which usually leads to the cooling of the body and facilitates the individual transmission of pathogens. The seasonal variation in air temperature and humidity also affects the possibility of SARS-CoV-2 virus transmission, including in conditions of co-infection.

Virus transmission, temperature and humidity

Contrary to hopes, the SARS-CoV-2 virus did not prove to be a seasonal virus and did not disappear like SARS-CoV did in 2003. The impact of the changing climate turned out to be too weak to inhibit virus transmission. This does not mean, however, that the change in weather had no impact on the course of the pandemic. The available research suggests that the chance of becoming infected does indeed increase with increasing temperature and humidity. Malki et al. (2020) have shown that transmission is highly dependent on temperature, sunlight (exposure to UV light) and humidity. As such, it may be speculated that if the same rules regarding social distancing, hygiene and isolation are kept in place, the number of cases will start to rise as the weather changes in the autumn. Some authors are even suggesting that epidemic risk assessments should also factor in weather forecasting, but it should be borne in mind that the development of the epidemic in spring was very dynamic and dependent on many factors, and so any real correlation between the season and the course of the pandemic will be identifiable only after the full season is analyzed.

General state of health and respiratory condition

Infection with SARS-CoV-2 virus may proceed asymptomatically, but it may also involve a wide spectrum of symptoms, ranging from cold and flu-like symptoms to life-threatening pneumonia, or even multi-organ disorders. We know of certain risk factors that predispose infected people to experiencing a severe course of the disease, including age, being overweight, having diabetes, etc. On the other hand, however, it should be noted that people's general health typically deteriorates in the fall and winter season, due to a number of factors including poorer diets, less sun exposure, co-infections, and reduced respiratory efficiency caused by the dry air in heated homes and the cold outside air.

Co-infections

Respiratory system diseases are very often a result of simultaneous infection with several different viruses, bacteria or fungi. It has long been known that individual pathogens may interact closely to inhibit or promote co-infections. To illustrate the importance of such interactions, it is worth mentioning that most of the deaths caused by the Spanish Flu a century years ago were due to secondary bacterial infections. For coronaviruses, too, co-infections in humans are extremely common.

For COVID-19, relatively limited data is yet available, as co-infection testing is a difficult and demanding process, and the available literature is incomplete due to a lack of data for the fall season. However, some reports already suggest that co-infections may be playing a role in the high COVID-19 mortality. In some cases, group stratification by severity of the course of the disease shows that patients experiencing it severely do exhibit the highest rates of co-infections. At the same time, among people infected with the virus, the incidence of concurrent infections with other viruses and bacteria does not appear to be abnormal. This suggests that infections with other pathogens do not increase the risk of SARS-CoV-2 infection; however, they may affect the course of the disease and may alter how the disease presents in the autumn and winter period.

Air pollution

Air pollution is one of the main factors affecting the condition of our respiratory system. Pollution alone may lead to the development of certain diseases, or aggravate others. Already at the outset of the pandemic, epidemiological research showed a correlation between air pollution and the course of the disease and epidemic. However, it should be borne in mind that this is a multi-factor analysis and air pollution also correlates with population density, so it sometimes may not be possible to tease apart the influence of the different factors.

Possible scenarios

Efforts to forecast the development the epidemic in the fall-winter season are hampered by uncertainty about the role of children and adolescents in spreading the virus, about the degree of people's compliance with the recommendations to wear face masks, to abide by respiratory and hand hygiene, and to maintain social distancing also in workplaces, and about the efficiency of the system of testing and isolation or quarantine.

In the optimistic scenario, assuming a low infectivity among children and more stringent compliance with recommendations, e.g. in response to the greater number of upper respiratory tract infections generally present in the environment, the number of SARS-CoV-2 infections will not increase – a constant effective virus reproductive rate (R) of <1.1 can then be assumed. Stringent compliance with the recommendations for social distancing will also entail lower incidence of influenza, so fewer people with symptoms suggestive COVID-19 will require testing, and so the testing and quarantine system will maintain greater efficiency.

In a less optimistic scenario – still assuming low infectivity among children but at the same time less stringent compliance with recommendations – we should expect to see local outbreaks, much as is the case today. Some outbreaks may be successfully extinguished, but in the case of larger ones or those detected only after a delay, numerous secondary infections will occur and local transmission will be maintained at a higher level. The increased number of cases, even with a stable pace of growth, will place a greater burden on public health services and bring a risk of system failure. Overstretching the capacity of the testing system, on the other hand, will cause delays in the diagnosis of outbreaks, limiting the effectiveness of local anti-epidemic measures.

The pessimistic scenario, in turn, assumes infectivity among children analogous to the rate among adults, as is the case for influenza. In this case, within a few weeks from the start of the school year, outbreaks can be expected to crop up at educational institutions, especially in areas where an increased incidence is already observed and cases are not related to an identified outbreak. This scenario also factors in a second element of risk, namely the lack of compliance with the recommendations for social distancing and mask-wearing, and takes into account that for weather-related reasons, in the autumn and winter period people more often spend time in confined spaces, where the risk of transmission is many times higher. In this scenario, the capabilities of the State Sanitary Inspection (“Sanepid”) would most likely be quickly overtaxed, resulting in a rapid increase in case numbers.

4.2 Preparing for the autumn-winter season

Threats in the autumn-winter season

After the easing up of restrictions in the summer, the incidence of COVID-19 is now exhibiting an upward trend, with the reproductive number R at the level of 1.3. Moreover, in the coming autumn we can expect a faster pace of spreading, in other words an increased reproductive number, due to the more frequent presence of people in indoor spaces and the opening up of educational institutions. The pace of spread is one of the threats in the coming season: with R above 1.5, the epidemic will exceed the capacities of the healthcare system even before the year is out. The nationwide index is made up of locally occurring outbreaks; the weakness of our anti-epidemic measures may prove to be their delayed detection. Already now, it is impossible to clearly establish an epidemiological link for one out of every four diagnoses, pointing to deficiencies in testing. There are also numerous reports in the media that the current system of test referrals, sampling and laboratory testing does not fully satisfy the existing needs – for example in terms of testing people exhibiting COVID-19 symptoms, which is an internationally recognized standard. Due to the often similar clinical presentations of influenza and COVID-19, this demand is likely to increase significantly in the fall. To cope with this, the system's capabilities must be boosted, and not only in terms of the laboratory base. Due to the lack of uniform, documented testing criteria, a certain degree of arbitrariness prevails in this respect, with both the frequency of testing and the groups that get tested possibly differing from region to region. As a result it is difficult to determine, on the basis of the registered number of new diagnoses, to what extent the virus may be circulating in a given community and whether there may be outbreaks occurring in it – information crucial for locally shaping anti-epidemic measures. In addition to ongoing monitoring of testing, environmental (wastewater) studies and seroprevalence testing may be helpful in determining the local situation.

Of course, COVID-19 is not the only health-related problem that the healthcare system needs to cope with. The demand for healthcare services is subject to considerable seasonal fluctuations and does traditionally peak in winter. The healthcare system’s being significantly focused on COVID-19 will limit its capacity to care for patients with other illnesses. This is likely to result in increased incidence of insufficiently controlled chronic diseases or undiagnosed diseases. The effects of hampered access to basic services for patients with chronic diseases such as diabetes or cancer patients are already visible. Ensuring the continuity of medical care for people suffering from other illnesses must remain a priority in the coming season.

Opening up schools and universities

The role of children in transmitting the virus remains a controversial point of debate. Children more often experience the infection asymptomatically and some studies indicate that they are less often a source of infection in adults. Nevertheless, outbreaks in groups of children and transmission from a child to the remainder of his or her household have been documented. Therefore, when it comes to having students return to school, it should not be assumed that schools will function just as they did before the outbreak of the epidemic, or only in a slightly modified way. The harm entailed by having children not attend school is significant: not only economic losses related to the need for parents to stay at home with smaller children, but also harm to children's health (overweight, depression, anxiety, injuries in the home environment) and developmental shortcomings. Therefore, school closings should only be a last resort and only in areas with an unfavorable epidemic situation. However, the obligation to wear masks in schools should be universal, at least among older children. Where there is a scenario of increased local transmission, this recommendation should be further augmented to include increasing the distance between students' desks, maintaining separate "bubbles" of students who can contact each other but not those in other "bubbles," delegating teachers to specific classes (so as to prevent extensive transmission if a teacher becomes infected), limiting the movement of students in common spaces (such as by introducing asynchronous breaks), airing out rooms during the day and disinfecting desks, door handles, and common items after classes.

Public health inspectors should carefully monitor the situation at schools, but also among the families of students, teachers and technical staff. The detection of a COVID-19 case at a school should trigger the initiation of a pre-developed sanitation procedure, agreed at the local level between the education authorities, public health inspectors, and the principals of individual schools. Schools that operate in regions with relatively high epidemic intensity and are unable to follow the stringent sanitary regime outlined above should switch over to a distance-learning system. Education authorities should already now be developing recommendations that would be universally applicable to schools, depending on the given scenario. Such guidelines should act as an algorithm for dealing with specific cases, maintaining maximal functionality while ensuring quick responses to local or regional events.

Flu vaccines

With the onset of autumn (late November and early December), mass numbers of flu cases will start to occur in Poland, peaking in February and March. Although the currently circulating strain of influenza is less dangerous than SARS-CoV-2, influenza is a dangerous life-threatening disease that can leave behind permanent traces on our health. There is little data on co-infection of the SARS-CoV-2 virus and influenza virus and the impact of previous infections on the course of the disease. It is possible, however, that the viruses may act synergistically, drastically increasing the mortality rate, including among younger people. At the same time, it is virtually impossible to distinguish influenza from SARS-CoV-2 in the early stages, so influenza could end up stretching the occupancy of hospitals and diagnostic units beyond their capacity. This could lead to the paralysis of the healthcare system, and ultimately the entire country.

Influenza is one of the few respiratory illnesses for which a vaccine is available. Because the virus is highly variable, a new vaccine is developed each year to match the strains currently circulating. This season, this vaccine will appear in September. Due to the dangers of the SARS-CoV-2 virus, it is crucial that as many people as possible get vaccinated against the flu. This will improve the chances that critically ill patients will receive the help they need.

Cooperation – Europe

In order to avoid disruptions due to the imposition of restrictions as seen in spring 2020, the European Commission has listed the priorities of harmonizing SARS-CoV-2 testing across countries, contact tracing (including via interoperable applications), and epidemiological surveillance. In addition, arrangements are being finalized with pharmaceutical companies regarding the central purchasing of vaccines for all EU countries, and on 28 July 2020, the European Commission signed a contract for the supply of remdesivir. Centralized purchases are now also being carried out for personal protective equipment, respirators, and laboratory equipment.

Close cooperation is also evident within the scientific community. Under the framework of the Horizon 2020 program alone, 41 international research projects are being carried out. Validated data provided by designated national institutions (in Poland this is the National Institute of Public Health – PZH) and analyzes of the occurrence of COVID-19 in Europe are presented by the European Center for Disease Prevention and Control.

