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Health Security as a Global Public Good in the Conditions of the Revolution 4.0

Abstract

Objectives: Although the concept of health security is becoming accepted in public-health-related literature and practice, there is no full agreement on the scope and content. The aim of this paper is to draw attention to the definition of health security and its role within the Revolution 4.0.

Research Design & Methods: This is a theoretical article and as such addresses a problematic situation concerning missing standards in health security and the Revolution 4.0.

Findings: The WHO (2018) has stated unequivocally that 'functioning health systems are the bedrock of health security'. The authors attempt to prove that health security in the conditions of the Revolution 4.0 needs to be defined more precisely and has to be implemented as a global public good nationwide with accepted minimal standards.

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Implications / Recommendations: Health security belongs to the sphere equally important to that of the Revolution 4.0. A concept of Health Security that is not widely accepted and implemented creates a problematic mélange for employees as well as for industrial development. These features will be considered.

Contribution / Value Added: This paper tries to underline the relative shortage of common agreements on health within the Revolution 4.0.

Keywords: Revolution 4.0, health security, mental and physical health

Article classification: conceptual paper

JEL classification: Y

Introduction

In 1948, Norbert Wiener recounted that the origin of ideas in his book on Cybernetics was a ten-year-long series of meetings at the Harvard Medical School, where medical scientists and physicians discussed scientific methods with mathematicians, physicists, and engineers. He detailed the interdisciplinary nature of his approach as well as his early thoughts on the features and design principles of future digital calculating machines. Nowadays, we are on the edge of the Fourth Digital Revolution, also referred to as the Revolution 4.0. Therefore, the link between health and the digital environment is becoming more and more important, but it is very often disregarded in terms of its importance.

In recent years, the authors of this article have been very much concerned with health and working conditions. We had conducted several empirical studies on this issue alone (Titov et al., 2022; Titov et al., 2020, Seyfried et al., 2014, Rabe et al., 2012a, 2012b). These studies were mostly carried out in the context of the Third Industrial Revolution. We are now in the fourth expansion phase of the industrial evolution and health issues in this regard are becoming more and more important. The concept of health security is becoming increasingly accepted in public health literature and practice. However, there is no full agreement on its scope and content.

The link between security and health is not a discovery. According to Augustynowicz et al. (2022), despite the widespread recognition of the social importance of health security, there is no single common definition of this concept. The aim of this paper is to draw attention to the definition of health security and its impact within the Revolution 4.0. Therefore, the authors would like to draw attention to this topic from a more theoretical point of view regarding the more problematic situation of missing standards within health security and the Revolution 4.0.

Health security – an ambiguous concept

As is very well-known, local public good benefits all members of a local community and can possibly include the citizens of more than one country. Furthermore, an international public good benefits more than one country. Global and regional public goods are both international public goods. However, some international public goods are neither regional nor global. According to the Encyclopedia of Health Economics (Culyer, 2014), the global public good concept is an extension of the economic tradition of classifying goods and services according to where they stand along two axes – one measuring rivalry in consumption, while the other measuring excludability. Global public good benefits all countries and, therefore, all persons. Public goods theory purports to show why goods with rigorously defined characteristics of publicness cannot be produced efficiently by the private sector of the economy, creating a market failure which implies a role for government in the production of those goods for which the market fails. Technically, in their purest form, public goods are those that share two qualities – non-excludability and non-rivalry, in economists' jargon. This means, respectively, that when provided to one party, the public good is available to all, and consumption of the public good by one party does not reduce the amount available for others to consume. Traditional examples of national public goods include traffic control systems and national security – goods that benefit all citizens and national private actors, but none that any of the latter could afford to supply under their own initiative.

The health sector is one of the sectors that is the most exposed to technological evolution, so it is being impacted by digitisation, revolutionising the way healthcare is provided, from the interaction

between patients and caregivers to governments and stakeholders (Schwab, 2017). According to Jagme et al. (2020), the Fourth Industrial Revolution is changing the way in which health is understood, transforming methods of treatment and diagnosis, as well as the relationship between health professionals and patients, altering the management and organisation of health systems.

Within the health sector, mental health plays an important role. Regarding mental health since the end of 2013, the Occupational Health and Safety Act has explicitly required that mental stress must be considered in risk assessments (da Silva et al., 2019). This means that all companies and organisations must also identify those hazards for their employees that result from mental stress at work. In occupational sciences, "mental stress" is understood to mean all influences that come from outside and have a mental effect on people at work. It is, therefore, about the demands of the work or the work activity and the working environment.

William Aldis (2008) underlined that ambiguity and confusion surround the concept of 'health security'. According to Aldis, this has caused damage to international relationships and is likely to lead to more serious problems in the future. For Aldin and many others, the global public health community must work towards a common understanding of the concept, starting with acceptance of the fact that there is a problem. As Aldis pointed out, reaching a consensus on what is meant by 'health security' and 'global public health security' will not be easy; hidden national security agendas will have to be brought out into the open. An uncritical insertion of military and foreign policy (political) interests into the arena of global public health is problematic. Much of the literature makes simplistic assumptions about natural harmony between 'health security', 'global public health security', national security, and foreign policy, as Aldis already underlined in 2008.