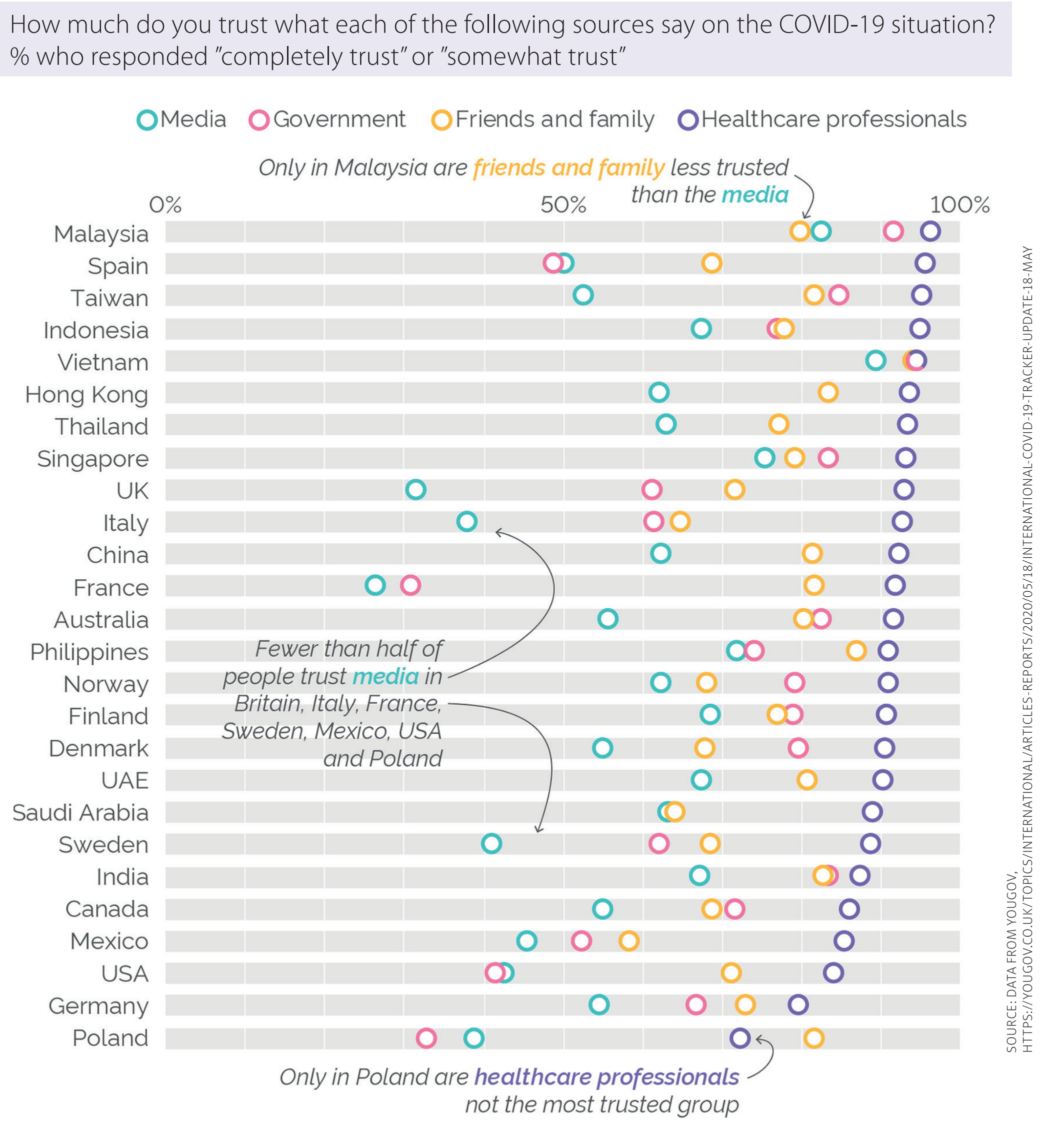
4.3 Society

The second wave and easing up: a matter of trust

This report is being prepared at a distinctive time, when two different trends are clashing. On the one hand, the epidemic is by no means waning out and the daily numbers of newly reported cases are exceeding the previous maximums. On the other hand, Polish society, having initially complied with imposed rigors, following a series of not entirely consistent statements by officials (especially during the election campaign) now does not seem prepared to accept a return to such restrictions. And so, the so-called "second wave" of the epidemic is in Poland meeting up with a certain easing up on the part of society. This is not a safe combination.

At such a time, the issue of public trust in various sources of information on COVID-19 becomes particularly important, significantly shaping patterns of behavior and social and individual reactions. According to international research by the YouGov group, Poland ranks lowest among the countries surveyed when it comes to public trust in the media, governments, healthcare professionals, and friends and family (although in the latter case we are a bit more trusting than the Germans and Americans). This is not surprising and confirms the long-recognized low level of public-trust capital in Poland. Even so, it is surprising that Poland is the only country where, as the authors write, healthcare specialists are not the group most trusted as a source of information. Instead, family and friends are considered more reliable. This does fit in with observations on the importance of local micro-social ties in Poland. And so, we might say with a certain exaggeration, if we want to get recommendations across to the Poles, we must above all convince their friends and families. This is both a challenge and an opportunity in creating a system of

Table 3
Who do people across the world trust on COVID-19?



effective recommendations. While it is is true that, as Paweł Marczewski (2020) points out, the advantage of relatives over experts in terms of credibility is not a new phenomenon in Poland, it certainly takes on additional importance in an epidemic situation.

In an in-depth study of the relations between public trust and the epidemic situation, Marczewski (2020) reaches two conclusions that appear particularly important from the standpoint of social behavior during the epidemic:

1. Although it has been argued by some that the frequent distrust of others in Poland may actually be functional in relation to the social-distancing recommendations, Marczewski points out that the positive impact of this distrust is nevertheless limited. It fails when the recommendations go beyond social distancing and self-isolating, and begin to involve taking actions that require cooperation. Then the deficit of trust becomes an obstacle. Simply put, a low level of trust in others and in institutions can be 'useful' when it comes to negative recommendations (what not to do), but fails when it comes to cooperative positive actions.

2. The Polish lack of trust in public institutions and services, including the health-care system, is much more closely related to low assessments of their quality than to any specific traits on the part of the respondents (e.g. their level of education or income).

All in all, it is clear that the role of credibility and trust is crucial here. Once again, it turns out that its placement mainly at the local level, in the microstructures of collective life more than in formal institutions at the state level, entails both a challenge and an opportunity. Such an opportunity may especially be espied in the public trust enjoyed by local-level institutions (e.g. local governmental authorities), which can serve as a reliable source of public policies and recommendations.

Views and social behavior vs the dynamics of the epidemic: implications for recommendations

The effectiveness of any recommendations for social behavior during an epidemic depends largely on the perceived level of individual risk. The figure below shows the relationship between certain attitudes towards the epidemic reflecting a sense of threat, and the daily numbers of new infections in Poland at the times when those attitudes were examined.

The figure indicates that there is no simple positive relationship between increased case numbers and an increased sense of danger. The latter was probed through questions about government policies ("The government is overreacting" and "The worst is yet to come"). Note that even during the period of a large number of daily infections (between May 19 and 29) there was a marked decline in the frequency of beliefs that "the worst is yet to come" and an increase in the frequency of beliefs that "the government is overreacting." In other words, people's beliefs about the threats must depend on factors other than the publicly reported data on the course of the epidemic. If these analyzes of attitudes were available for even later periods, it is possible we might be able to observe an even wider divergence between the objective state of affairs and the

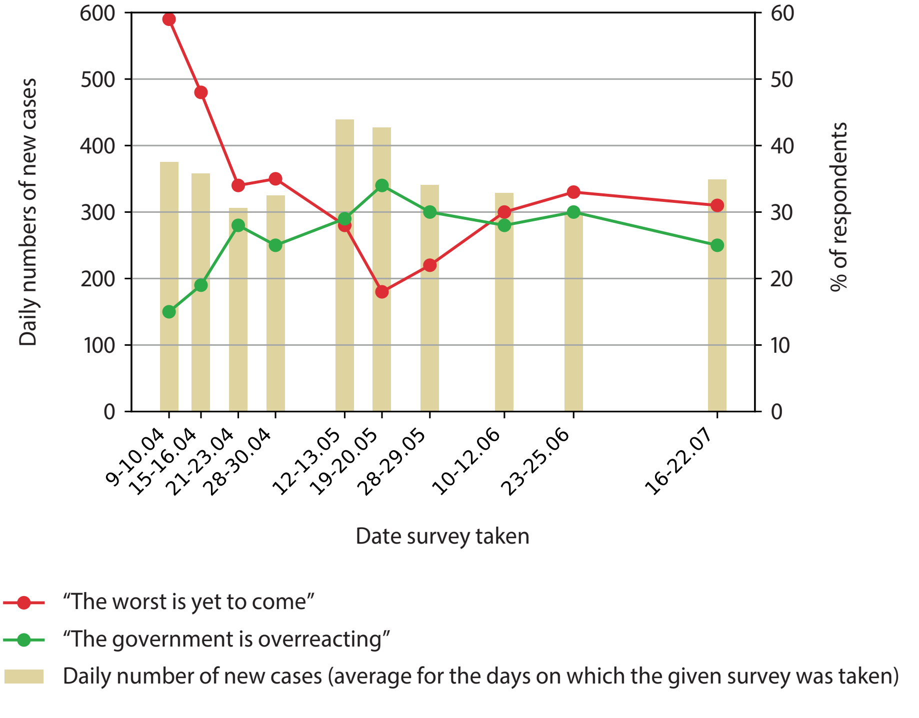


Fig. 14
The dynamics of the epidemic in Poland against the backdrop of public attitudes

SOURCE:
PUBLIC OPINION DATA FROM A STUDY CARRIED OUT BY THE CENTER FOR THE STUDY OF DEMOCRACY, SWPS UNIVERSITY OF SOCIAL SCIENCES AND HUMANITIES, LED BY R. MARKOWSKI. THE QUESTIONS WERE "WHICH OF THE FOLLOWING DESCRIPTIONS OF THE DEVELOPMENT OF THIS EPIDEMIC IN POLAND OVER THE COMING TWO-THREE MONTHS SEEMS TO YOU TO BE MOST LIKELY?" WITH PERCENTAGES BEING REPORTED FOR THE RESPONSE "THE WORST IS YET TO COME", AND "HOW IS THE GOVERNMENT BEHAVING WITH RESPECT TO THIS EPIDEMIC?" WITH PERCENTAGES BEING REPORTED FOR THE RESPONSE: "THE GOVERNMENT IS OVERREACTING – SOWING UNNECESSARY PANIC." DATA FOR THE AVERAGE DAILY NUMBERS OF NEW CASES FROM: COVID-19 DATA REPOSITORY BY THE CENTER FOR SYSTEMS SCIENCE AND ENGINEERING (CSSE) AT JOHNS HOPKINS UNIVERSITY, HTTPS://GITHUB.COM/CSSEGISANDDATA/COVID-19

sense of danger. Such sentiments probably depend to a large extent on twists and turns in announcements by public officials about whether the epidemic is still dangerous or already almost defeated. Such not entirely consistent messaging has indeed been evident in Poland, especially during the election period. The sentiments may also be a reaction to the easing up of the restrictions, also not fully correlated with the state of the epidemic.

It should also be taken into account that apart from rational views based on solid scientific data, irrational views that even deny the existence of the epidemic in general and thus call into question the sense of various recommendations have become more and more audibly voiced in the public sphere of late. These views are being expressed not only on social media, but also in book publications and at organized collective events (protests against mask-wearing, etc.). They can even be described as an increasingly institutionalized part of the Polish public discourse on the epidemic. Against the backdrop of the clash of these "two armies," rational vs irrational, there is also a third, less visible army, whose size is difficult to accurately determine: the ranks of those who do not question the epidemic, but somehow disregard it even so, convinced that it does not really concern them. This is the less institutionalized, scattered, but potentially large army of "people wearing face-masks on their chins."

The mutual interactions of these three groups of actors depend on many factors. One of them is how well-prepared society is for the fact that rational views based on empirical data may nevertheless change and evolve, especially at a time of such dynamic development of the epidemic. We are not only in the very midst of an epidemic, but also in the very midst of scientific research into its underlying mechanisms. Thus, arguments that are based on scientific methods and real data may end up shifting. Public opinion must be properly prepared for this, so that the results of investigations based on rational methods do not end up getting disavowed. Such changes, such new conclusions, do not prove that researchers are unreliable – rather, they are the result of researchers' continual pursuit of what is itself a dynamic epidemic.

However, apart from the findings of scientific research and the stance and credibility of the media, the attitude of leaders is also of fundamental importance for tipping the balance in favor of the group prioritizing rational views. Although, for the reasons presented above, the credibility of central leaders and institutions is not excessively high in Poland, the kind of local-level leaders who are bestowed with greater trust – mainly local governments but also NGOs – have a potential opportunity to reinforce the effectiveness of protective recommendations. Their role is especially increasing as the state of the epidemic itself becomes more locally dispersed and heterogenous. Therefore, it is particularly important at present to equip local governments and NGOs with appropriate organizational and financial instruments to protect society against the effects of the epidemic.

4.4 Summary and recommendations

4.4.1 What threat does COVID-19 pose to people at various ages? It is hard to imagine a fifty-year-old athlete breaking the world record in the 100-meter dash or high jump. The fact that older individuals do not break sporting records does not surprise anyone, because we know from our observations of our older friends and family members, for instance, that the human body's fitness, endurance, coordination, and reflexes deteriorate with age. In athletic disciplines, it is evident that there is a gradual weakening of the muscular, nervous, and circulatory systems. As a general rule, once past the point when we attain adulthood, the efficiency of all our bodily systems is in decline. The immune system is no exception in this regard, and so older individuals are less able to cope with inflammations and infections. They are also more susceptible to various illnesses, because not only the above-mentioned bodily systems but also the digestive, endocrine, and urinary systems, etc. show decreased efficiency. Therefore, older individuals typically suffer from various illnesses in general and they account for the greatest share of COVID-19 fatalities.

This is a very serious social problem because it affects a large share of society. According to statistical data from 2019, there are 6.9 million people in Poland over 65 years old, which constitutes 18.1% of the total population. The fact that they are often suffering from illnesses is clearly demonstrated by data of the following sort. To take just the circulatory system, hypercholesterolemia (blood cholesterol levels significantly in excess of the norms) affects about 5 million people over the age of 65 in Poland, arterial hypertension about 4 million, ischemic heart disease about one million, and clinically significant heart rhythm disorders about 0.7 million. Type 2 diabetes has been diagnosed in 1.44 million people over 65. According to data from 2017, there were 44,000 women and 51,000 men over 65 fighting various forms of cancer – accounting for 54% and 62% of all cases of such diseases in Poland, respectively. Obesity is another serious health problem that affects the elderly. Thus, adding an additional health problem such as COVID-19 to what an already sick older individual is dealing with can be very dangerous.

Older individuals are, therefore, the group at highest risk of COVID-19, and they will remain in need of special care from society until a specific and effective vaccine is available – for at least several more months, possibly another year or two. In other words, not only older individuals but everyone who comes into close physical contact with them should observe strict sanitary discipline during this time.

However, COVID-19 may be a dangerous disease also for people with no previous health burdens, i.e. young and middle-aged people. In the period immediately after infection with the SARS-CoV-2 virus, the disease is usually asymptomatic or its symptoms are mild. However, it is presumed that its later complications may still be serious; not enough time has passed since the emergence of this disease to fully evaluate this issue.

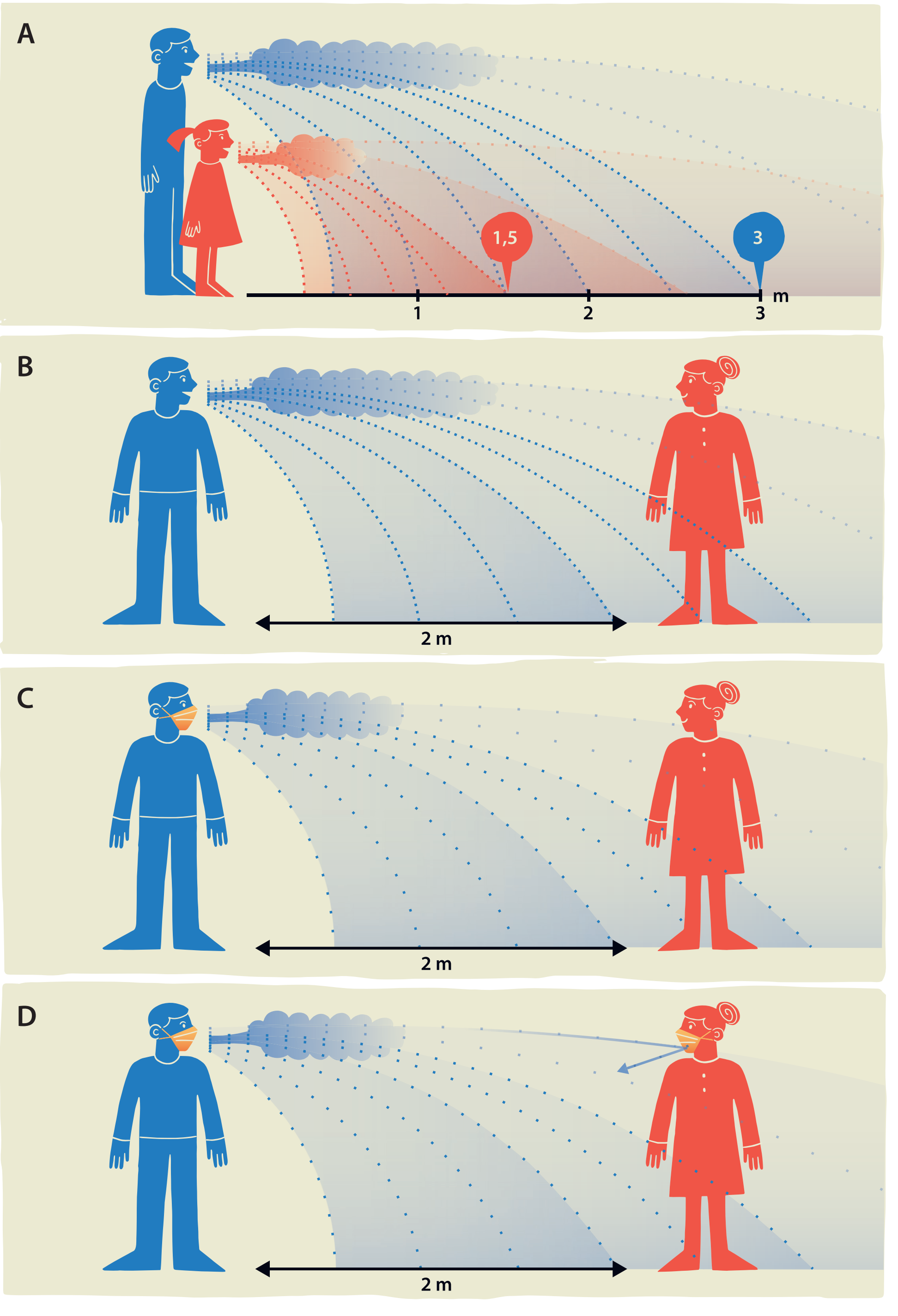
COVID-19 can also cause serious damage in children. The disease progresses atypically in them, but the loss of smell and taste in children may result in loss of appetite and severe exhaustion or dehydration. The long-term health effects of COVID-19 in children are still being studied. Again, we must admit that too little time has passed since the emergence of this disease to fully assess this point.

4.4.2 General recommendations for the public. After seven months of exposure to the SARS-CoV-2 virus, we already know that infection with this respiratory coronavirus most often occurs through prolonged (typically more than 15 minutes) and close (less than 2 m) contact with an already infected person in an indoor space. **The chances of becoming infected can be reduced by striving to shorten the contact time, consistently maintaining a proper distance (at least 2 m), not raising one's voice in conversation, and additionally wearing a face mask that carefully covers the mouth and nose. It is equally important to wash one's hands frequently and avoid touching one's face.** These sanitary rules should be strictly applied in closed indoor spaces.

Widespread mask-wearing sparks resistance in some people, who question whether wearing face-masks significantly reduces infection with the virus. On the other hand, they confidently warn about certain dangerous effects of wearing them, such as carbon dioxide poisoning, mycosis of the respiratory tract, and in the case of asthmatics – exac-

Fig. 15
An illustration of the main means of SARS-CoV-2 virus transmission between individuals, showing why maintaining the right distance and covering the nose and mouth with a mask significantly hampers transmission

An infected individual emits from their nose and mouth: i) airborne aerosol and ii) droplets of saliva or nasal secretions that fall to the floor. Those droplets are of various sizes; the larger they are the closer they fall to the emitting person. Larger droplets also usually have greater virus content. It is clearly visible that shortening the prescribed distance between individuals (to less than 2 m) will mean that a larger number of droplets emitted by an infected person will reach an uninfected one. A face mask worn by an infected speaker curbs the intensity of the direct stream of aerosol and droplets projected towards the uninfected individual. A mask covering the nose and mouth also gives the listening individual additional protection from transmission of the virus.



SOURCE: PAS OWN MATERIALS, BY: JANA KULMATYCKA

erbated breathing problems. These concerns have no solid scientific basis. It is true that wearing a mask is cumbersome, but we have to accept it, because numerous scientific studies show that it significantly reduces the chance of transmitting the virus. Masks significantly reduce virus emission through the mouth and nose of an infected person, and to a lesser extent they protect uninfected persons.