In the light of this discussion, Feldbaum et al. already in 2006 gave a more general idea of health security, which could be useful for a more practical point of view:

> *Global health is a humanitarian endeavour that seeks to improve the world's health including the most vulnerable peoples, while national security works to protect the interests of people within a given state … While there is potential to expand global health activities through partnership with the security and foreign policy communities, treating global health issues as national security threats may focus attention disproportionately on countries or diseases which pose security threats to wealthy nations, rather than on the greatest threats to global health. The global health community should carefully scrutinise areas where global health and national security interests overlap* (p. 196).

Ravi et al. (2019) synthesised various foundational principles for measuring global health security. Their review broadly affirmed that when it comes to the conceptual challenges associated with measuring global health security, several practical barriers continue to pose technical challenges. Even with a strong theoretical foundation, measurement efforts might still be hindered by limited data availability. Many of the metrics employed in other tools – both qualitative and quantitative – are not regularly or systematically collected in a standardised manner. Ravi et al. (2019) stated that, although alternative metrics could support more conceptually sound methods of measurement, poor data availability would still preclude their adoption and meaningful use.

Nevertheless, in 2020, Stoeva pointed out that there was no consensus among analysts about the specific parameters of health security. According to Stoeva, this inhibits comparative evaluation and critique, and affects the consistency of advice for policymakers. She claims that a broader conceptualisation of health security could transform the politics of health security, thus improving health outcomes beyond acute crises and thereby contributing to broader debated within security studies.

According to the last release of the WHO, global public health security is defined as the activities required, both proactive and reactive, to minimise the danger and impact of acute public health events that endanger people's health across geographical regions and international boundaries. Population growth, rapid urbanisation, environmental degradation, and the misuse of antimicrobials are disrupting the equilibrium of the microbial world. New diseases, such as COVID-19, are emerging at unprecedented rates, disrupting people's health and causing negative social and economic impacts. Billions of passengers travel by aeroplanes each year, increasing the likelihood for a rapid international transmission and spread of infectious agents and their vectors (WHO, 2022).

However, within the framework of systematic occupational safety and health action, the risk assessment process should be reviewed from time to time and improved if necessary. The aim of risk assessment is to identify potential health hazards at work as early as possible and to avoid or reduce them by taking appropriate protective measures. How risk assessments are to be carried out is not prescribed by law.

However, the future will be within a more digital construction of cities and environment. They will be called within the UN nomenclature `Smart Cities`.

Revolution 4.0

Since the 1960s, companies have integrated and made increasingly greater use of information technologies. Desktop PCs, the use of office IT, and the first computer-based automation have revolutionised industry. For the development of the Revolution 4.0, the central technology is not the computer, but the Internet (Colombo et al., 2014).

With global networking across companies and country borders, the process of digitalising production integrates new technologies of higher quality: the Internet of Things, machine-to-machine communication and production facilities that are becoming increasingly intelligent and heralding in a new era, namely the Fourth Industrial Revolution. People, machines, and products are being directly networked with each other (Schwab, 2017).

Typical examples include remote diagnostic systems, automated transport trolleys, or cloud-based monitoring of the condition of machinery. However, there are also projects that present more integrated solutions and map an overall concept for the smart factory. However, current examples show that the Industry 4.0 is still very often located in an area of research and development (Lim, 2019).

The term 4.0 should describe the new economic miracle, i.e. digital transformation. If one counts the frequency of these buzzwords in business and in technology media, one could almost get the impression that all of these concepts have already been realised. However, companies are only at the beginning of a development that will determine the next ten years across all sectors (Orsolin et al., 2022).

The number '4.0' is generally intended to express the goal of ushering in the Fourth Industrial Revolution:

- The First Industrial Revolution consisted of mechanisation using water and steam power.
- The Second Industrial Revolution was characterised by mass production with the help of assembly lines and electrical energy.
- The Third Industrial Revolution, or digital revolution, is marked by the use of electronics and IT (especially programmable logic controllers and CNC machines) to automate production.
- The number '4.0' is used to describe the process of automation within digital networks.

Implementing the Industry 4.0

According to Castro et al. (2020), an effective and efficient implementation of disruptive technologies requires global interaction between governments, health professionals, stakeholders, and society, which is essential in ensuring that such changes are made possible. Currently, the effects of certain advances remain largely undefined and unaddressed while many conversations have taken place in a somewhat siloed fashion. Implementing the Industry 4.0 is, therefore, a complex endeavour involving different players. Uniform norms and standards for different industrial sectors, IT security, and data protection all play a more central role than the legal framework, the change in education and work, the development of new business models, and the necessary research. How the global, digital ecosystems of the future can be shaped is stated, for example, within the 2030 mission statement for the Industry 4.0, which emphasises sovereignty, interoperability, and sustainability as a central topic (*BMWi*, 2019).