The recommendation for children to wear masks, for example at public events or school activities, is particularly subject to attack. The joint recommendation put forward by the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) in August 2020 is clear on this point:

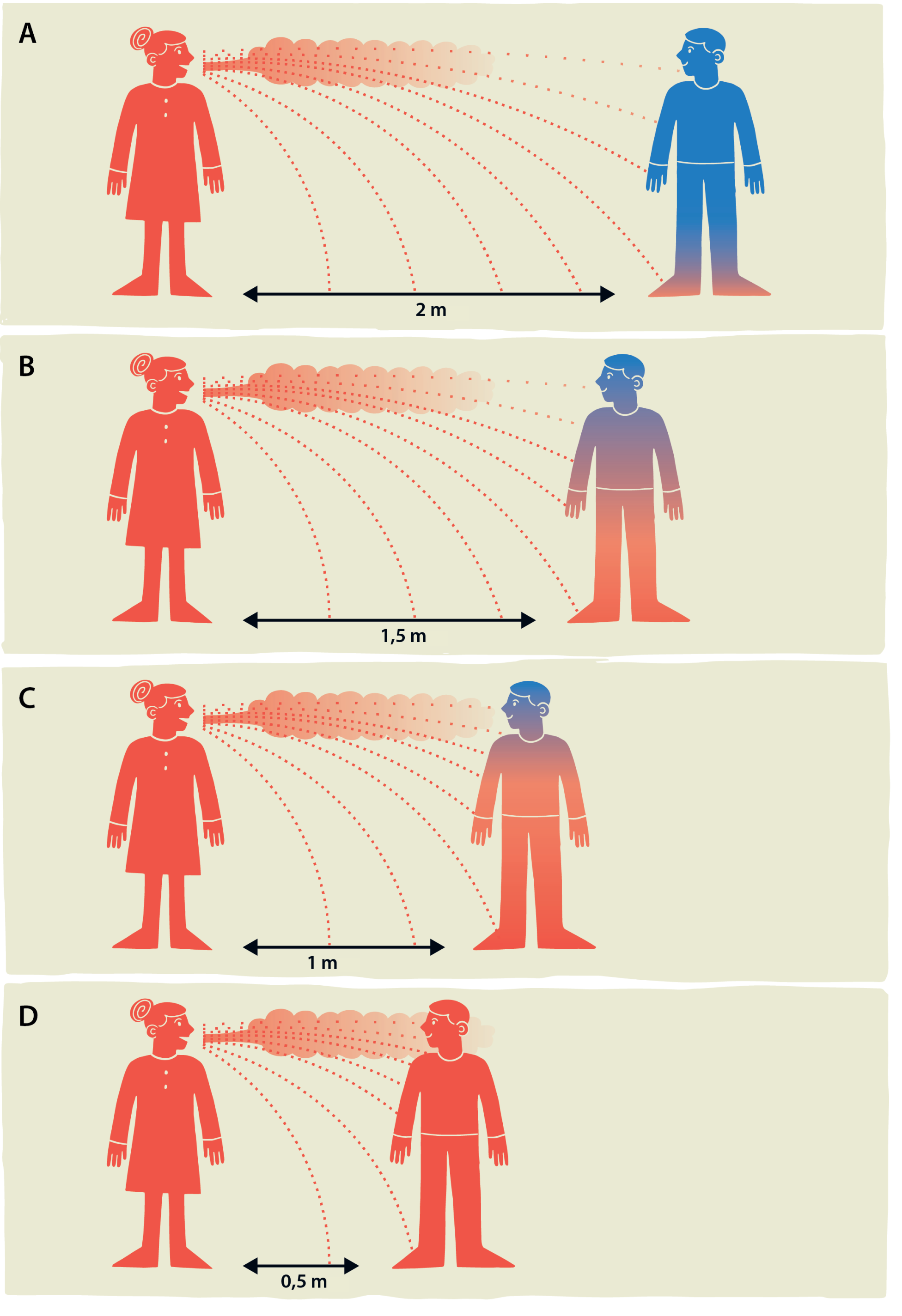


Fig. 16
Keep a proper distance of at least 2 m

SOURCE: PAS OWN MATERIALS, BY: JANA KULMATYCKA

"WHO advises that people always consult and abide by local authorities on recommended practices in their area. An international and multidisciplinary expert group brought together by WHO reviewed evidence on COVID-19 disease and transmission in children and the limited available evidence on the use of masks by children. Based on this and other factors such as children's psychosocial needs and developmental milestones, WHO and UNICEF advise the following:

*Children **aged 5 years and under** should not be required to wear masks. This is based on the safety and overall interest of the child and the capacity to appropriately use a mask with minimal assistance.*

WHO and UNICEF advise that the decision to use masks for children ***aged 6–11*** *should be based on the following factors:*

- *Whether there is widespread transmission in the area where the child resides*
- *The ability of the child to safely and appropriately use a mask*
- *Access to masks, as well as laundering and replacement of masks in certain settings (such as schools and childcare services)*
- *Adequate adult supervision and instructions to the child on how to put on, take off and safely wear masks*
- *Potential impact of wearing a mask on learning and psychosocial development, in consultation with teachers, parents/caregivers and/or medical providers*
- *Specific settings and interactions the child has with other people who are at high risk of developing serious illness, such as the elderly and those with other underlying health conditions*

WHO and UNICEF advise that children ***aged 12 and over*** *should wear a mask under the same conditions as adults, in particular when they cannot guarantee at least a 1-metre distance from others and there is widespread transmission in the area.*"

In the open air, these strict guidelines may be relaxed to a small extent. It is known that it is much more difficult to transmit the virus out in the open. According to some estimates, the chance of infection during the very same encounter between two people may even be twenty times less when it occurs outdoors as compared to an encounter in a closed, badly ventilated or ventilated indoor space. However, **even in the case of meetings out in the open air, a sufficient distance should be maintained (at least 2 m). If this is not possible, masks should be worn. Religious ceremonies (mass), family events (celebrating weddings, name days, birthdays, or anniversaries) and public events (sports matches, concerts, theater performances), which gather a lot of people and at which it is impossible to comply with the appropriate sanitary recommendations, should definitely be avoided in regions with a high incidence of COVID-19. Additionally, those attending such gatherings should refrain from close-contact greetings, farewells, other cordial gestures, hugs, etc.**

The threat of infection with SARS-CoV-2 should encourage us to get vaccinated against seasonal influenza and pneumococci. Simultaneous infection with influenza viruses and SARS-CoV-2 (co-infection) is particularly dangerous; every effort should be made to avoid this. Prior vaccination against seasonal flu is a step in this direction, because it enables the immune system to quickly cope with the flu virus and thus allows it to fight on "only one front at a time." Vaccination against pneumococci largely prevents various complications that occur during COVID-19.

Getting vaccinated against influenza will also help protect healthcare facilities from becoming overcrowded with the millions of people potentially suffering from influenza in the autumn and winter season (see Table 4 "Influenza and suspected infections with influenza and influenza-like viruses in the epidemic seasons from 2017/2019 to 2019/2020") in addition to the thousands of people with suspected COVID-19. Distinguishing which of these two diseases with initially similar symptoms may be affecting a person is no trivial task.

The social and economic consequences of the two-and-a-half-month lockdown (from mid-March this year to the end of May this year) in Poland turned out to be very serious. The imposition of the lockdown in March of this year may possibly have been a rash decision. However, we knew much less about the epidemic back then than nowadays,

Table 4
Influenza and suspected infections with influenza and influenza-like viruses in the epidemic seasons from 2017/2019 to 2019/2020

Epidemic season	Infections	Deaths	Hospital referrals
2017/2018	5,337,619	48	18,320
2018/2019	4,675,043	150	17,499
2019/2020*	3,550,666	65	16,522

* data as of 17 June 2020

SOURCE: BRYDAK L. B., 2020 (CITED AFTER NIZP-PZH)

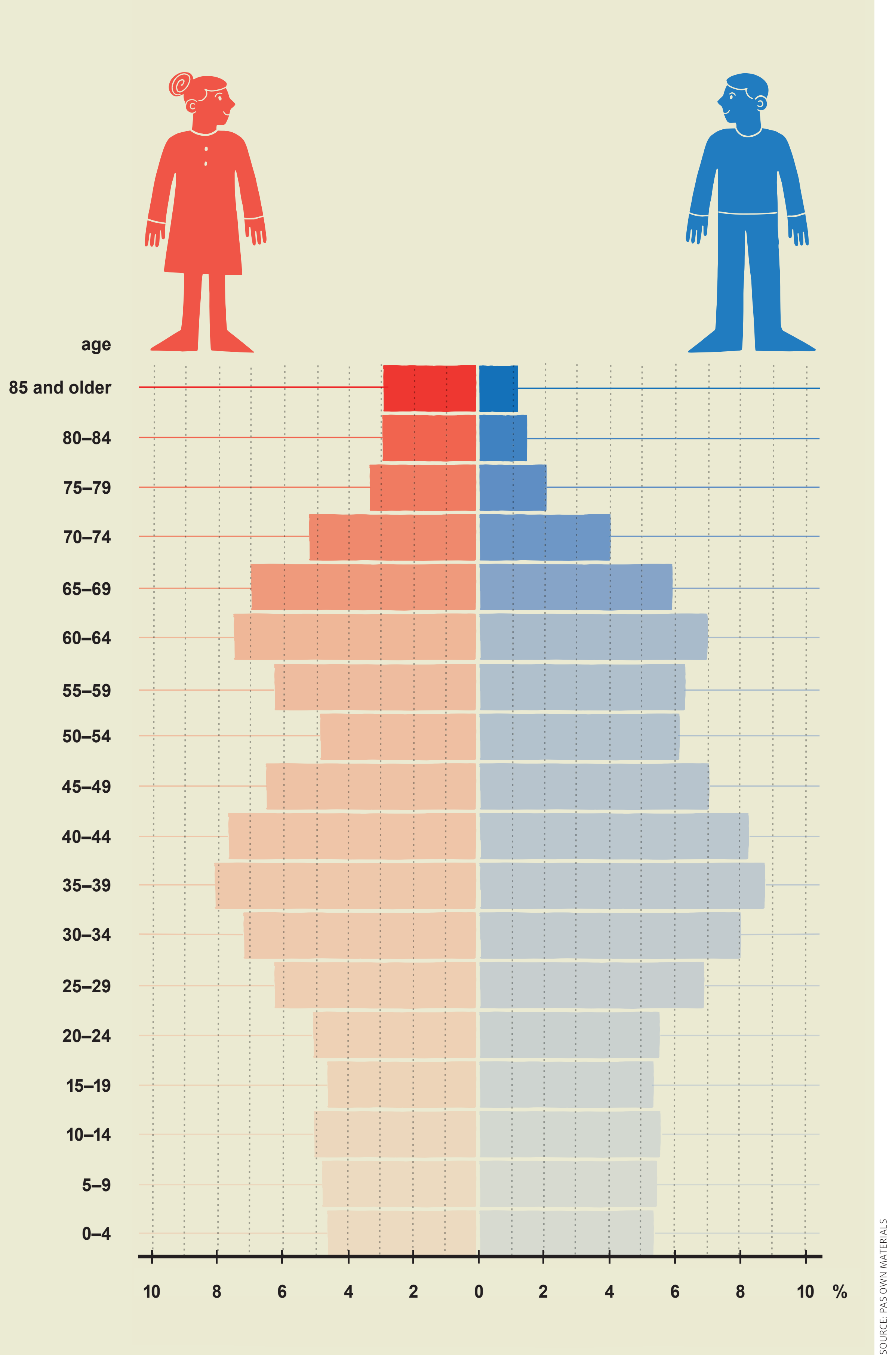
and there were major fears of an uncontrolled pandemic. The tragic situation evident in northern Italy and certain regions of Spain, for instance, fueled those fears. Now, after a few additional months of dealing with COVID-19, we know that perhaps then we should have above all introduced the sanitary recommendations listed above. However, back in March, not only were we not as knowledgeable as we are today, we were also not technically ready to apply such recommendations on a large scale; for example, the supply of masks and disinfectants then still remained limited.

Undoubtedly, the reintroduction of a lockdown in the autumn and winter season, should the epidemic situation become very bad, would weaken Poland's already weakened economy, as well as the financial condition of many companies and employees. Therefore, before resorting to such a move as freezing the economy once again in order to fight the epidemic, less drastic measures should first be applied – namely, promoting the scrupulous observance of the above-mentioned sanitary recommendations. The experience of other countries shows that if society is highly disciplined in this regard the epidemic can be suppressed to a sufficient degree, and then it will not be necessary to resort to a general freezing of the economy.

4.4.3 The group most at risk: adults 65+ with chronic diseases. Among adults, the course of COVID-19 becomes more and more dangerous with age. This is not only because the immune system weakens with age, but also because older people more commonly struggle with chronic diseases. The 2018 European Union Statistics on Income and Living Conditions (EU-SILC) study noted that two-thirds (67.0%) of people over the age of 60 in Poland indicated they had long-term health problems or chronic illnesses. The results of the European Health Interview Survey (EHIS) of 2014 were also interesting in this respect – its findings pertaining to older people (over 60) in Poland also pointed to the prevalence of diseases or chronic ailments; only one in nine such respondents reported no such problems. With age, the number of common diseases or chronic conditions increases: an average of 3.1 chronic diseases or ailments were reported per person from the 60–69 age group, 4.1 among seventy-year-olds, and 4.5 among the oldest group.

People aged 85+ are most at risk of being severely affected by COVID-19, but the serious health risk already begins at the age of 65+. Many people above 65 who have contracted COVID-19 have required hospitalization in an intensive care unit and the use of a respirator. Despite such medical care, their illness quite often ended in death. In the United States, 80% of COVID-19 deaths are people over the age of 65. As of 29 August 2020, 145,000 people over 65 in the US had died due to COVID-19. Therefore, until a vaccine is discovered, older people should:

Fig. 17
The age structure of Poland's population, with the risk of death in individual age categories represented by color shading (the more intense the color, the greater the risk)



SOURCE: PAS OWN MATERIALS

a) **limit their contacts with other people as much as possible, even with close family members,**
b) **in the case of contacts necessary for their existence, rigorously observe the above-mentioned sanitary recommendations and enforce their observance by the people with whom they have contact,**
c) **monitor their everyday health, measure their body temperature and blood pressure, and if any alarming symptoms are noticed (temperature above 38°C, breathing problems, loss of smell or taste, etc.), immediately turn to the appropriate public health authorities or the nearest infectious hospital,**
d) **get vaccinated in advance against seasonal influenza and pneumococci.**

4.4.4 Preparing for potential SARS-CoV-2 infection on the part of adults 65+. The time of the COVID-19 epidemic has made many changes to our daily routines. Such changes are particularly problematic for older individuals, who are usually accustomed to their chosen lifestyle and are reluctant to accept any changes to it. Recently they have been suddenly cut off from most of their social contacts; they are much less visited by friends, even those closest to them; they also leave the house less frequently. All this contributes to the deterioration of their mental mood, it often makes them feel depressed, anxious, confused, insecure, anxious, helpless, or even slightly depressed. Apart from abiding by the sanitary recommendations listed above, older people should try to prepare for possible infection, taking preventive measures that may contribute to a milder possible course of COVID-19. Recommended preventive practices include:

1. "inventing" a new way of functioning in society, learning new ways of communicating with family and friends (for example, social media), developing new interests – older individuals should be helped in this by their relatives and friends;
2. taking care to maintain a proper diet and body weight;
3. engaging in everyday activity and physical exercises, of course as appropriately tailored to their capabilities.

Similar rules of conduct should also apply to those who are not necessarily older, but are struggling with chronic illnesses – including cancer, conditions requiring the use of immunosuppressants, obesity (BMI over 30), type 2 diabetes, chronic obstructive pulmonary disease, coronary artery disease, cardiomyopathy and other heart diseases. For them, COVID-19 poses a great threat and the course of this disease is often severe. Also, asthmatics, people with cystic fibrosis or hypertension may be more severely affected by COVID-19 than healthy individuals. An updated list of medical conditions in which COVID-19 poses an increased risk to health and life can be found on the website of the US Centers for Disease Control and Prevention (CDC): https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/people-with-medical-conditions.html.

Pregnant women should also take great care not to contract the SARS-CoV-2 virus, as COVID-19 may threaten the normal course of pregnancy. Pregnant women should follow the recommendations listed for older individuals.

4.4.5 Recommendations for public authorities and the media. Fighting the COVID-19 epidemic requires careful monitoring of the current epidemic situation. It is extremely important, at the central and local level, for epidemiological data to be comprehensive and to be updated and digitized on an ongoing basis. In particular, the data collected needs to make it possible to assess the intensity of transmission, not just the frequency of diagnosis (which is contingent upon testing), as well as to monitor the circumstances under which infections are occurring. Also very important are indicators of how well state sanitary inspection and the healthcare service are performing. The demands for information are therefore quite extensive. At the same time, all data feeding into the information system or systems are ultimately obtained by the same people working in the healthcare service or in state sanitary inspection. Moreover, these are people for whom reporting obligations are a supplementary activity, by no means a priority of their work. Simplicity and maximal integration of systems is therefore essential. In Poland, overall there are several systems for reporting medical data on infectious diseases: we have an epidemiological supervision system managed by the Chief Sanitary Inspectorate and the National Institute of Public Health – National Institute of Hygiene (NIZP-PZH) (known as the EpiBaza system), we have a major database of medical services maintained by the National Health Fund, as well as e-prescription and e-referral databases implemented under the e-Health Center and a Threat Monitoring System. In reaction to the pandemic, a module was created as part of the epidemiological surveillance system, and additionally systems dedicated to COVID-19 related measures were also set up: a Registry of Entries to Poland (EWP) and a clinical register COVID-19 patients maintained at the Institute of Cardiology (IKARD). The EWP system was initially used to monitor people in quarantine upon arrival in Poland, when the borders were closed. Subsequently it was expanded to include a module for registering all people in quarantine, supplemented by the State Sanitary Inspection, and also a module for commissioning publicly financed COVID-19 testing – here the data is entered by hospitals (through the IKARD system), the State Sanitary Inspection and laboratories performing tests, and recently also by family doctors through the "e-gabinet" system. Doctors treating COVID-19 patients in hospitals have been required to enter detailed clinical data on the course of the disease in the IKARD registry. Together, these systems constitute an exceptionally rich set of data, yet unfortunately each of them was built on a different platform with different classifications and dictionaries, and work on their integration still remains incomplete. Initially, such integration focused on functional solutions mainly meant to enable automatic ordering of tests by the system. Monitoring of the use of healthcare resources, including hospital beds and respirators, is performed separately. Streamlining the data and the channels of data flow is therefore an urgent task facing the state services.

Within this fight there is also a significant role to be played by the media, which has an enormous duty to support measures combatting the COVID-19 epidemic, to avoid sensationalism and spreading fake news – stories unsupported by reliable research and scientific expertise. Respectful media outlets should not contribute to the "infodemic," the excessive surplus of information being generated during and about the epidemic. It is estimated that hundreds of millions of news reports (sic!) pertaining to the COVID-19 pandemic have been generated since its beginning. Some of them are reliable, some are not. So much of this information reaches the average person that it is difficult for them to assess the value and credibility of individual messages, analyzes, or evaluations. Therefore, it is difficult for them to form a rational picture of the epidemic and make decisions on how to properly proceed during it. This leads to chaos in social activities.

Much of the infodemic is generated in good faith, but by people without proper knowledge. There are also many indications, however, that a large share of the infodemia is being created in bad faith, by armies of trolls or bot factories, with the objective of weakening a given country. Today's advanced information technology is able to distinguish one from the other, because the network and means of propagation of information generated in good faith (organic) and in bad faith (inorganic) differ significantly. Nevertheless, for the average person it is practically impossible to distinguish them.

In a nutshell, only a small amount of the information circulating on the web and by word of mouth among society is actually credible. This is usually information produced by specialists, scientists, highly experienced science communicators or science journalists. The tasks of self-respecting media outlets should include promoting authority figures, i.e. people trusted by the public on issues related to the COVID-19 epidemic. These tasks should also include filtering information, separating reliable reports from doubtful or even false ones, and at least indicating which information being propagated in, for example, social media is incorrect or doubtful. In addition, the media should have an institutionalized mechanism of quick cooperation with proven experts.

4.4.6 Concluding remarks. The objective of our Report has been to equip society, decision-makers, and the media with a basic body of knowledge about the COVID-19 disease and epidemic. Such knowledge is still being intensively gathered and will undoubtedly need to be updated on a continual basis. Such is the nature of the scientific process. The overall state of affairs that emerges from the summary presented in this Report can be summed up in the following bullet points:

1. **Nearly 7 million people in Poland are above 65 years of age, and about 90% of them are burdened by chronic illnesses, often more than one. Moreover, those individuals who are below 65 but already have a serious health burden also constitute a significant part of society.**
2. **It is for this numerous segment of the Polish population that contracting the SARS-CoV-2 virus and the COVID-19 disease, as a rule, poses a serious threat.**
3. **Widespread compliance with the sanitary recommendations presented in this study can effectively protect people from the highest risk groups against the danger of COVID-19 and reduce the intensity of the COVID-19 epidemic in Poland. With stringent compliance, we can avoid a healthcare crisis.**
4. **If such compliance is not forthcoming, however, it will be necessary to resort to the re-freezing of the economy and social life (imposing a new lockdown). The costs of this solution will be enormous to citizens and the state. Therefore, we should do our utmost to ensure universal, consistent, empathetic and solidary compliance with the public health recommendations announced by the competent state services.**

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Trustworthy websites

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https://www.gov.pl/koronawirus
Polish Ministry of Health – Twitter feed (in Polish)
https://twitter.com/MZ_GOV_PL
Polish Chief Sanitary Inspectorate website (in Polish)
https://gis.gov.pl/
National Institute of Public Health – National Institute of Hygiene (NIZP-PZH) (in Polish)
https://www.pzh.gov.pl/
Polish Academy of Sciences – information on SARS-CoV-2 and COVID-19
https://informacje.pan.pl/index.php? option=com_content&view=article&id=2915 (in Polish)
https://institution.pan.pl/index.php?option=com_content&view=article&id=462 (in English)
Central Institute for Labour Protection – National Research Institute (CIOP-PIB)
https://www.ciop.pl/
Central Statistical Office (Statistics Poland) (GUS)
https://stat.gov.pl/covid/ (in Polish)
https://stat.gov.pl/en/covid/ (in English)

Outside Poland
World
World Health Organization (WHO)
General information on COVID-19
https://www.who.int/coronavirus
Clinical management of COVID-19, interim guidance, 27.05.2020
https://www.who.int/publications/i/item/clinical-management-of-covid-19

Europe
European Centre for Disease Prevention and Control (ECDC)
https://www.ecdc.europa.eu/en/covid-19-pandemic
An independent agency of the EU, tasked with protecting Europe against infectious diseases. It analyzes and interprets epidemiological data from the EU countries, provides scientific consultations to their governments and to EU institutions, and works towards early detection and analysis of health threats in the EU.
Situation updates on COVID-19
https://www.ecdc.europa.eu/en/covid-19/situation-updates
COVID-19 situation update for the EU/EEA and the UK
https://www.ecdc.europa.eu/en/cases-2019-ncov-eueea
Laboratory support for COVID-19 in the EU/EEA
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Rapid Risk Assessment: Coronavirus disease 2019 (COVID-19) in the EU/EEA and the UK – eleventh update: resurgence of cases, 10.08.2020
https://www.ecdc.europa.eu/en/publications-data/rapid-risk-assessment-coronavirus-disease-2019-covid-19-eueea-and-uk-eleventh
European Commision
European Commision: Coronavirus response
https://ec.europa.eu/info/live-work-travel-eu/health/coronavirus-response_en
The European Commission proposes new EU regulations and the directions of EU policies, monitors their implementation, and manages the EU budget.

United States
U.S. government agencies under the Department of Health and Human Services
U.S. Centers for Disease Control and Prevention (CDC)
https://www.cdc.gov/coronavirus/
U.S. Food & Drug Administration (FDA)
https://www.fda.gov/coronavirus
Universities
Harvard Medical School, Coronavirus Resource Center
https://www.health.harvard.edu/diseases-and-conditions/coronavirus-resource-center

Data, visualizations
Poland
COVID-19 in Poland – data collected by Michał Rogalski
https://bit.ly/covid19-poland
Michał Rogalski recently passed his secondary school-leaving examinations. He has created Poland's most complete collection of epidemiological data on COVID-29, updated by volunteers. The data come from many sources: the Ministry of Health, the voivodship offices, the voivodship and powiat level public health inspectorates, the media, and information obtained from institutions via the public access request procedure.
COVID-19 in Poland – the situation in the powiats (districts)
http://bit.ly/powiaty
Visualizations by Piotr Tarnowski based on Michał Rogalski's data.
World
WHO Coronavirus Disease (COVID-19) Dashboard
https://covid19.who.int/
European Centre for Disease Prevention
https://qap.ecdc.europa.eu/public/extensions/COVID-19/COVID-19.html
Interactive maps and charts
COVID-19 Dashboard by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University (JHU)
https://coronavirus.jhu.edu/map.html
CoronaTracker, Covid-19 Overview
https://www.coronatracker.com/analytics/
A social project produced by volunteers from the entire world. Epidemiological data comes from the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University (JHU).
TrackCorona, COVID-19 tracker and live map
https://www.trackcorona.live/
Website created by students from Stanford University, the University of Virginia, and Virginia Tech in the United States.
Worldometer
https://www.worldometers.info/coronavirus/
Statistical data service provided by a small and independent US-based digital-media company, funded from advertising. Epidemiological data on COVID-19 come from the reports of public institutions and media sources.
How coronavirus spread across the globe – visualised. Seán Clarke, Antonio Voce, Pablo Gutiérrez and Frank Hulley-Jones, The Guardian, 9.04.2020
https://www.theguardian.com/world/ng-interactive/2020/apr/09/how-coronavirus-spread-across-the-globe-visualised
Coronavirus: seconde vague, reflux, maîtrise... visualisez l'évolution de l'épidémie dans 140 pays, Pierre Breteau, Le Monde.
https://www.lemonde.fr/les-decodeurs/article/2020/03/27/coronavirus-visualisez-les-pays-qui-ont-aplati-la-courbe-de-l-infection-et-ceux-qui-n-y-sont-pas-encore-parvenus_6034627_4355770.html
Article updated every 24 hours.

Data in downloadable format
COVID-19 Data Portal
https://www.covid19dataportal.org/
Database drawn from scientific research on COVID-19: genetic sequences, data on gene expression, proteins, and biochemistry, scientific literature. The platform is run by the European Commission and the European Bioinformatics Institute (EMBL-EBI), together with EU Member States and research partners like ELIXIR.
European Centre for Disease Prevention
https://www.ecdc.europa.eu/en/covid-19/data
Epidemiological data: hospitalizations, bed occupancy at intensive care wards, COVID-19 testing, deaths, restrictions imposed by state authorities.
COVID-19 Data Repository by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University
https://github.com/CSSEGISandData/COVID-19
Epidemiological data: infections, deaths, recoveries.
Poland's Central Statistical Office (GUS, Statistics Poland) – Bank of Local Data
https://bdl.stat.gov.pl/BDL/dane/podgrup/temat (in English)
Under the "Population" tab, one can find death certificates broken down by various criteria (last full data for 2019, but for the first half of 2020 for some criteria).
Poland's Open Data Portal
https://dane.gov.pl/ (in English)

Database of public data, gathered from more than 100 public institutions in Poland. Under the "Society" tab one can find registered death statistics (as of 16.06.2020).
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https://www.rwi-essen.de/presse/corona/unstatistik
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https://hbr.org/2020/03/lessons-from-italys-response-to-coronavirus
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7. Appendix

Timeline of the epidemic in Poland

Date	Timeline of the epidemic in Poland
4 March 2020	Poland's "patient zero" at the hospital in Zielona Góra
7 March 2020	Poland's National Sanitary Inspectorate does not recommend travel to China, Hong Kong, South Korea, Iran, Japan and Italy
8 March 2020	National Sanitary Inspector recommends cancelling all mass events with more than 1,000 individuals, organized in indoors
9 March 2020	Sanitary controls on Poland's borders
12 March 2020	The Minister of Health declares a state of epidemiological danger in Poland The first death from coronavirus in Poland
13 March 2020	The borders of the Republic of Poland are temporarily closed and flights are suspended
15 March 2020	The first charter flights organized by LOT Polish Airlines enabling Poles abroad to return to the country – known as the "LOT Home" campaign
the night from 15 to 16 March 2020	All of Poland's borders are closed. They can be crossed only in designated places and on specific terms. Strict border and sanitary controls are introduced, and every Polish citizen must undergo a mandatory 14-day quarantine. Foreigners are banned from entering Poland for 10 days
16 March 2020	The closure of all educational institutions and universities. The Ministry of Health announces the death of a fourth patient infected with coronavirus
20 March 2020	The Minister of Health announces his signing of an ordinance declaring a state of epidemic in Poland
25 March 2020	The country's borders will remain closed until April 13. People working on the other side of the border may freely cross the border only until 27 March
29 March 2020	Two weeks have passed since the launch of the "LOT Home" campaign. Since March 15, almost 42,000 people have returned to the country
31 March 2020	People in public places must remain at least 2 meters away from one another. The number of people allowed in stores is restricted to a maximum of 3 individuals per checkout, and in post offices to two people per counter. Children and adolescents under the age of 18 are permitted to be outside their home only under the supervision of an adult. Access to parks, boulevards, promenades and other recreational areas is restricted Gloves must be put on before entering a store. Home-improvement stores closed on weekends. Grocery stores, pharmacies and drugstores remain open on weekends. From 10:00 AM to noon, stores and pharmacies will be open only to people over 60 years of age
2 April 2020	Employers are obliged 1) to provide all employees, regardless of their basis of employment, with disposable gloves or means for disinfecting their hands, 2) to ensure that work stations are at least 1.5 m apart from one another
3 April 2020	On April 3-11, access to forests and national parks is temporarily prohibited
7 April 2020	Under the "LOT Home" campaign, 54,000 have Poles returned to Poland
9 April 2020	Schools will remain closed until 26 April, borders will remain closed until 3 May The *matura* exam (at the end of high school) and eighth-grade exams are postponed: they will be held no earlier than in June

Date	Timeline of the epidemic in Poland
10 April 2020	The government prolongs the ban on moving, traveling and staying in public until 19 April
16 April 2020	A government regulation is in force in Poland, imposing a requirement to cover one's nose and mouth in public places
17 April 2020	The president signs into law the so-called Special Funding Act, i.e. a set of special measures implementing operational programs in connection with the occurrence of coronavirus, and the Anti-Crisis Shield Act 2.0
20 April 2020	A new stage of the gradual removal of restrictions begins – the first change is the opening up of forests and parks and the relaxation of trade regulations. More people will be permitted to attend masses – one person per 15 square meters
24 April 2020	Schools, nurseries and kindergartens will be suspended until 24 May. *Matura* exams – without the oral component – to start on June 8, with retake exams scheduled for early September Eighth-grade exams scheduled for 16 to 18 June. Exams for professional qualifications may resume on June 22. Exams for students of vocational colleges in mid-August
27 April 2020	Due to the extension of the flight ban by the government and the European Union, LOT Polish Airlines announces the cancellation of all scheduled flights until 15 May
29 April 2020	The second stage in the lifting of restrictions unveiled. From 4 May on: ● Hotels and other accommodation providers will be open; the restaurants at such facilities will remain closed ● Shopping malls will be open ● Rehabilitation treatments will be reinstated ● Museums, art galleries, libraries, archives and bookstores will resume activity From 6 May on: ● Day-care centers and preschools may open; decisions in each case are to be made by their founding authorities
30 April 2020	The state childcare allowance (paid to parents who have to remain home with children) prolonged to 24 May for children up to the age of eight
4 May 2020	The second stage in lifting COVID-19 related restrictions: ● Shopping centers and supermarkets will be open, but with a limited number of people and no consumption of meals ● Home improvement stores will be open on weekends ● Hotel operations resume, but operations of hotel restaurants and recreational spaces remain restricted. Gyms, large halls and swimming pools remain closed. Hotel restaurants may provide hotel guests with meals to their rooms, but not to be consumed at dining facilities ● People with illnesses may return to rehabilitation, and libraries and cultural institutions will be gradually opened after consultations with public health authorities. ● Changes in the functioning of day-care centers and preschools
5 May 2020	425 new cases reported within a day; this is the highest daily case number since 19 April (545)
6 May 2020	First day of day-care centers and preschools reopening – of the 22,000 such facilities, 1,600 resume operations
10 May 2020	A regulation of the Prime Minister prolonging the ban on air traffic in Poland until 23 May comes into force

Date	Timeline of the epidemic in Poland
15 May 2020	The additional childcare allowance prolonged to 14 June. It will also be awarded to parents who, despite the opening of day-care centers, for instance, opt not to send their child to such a facility
17 May 2020	50% more people will be able to attend masses than previously – now limited to one person per 10 square meters
18 May 2020	In the Slaskie Voivodship, the number of cases of SARS-CoV-2 exceeds 5,500 Third stage in the lifting of restrictions. Hair salons and beauty salons open Suspension of in-school teaching prolonged to 7 June
19 May 2020	Spas will be opened in mid-June. Starting on 1 June, individuals who travel there will be tested for coronavirus
20 May 2020	The Silesia province (Śląskie Voivodship) is the first region in Poland where the number of confirmed coronavirus cases exceeds 6,000 Another package of anti-crisis measures includes protection for Polish companies from hostile takeovers, holiday loans for those who lost their sources of income, financial protection for local governments, and more flexible labor law provisions
22 May 2020	As part of the next stage of "unfreezing" the economy, the Ministry of Health recommends permitting the organization of weddings with up to 50 participants
25 May 2020	Under a decision by the Minister of National Education, from May 25, schools in Poland may provide in-school care to students in grades 1–3. Local governmental authorities are to "decide whether a school will be open for the needs of the youngest students" State offices have resumed normal activity
27 May 2020	Unveiling of the fourth and final stage of lifting coronavirus-related restrictions, effective from Saturday, 30 May: the requirement to wear masks in outdoor spaces will be lifted From June 6, cultural centers such as cinemas and theaters may open, as may sports centers: gyms, fitness clubs, swimming pools
30 May 2020	4th stage of easing restrictions: ● Covering the face and nose is no longer required outdoors and in places where a distance of 2 meters can be maintained from other people; ● Limits on the number of people permitted to be in stores and churches at the same time will be lifted The government has eased up passenger limits on public transport: from June 1, either all seats (without standing places) or half of all available places (seated or standing) may be occupied in such vehicles.
31 May 2020	No limits on church attendance: ● The restriction imposed by government regulations on the numbers of worshippers allowed in churches ceases to apply. ● However, facemasks must still be worn during mass and distance maintained from other individuals
1 June 2020	Another stage in the easing of restrictions: ● In primary and secondary schools, in-school consultations are organized for all students ● Passenger air connections are launched; for now domestic travel is permitted.
6 June 2020	Another stage in the lifting of restrictions. Cinemas, theaters, concert halls, circuses, fitness clubs, gyms, swimming pools, and amusement parks may resume activity. Weddings may be organized for up to 150 participants Record daily number of new coronavirus cases since the start of the pandemic: 576

Date	Timeline of the epidemic in Poland
8 June 2020	Suspension of mining at twelve mines in Silesia – two facilities owned by JSW, ten owned by PGG 599 new infections: the highest daily tally since the beginning of the epidemic The first day of the *matura* exams
10 June 2020	The Prime Minister sets the date for the opening of Poland's borders: From June 13, Poland will open its borders to European Union countries International flights will be permitted starting 16 June
18 June 2020	314 new cases of coronavirus in Poland, with the largest numbers being recorded in the Śląskie (88) and Łódzkie (75) Voivodsihps. A further 30 people have died – such a large daily number of deaths has not been recorded since late April.
23 June 2020	The testing of miners has been completed; mines that experienced outbreaks were tested twice. The Ministry of Health announced on Tuesday that a total of 129 new cases had been reported in Silesia.
28 June 2020	The first round of the presidential election is held. It had been postponed from 10 May 2020 in view of the coronavirus pandemic
29 June 2020	Normal border traffic between Poland and the Czech Republic in the Silesian Province to be restored on June 30.
30 June 2020	From 17 July, the regulations for art and entertainment events organized outdoors will change. More than 150 people will be able to participate in them, on condition that social distancing rules are maintained. The organizer must provide at least 5 square meters per person, mark places for the audience with horizontal signs
2 July 2020	The number of confirmed cases in Poland increases to over 35,000. Another 15 people infected with the coronavirus have died The Ministry of Health also announces that in the run-off round of the presidential election, seniors, pregnant women and people with disabilities will be able to vote without waiting in line
3 July 2020	259 new cases of coronavirus infection in Poland; another 15 people have died The organizers of mass sporting events urge the authorities to lift epidemiological restrictions
4 July 2020	314 new coronavirus infections; 4 more patients have died. The world notes a record daily tally of infections of over 212,000, including over 57,000 in the United States, which is also a daily record there
5 July 2020	231 new coronavirus infections; 5 more patients have died The police are enforcing compliance with the obligation to cover one's nose and mouth in shops, trams, city buses, etc. Warnings given to 42,000 people and 13,000 fined
14 July 2020	A total of 38,457 confirmed infections in Poland, including 267 new cases. The largest number, 72, was recorded in the Śląskie Voivodship A wedding celebration in Nawojowa (in the Małopolskie Voivodeship) over a month ago led to coronavirus infection in 151 people. Another thousand individuals are in quarantine. "This is currently the most serious cluster in the Małopolskie Voivodeship," public health officials warn
17 July 2020	8 more people have died in Poland from COVID-19, and 353 new coronavirus cases have been confirmed From 17 July entertainment events can be organized outdoors with no limit of 150 people. Already during the first weekend after the lifting of this restriction, concerts were organized for larger audiences

Date	Timeline of the epidemic in Poland
19 July 2020	The Ministry of Health reports 358 new, confirmed cases of SARS-CoV-2 infection and the death of six more people. The number of infections in Poland exceeds the level of 40,000 people (reaching a total of 40,104), of whom 1,624 have died
21 July 2020	Nine more people have died and 399 new infections are reported – the highest number since June 17 Further restrictions lifted: ● The required social distance in public spaces is reduced from 2 meters to 1.5 ● Sports facilities are permitted to reach 50 percent capacity ● Swimming pools – both indoor and outdoor – no longer have to limit their number of users ● Waterparks are now permitted to operate up to 75% of maximum occupancy ● Cinemas and theaters are no longer required to only fill every second seat; however, they are still only allowed to reach 50% capacity. ● There are no changes in terms of wearing masks and covering the nose and mouth
22 July 2020	The privately-owned mine “Silesia” in the town of Czechowice-Dziedzice has seen a sharp increase in infections in recent days. 20 people infected with the coronavirus and over 260 people quarantined – such is the aftermath of a wedding that took place at the beginning of July in Starachowice in the Świętokrzyskie Voivodship.
23 July 2020	More than 400 new cases of coronavirus infections recorded in Poland. More miners are infected, and screening tests are planned in two mines
25 July 2020	Changes in the rules for maintaining social distancing during cultural and entertainment events: ● Up to 50 percent of the number of seats in the audience may be in use ● If places are not designated, audience members should maintain a distance of 1 m ● Event participants are required to cover their mouth and nose ● Cinemas, theaters, concert halls, music clubs, entertainment and sports halls, amphitheaters and concert shells may make up to 50 percent of places available ● The distancing requirement does not apply to individuals accompanying a child under 13, a disabled person, or a person who is unable to move independently ● The distancing requirement does not apply to people who live together or share a household
30 July 2020	The daily number of new cases in Poland sets a new record, exceeded 600 cases for the first time
31 July 2020	● The government’s Crisis Management Team met on Friday, in response to the setting of another record number of new infections in Poland (657 cases) ● So far no decision has been made to impose compulsory quarantine on people returning to Poland from countries where the risk of infection is higher ● No new decisions were made regarding possible restrictions, but consideration was given to “new decisions and plans for the coming weeks.” ● A regional approach to restrictions was analyzed. They may be imposed by individual municipalities (gminas) or districts (powiats)
3 August 2020	Three senators have confirmed coronavirus test results. Due to the risk of infection, a session of parliament has been postponed.
4 August 2020	A military parade slated for on August 15 was canceled due to the risk of infection. Another new record was set in Poland, with 680 new cases confirmed

Date	Timeline of the epidemic in Poland
5 August 2020	Students will return to schools as of 1 September. Students will not be required to wear face masks in class, but should be mindful of the hygiene rules It is recommended for schools to organize students' time so as to make it possible to maintain distance, e.g. by having staggered starting times Students may not attend school if they have symptoms of respiratory infection or when a member of their household is in quarantine or isolation
6 August 2020	The Ministry of Health reports 726 new cases of infection – the highest number of new cases recorded in Poland since the start of the epidemic
7 August 2020	The Ministry of Health presents the details of the restrictions that will apply in the districts (*powiats*) where the most new cases of infection are recorded. ● Stricter rules will apply to nineteen districts (powiats) in the Śląskie, Wielkopolskie, Małopolskie, Łódzkie and Podkarpackie Voivodships, ● Recognized as "red" zones, with the highest case counts, are the following districts: Ostrzeszowski, Nowosądecki, Wieluński, Pszczyński, Rybnicki, Wodzisławski, and the towns of Nowy Sącz, Ruda Śląska, and Rybnik ● Marked as "yellow" zones are the following districts: Wieruszowski, Jarosławski, Kępiński, Przemyski, Cieszyński, Pińczowski, Oświęcimski, and the towns of Jastrzębie Zdrój, Przemyśl and Żory ● Districts where the critical infection thresholds are not exceeded will be considered "green" zones. ● In "red" zones, it will be obligatory to cover the nose and mouth in public spaces (on sidewalks, in parks) and prohibited to organize conventions and trade shows, to operate amusement parks, to hold any cultural events. Gyms, cinemas, sanatoria, rehabilitation centers, baths, saunas, solariums, slimming salons and massage salons may not operate. Sports events will not be attended by public audiences. Catering establishments (e.g. restaurants or milk-bar cafeterias) may serve a maximum of one person per 4 square meters. ● In "yellow" zones the restrictions will be loser. ● In "green" zones the rules of behavior related to Covid-19 will not be made stricter.
8 August 2020	809 new cases – the highest daily number in Poland since the start of the epidemic
9 August 2020	The Ministry of Health announces a record number of coronavirus cases, with COVID-19 having been diagnosed in 843 people. The government has introduced new pandemic prevention regulations; "red" and "yellow" zones have stricter rules than the "green" ones.
12 August 2020	The Norwegian government on Wednesday recognized Poland, as well as the Netherlands, Iceland, the Faroe Islands, Malta and Cyprus as "red" countries due to the increase in SARS-CoV-2 infections in those countries
17 August 2020	Deputy Minister of Health Janusz Cieszyński resigns
18 August 2020	Łukasz Szumowski resigns as Minister of Health
20 August 2020	A new list of "yellow" and "red" zones (with additional restrictions), naming 19 districts (*powiats*). Now listed as "red" zones are following districts: Wieluński, Nowosądecki, Rybnicki, Lipski, Nowotarski, and the towns of Nowy Sącz and Rybnik. Marked as "yellow" zones are the following districts: Tatrzański, Ostrzeszowski, Ostrowski, Pajęczański, Łowicki, Przemyski, Pszczyński, Jarosławski, Radziejowski and the towns of Biała Podlaska, Ruda Śląska, and Żory For districts newly included on the lists, the changes will be effective from Friday. An alert has been issued for the city of Kraków: "If infections continue to be as dynamic as today, Krakow will be yellow next week." Katowice and Koszalin are also subject to similar alerts

Date	Timeline of the epidemic in Poland
21 August 2020	The daily number of infections in Poland reaches a new record: 903 confirmed cases of coronavirus infection. The government wants to expand the list of countries from which it will not be possible to travel to Poland by air
14 September 2020	The Ministry of Health reports 502 new and confirmed cases of coronavirus. The number of people infected in Poland has increased to 74,152. The Ministry also reports the death of another 6 patients. To date, 2,188 people have died of Covid-19

Global timeline of the epidemic

Date	Global timeline of the epidemic
31 December 2019	China informs the WHO about cases of an atypical pneumonia occurring in the country. Cases noted in Wuhan, a city of 11 million, and Hubei Province
1 January 2020	First patients identified as being employees at the Huanan Seafood Market. The new virus turns out not to be SARS
7 January 2020	WHO announces that the cause of the disease is a new virus that belongs to the Corona family – the virus is identified (nCoV)
10 January 2020	The first fatal nCoV case reported in China
12 January 2020	First confirmed cases observed outside China (Thailand and Japan). Both individuals had recently visited the city of Wuhan, China
12 January 2020	WHO calls the virus the new coronavirus 2019 (nCoV)
14 January 2020	WHO announces that Chinese officials are unable to find evidence of person-to-person transmission of the new coronavirus
15 January 2020	China raises CDC alert to Level 1 (the highest level)
16 January 2020	The first confirmed case in Japan after contact with Wuhan
17 January 2020	A second fatal case in Wuhan
18 January 2020	Cases confirmed in China outside of Hubei Province
20 January 2020	WHO publishes reports on the coronavirus. NCoV does spread person-to-person – cases have been identified in healthcare professionals
23 January 2020	Effective quarantine initiated in Wuhan. First fatal case in China outside Hubei Province. WHO does not declare "international public health emergency" due to lack of evidence that new type of coronavirus is spreading outside China
27 January 2020	The coronavirus epidemic encompasses France, as the first among European countries. All three quarantined patients had returned from a trip to China
30 January 2020	WHO declares a global threat
31 January 2020	Cases of infection reported in Russia, Spain, Sweden and the UK
2 February 2020	The first nCoV-related death outside China is recorded in the Philippines

Date	Global timeline of the epidemic
7 February 2020	The first person to publicly announce the epidemic, Li Wenliang, dies of the disease
10 February 2020	The death toll in China rises to 908, surpassing the death toll in the SARS epidemic in 2002–2003. The number of cases in China reaches 40,171
11 February 2020	WHO names the disease COVID-19
14 February 2020	WHO names the virus SARS-CoV-2
24 February 2020	Kuwait, Bahrain, Iraq, Afghanistan and Oman report their first cases of the coronavirus
26 February 2020	Saudi Arabia prohibits visits to Umrah. The number of deaths in the world reaches 2800, the number of cases exceeds 80 thousand. The virus is present in Norway, Romania, Georgia, Pakistan, Macedonia and Brazil
27 February 2020	First cases in Estonia, Denmark, Northern Ireland, and the Netherlands
2 March 2020	Saudi Arabia, Jordan and Tunisia announce their first cases of the coronavirus
4 March 2020	**The first confirmed case in Poland**
5 March 2020	The virus has spread to 84 countries. The number of cases in the world exceeds 95,000, the death toll exceeds 3,000
11 March 2020	WHO declares a pandemic
12 March 2020	The first fatal case in Poland. In the United States, a state of emergency is declared nationwide and flights to the EU are suspended
17 March 2020	The EU shuts its borders to non-member countries
18 March 2020	Europe has 3,421 fatalities from the pandemic
19 March 2020	First day with no new cases in Wuhan City, Hubei Province, China, the epicenter of the pandemic
24 March 2020	Olympic Games in Tokyo postponed for another year
25 March 2020	Curfew lifted in the Chinese province of Hubei
27 March 2020	China imposes an entry ban on foreigners
6 April 2020	British Prime Minister Boris Johnson in intensive care due to COVID-19
10 April 2020	EU countries agree to an approx. €540 billion economic package to counter the impact of COVID-19
2 May 2020	Laboratories in 212 countries confirm 3.5 million cases of infection and 250,000 deaths
4 June 2020	The worldwide number of cases reaches 6,626,374, the number of deaths 389,197, patients who have recovered 3,200,700
27 July 2020	Coronavirus cases: 16,446,932, deaths: 652,852 (6%), recovered: 10,068,202, active cases: 5,725,878, mild: 5,659,481 (99%), severe or critical: 66,397 (1%)
21 August 2020	From 31 December 2019 to 21 August 2020, a global total of 22,705,645 COVID-19 cases recorded, including 794,104 deaths
14 September 2020	From 31 December 2019 to 14 September 2020, a worldwide total of 29,212,017 COVID-19 cases reported, including 928,888 deaths

Decision No. 27/2020
of the President of the Polish Academy of Sciences
dated 30 June 2020

on establishing an interdisciplinary COVID-19 Advisory Team
affiliated with the President of the Polish Academy of Sciences

On the basis of Article 22 Paragraph 5 of the Act on the Polish Academy of Sciences dated 30 April 2010 (Dz.U. from 2019 item 1183 as subsequently amended) I hereby decide as follows:

§1

I hereby establish the COVID-19 Advisory Team affiliated with the President of the Polish Academy of Sciences, hereinafter the "Team", with the following members:
1) Chair – Prof. Jerzy Duszyński, President of the Academy;
2) Deputy Chair – Prof. Krzystof Pyrć – Jagiellonian University;
3) Secretary – Aneta Afelt, PhD – University of Warsaw;
4) Members:
   a) Prof. Radosław Owczuk – Medical University of Gdańsk;
   b) Anna Ochab-Marcinek, PhD, DSc – Polish Academy of Sciences;
   c) Magdalena Rosińska, MD, PhD, DSc – National Institute of Public Health – National Institute of Hygiene;
   d) Prof. Andrzej Rychard – Polish Academy of Sciences;
   e) Tomasz Smiatacz, MD, PhD, DSc – Medical University of Gdańsk.

§2

The main objectives of the Team are:
1) Ongoing monitoring of the status of the COVID-19 epidemiological threat in Poland and analyzing possible scenarios for the development of the epidemic in Poland and in Europe, against the backdrop of the global situation.
2) Preparing expert documents summing up the experience gained from successive stages of combatting the COVID-19 epidemic in Poland.
3) Putting forward recommendations as to how to build greater readiness to face a potential new wave of the COVID-19 epidemic or a new version of SARS-CoV-2 with altered virulence or infectivity.
4) Developing contacts with similar teams in other countries and exchanging experience with them.

§3

The Chair of the Team may invite other individuals to take part in the work of the Team, with an advisory vote.

§4

Meetings of the Team take place at times set by the Chair.
Administrative support for the Team is provided by the Secretariat of the Polish Academy of Sciences.

§5

Expenses related to supporting the Team will be covered by the Office of the President of the Polish Academy of Sciences.

§6

Team members are not entitled to remuneration for their participation in the work of the Team.

§7

The Team will conclude its work on 31 December 2021

§8

This decision comes into effect on the date it is signed.

President of the Polish Academy of Sciences
Jerzy Duszyński

Warsaw, 7 August 2020

Position Statement no. 1 of the COVID-19 Advisory Team
to the President of the Polish Academy of Sciences

In recent days, we have seen an increase in confirmed cases of SARS-CoV-2 infection. *It can be expected that the consequence of this will be growing numbers of patients with severe COVID-19 requiring hospital or ICU treatment.* Some of these cases will unfortunately result in the patient's death. *As we approach autumn, the situation is likely to become worse with every week.* With this in mind, we are greatly concerned about the growing amount of misinformation being spread in the public sphere, especially via social media and the press, denying the existence of the virus and the seriousness of the pandemic it has caused. The growing denial of the real, serious threat to individual and public health, in particular in the context of increasing numbers of individuals disregarding recommendations which aim to prevent the spread of the virus, may significantly contribute to a continuing rise in the infection rate and the serious consequences thereof.

There is absolutely no scientific basis for denying the existence of the virus, its pathogenicity or the consequences of infection. The most reputable international medical journals have published statements by some of the leading authorities in medicine, virology and epidemiology discussing the matter. As of 7 August 2020, there have been 1774 confirmed deaths caused by COVID-19 in Poland. *During the same period, there have been 65 deaths caused by influenza.* To date, there have been over 700,000 deaths caused by COVID-19 worldwide. Denying the existence of the virus and the pandemic is highly unethical, and it is disrespectful to those victims and their families.

We urge the public to not fall for misinformation and to continue adhering to simple recommendations which have a real effect towards curbing the pandemic and reducing the risk of infection: maintaining social distancing of at least 1.5 meters, washing and disinfecting the hands regularly and wearing a mask covering the nose and mouth when indoors. We urge caution when interacting with others, especially elderly and high-risk individuals. Following these simple recommendations may prevent further restrictions from being imposed on public life.

Position Statement no. 2 of the COVID-19 Advisory Team
to the President of the Polish Academy of Sciences

On students returning to school in September 2020

No one knows what the COVID-19 pandemic in Poland will look like in a few months' time. However, we need to posit forecasts based on experiences of other countries in order to prepare for possible scenarios depending on the rate of spread of the pandemic, known as the effective reproduction number R_0.

1) Good, when R_0 does not exceed 1.1;
2) Moderate, when R_0 falls between 1.1 and 1.7;
3) Worst-case, when R_0 exceeds 1.7.

In the worst-case scenario, even though we are currently accustomed to R0 remaining around 1.1, in a matter of weeks the value will start exceeding 1.7 and the pandemic will reach dramatic levels. It is possible that we are already seeing the first symptoms of this process, given that recent estimates show that R_0 has increased to around 1.3. Considerations which encourage us to take this scenario seriously are as follows:

1. The demands on the healthcare system show seasonal variation, and typically peak in winter.
2. Given that adherence to sanitary precautions is likely to have relaxed over the summer months, we can expect a significant increase in COVID-19 cases with local and even regional hotspots.
3. The demand on medical professionals to focus on COVID-19 hampers their ability to care for patients with other health problems. This is likely to result in an increased number of cases of chronic or undiagnosed illnesses. Additionally, the difficulty in distinguishing between infection with SARS-CoV-2 and other viruses means that many people will be completely unable to access basic medical care. Research shows clearly that patients with comorbidities experience more severe symptoms of COVID-19, which leads to an increased number of patients requiring intensive care.
4. It is likely that seasonal influenza epidemics, typical in our region, and high rates of other viral and bacterial infections in autumn and winter (the co-infection effect), combined with other factors such as lowered immunity and increased air pollution, will make the course of the disease more severe in many patients.

This is why all three scenarios outlined above must be taken into consideration when planning social policies for the coming months.

When it comes to students returning to schools, it is important to recognize that the situation will not be the same as before the outbreak of the pandemic anywhere in the country, and that schools will not be able function the same way or with only minor adaptations. We are fully aware that the disadvantages of children not returning to school are significant, not only in terms of the economy (parents unable to return to work to care for younger children), but also in terms of health (increased incidence of obesity, depression and anxiety) and children's development. This is why are approaching the issue of children returning to school with great care. However, even in the most optimistic scenario (R0 remaining below 1.1 in the coming months), which would mean the pandemic is maintained at a relatively low level, we recommend introducing mandatory mask-wearing for staff and at least older children in all schools.

In the event of the moderate scenario, we also recommend introducing **increased distances** between desks, **creating bubbles of students** who can be in contact with one another but not with those in other bubbles, **delegating teachers** to specific classes to prevent extensive transmission if the teacher becomes infected, limiting movement in common spaces (such as by introducing **asynchronous breaks**), **airing** all rooms during the day and **disinfecting** desks, door handles and any common items between all lessons.

Additionally, we recommend that the health situation in families of all students, teachers and other staff be closely monitored, and any confirmed COVID-19 infection in a given school should trigger carefully prepared sanitary procedures. Since testing all individuals may not be possible, we recommend using group and environmental testing methods which are currently under development by the PAS and associated researchers.

In the event of the worst-case scenario, schools in areas with relatively high pandemic levels which cannot maintain the strict sanitary regimes outlined above should return to remote teaching.

Education authorities should be working on recommendations for all schools in the event of all the scenarios outlined above, whereas schools, parents and students, sanitary institutions and local authorities need to make preparations for all cases. This will help head teachers make decisions based on clear guidelines, which should take the form of an algorithm for action in each given case to help maintain the highest possible functionality and ensure fast response times to local or regional events.

List of figures:

1 Number of research publications in PubMed containing the search terms COVID-19 or SARS-CoV-2 in the title or abstract 7
2 Reliability periods of molecular and serological tests to detect infection with SARS-CoV-2, as compared to the course of the disease in typical patients 9
3 Stages in the development of a new epidemic 12
4 Cumulative number of COVID-19 cases detected in countries neighboring on Poland. 14
5. Countries neighboring on Poland divided into three groups in terms of the occurrence of a "first wave" of the epidemic. 15
6 Number of cases (7-day moving average) of SARS-CoV-2 in the world, by geographical region 16
7 Overall number of COVID-19 cases by district (powiat), as of 27 April 2020. 17
8 Overall number of COVID-19 cases by district (powiat), as of 3 June 2020 18
9 Spatial concentration of confirmed COVID-19 cases, as of June 2020 with 19,000 diagnosed cases. 19
10 Total number of COVID-19 cases by district (powiat), as of 12 September 2020 20
11 Population density in Europe in 2018, based on Eurostat's NUTS 3 classification. 29
12 Time devoted to daily activities in various European countries 30
13 How have you most often spent your free time over the past 12 months? 31
14 The dynamics of the epidemic in Poland against the backdrop of public attitudes 43
15 An illustration of the main means of SARS-CoV-2 virus transmission between individuals, showing why maintaining the right distance and covering the nose and mouth with a mask significantly hampers transmission 46
16 Keep a proper distance of at least 2 m 47
17 The age structure of Poland's population, with the risk of death in individual age categories represented by color shading. 50

List of tables:

Table 1 Frequency of spending time outside the home 30
Table 2 Average number of chronic disorders per individual (ages 15 and up). 32
Table 3 Who do people across the world trust on COVID-19? 42
Table 4 Influenza and suspected infections with influenza and influenza-like viruses in the epidemic seasons from 2017/2019 to 2019/2020. 49