However, there is still a highly controversial assessment regarding the descriptions on the subject of health. A chain of ambiguities is responsible for this. For example, Popov et al. (2022) state that the Industry 4.0 in healthcare uses a wide range of modern technologies including digitisation, artificial intelligence, user response data (ergonomics), human psychology, the Internet of Things, machine learning, big data mining, and augmented reality. According to these authors, the healthcare industry is undergoing a paradigm shift owing to the Industry 4.0, which provides better user comfort through proactive intervention in the early detection and treatment of various diseases. The sector now seems ready to make its next move towards the Industry 5.0, but certain aspects need further consideration. Dupalga (2022) states that the technologies attributed to Health 4.0 are frequently perceived as the tools supporting patient empowerment. In his own literature review, the author revealed that – in addition to web-based applications – personal health records, remote monitoring, and electronic patient-physician communication are all perceived as keys to enhancing patient empowerment. Participation in online patient communities is also recognised as an enabling solution.

Smart Cities, blockchain[1] and health security within the Revolution 4.0

Blockchain technology (BCT), which emerged during the last decade, has gained a great deal of interest in the healthcare sector (Sharma et al., 2022). BCT was designed to revolutionise the management of smart cities with Blockchain4Cities. The technology, while initially focused on financial services, holds great promise in healthcare. According to Saeed et al. (2022), BCT is being applied in designing novel and advanced interventions to enrich the current protocol of managing, distributing, and processing clinical records and personal medical information. The

[1] A *block* is a list of transactions recorded into a ledger over a given period. The size, period as well as the triggering event for blocks is different for every blockchain. A transaction can be seen as recorded data. Assigning a value to it (such as what happens in a financial transaction) is used to interpret what that data means. A *chain* is a hash that links one block to another, mathematically "chaining" them together. The hash in a blockchain is created from the data that was in the previous block. The hash is a fingerprint of this data and locks blocks in order and time. A *network* is composed of "full nodes." Nodes can be seen as computers running an algorithm that is securing the network. Each node contains a complete record of all the transactions that were ever recorded in that blockchain. *A blockchain* is a decentralised, distributed, and often public digital ledger consisting of records called blocks that are used to record transactions across many computers so that any involved block cannot be altered retroactively, without the alteration of all subsequent blocks.

growing digitisation of medical care has advanced the acknowledgment of issues about secure storage, the accessing of patients' medical records, ownership, and associated medical data. Blockchain is recommended as a method of addressing critical issues faced in healthcare, such as the protected sharing of health records and adherence to data privacy laws (Saeed et al., 2022).

Qui et al. (2018) have recently stated that the integration of healthcare and smart cities has led to the utilisation of information and technology in health and medical practices around the world. According to Qui et al., this integration has improved the life and health quality of residents in smart cities, though they also point out that the integration has also exposed the healthcare industry to security challenges, which include patients' private health information as well as the security of mobile health users in the vicinity. The use of Blockchain (see Qui et al., 2018) is a promising technology, which will enable healthcare to counter security challenges in smart cities. Blockchain technology facilitates a safe and secure storage of patient information within the healthcare system.

In the year 2020, there was a ratio of approximately six intelligent devices/things for every human on the planet. In a world of digital business, individuals and IT leaders will need to orchestrate these new devices, new data streams, and new experiences in order to create value. But what principles will these IT leaders apply? How will they deal in their approach to the issue of health security?

Tim Berners-Lee, one of the founders of the World Wide Web, diagnosed that those digital systems are on an edge. This is because of:

- the accelerated monopolisation of data and services;
- a complete transparency of people (not only direct users) while the procedures of companies remain secret;
- fuelling social polarisation in social networks via filter bubbles;
- increased surveillance by governments;
- pseudo-neutrality by delegation of decision-making processes to algorithms, etc.

Despite technology advancements having significant benefits in our lives, the often-overlooked consequences are scary.

We now almost always need to have something electronic in our hands – a technological device that connects us to the Internet. We are bypassing the real world and spending an unprecedented amount of time socialising, working, and thinking with computers.

People are no longer interfacing with people; instead, they rely primarily on technology for knowledge. With less human-to-human interaction, we stagnate our social skills. It also removes open-ended conversations with others, even though they lead to our most creative moments.

Social inclusion is incredibly important to us – just look at the immense popularity of social networking sites. We are constantly focused on what others think and we post pictures not for ourselves, but for others to enjoy. When we spend too much time attempting to please others, we lose track of what we actually want or like. Think about how different our children will be to our grandparents' generation. Children now play with iPads even before they can talk. What impact will this have on the societies to come?

The United Nations International Telecommunication Union (UN ITU) deals with the assessment and measurement of the environmental efficiency of AI and emerging technologies (Alessie et al., 2019; Guo et al., 2020; ITU, 2021). A smart and sustainable city is considered as an innovative city that uses information and communication technologies (ICTs) and other means to improve the quality of life, the efficiency of urban operations, as well as services and

competitiveness while at the same time ensuring that it meets the needs of present and future generations with respect to economic, social, environmental, and cultural aspects (Recommendation ITU-T Y.4900).

Blockchain is an open and shared distributed ledger technology (DLT), which can record transactions between two parties efficiently, permanently, and in a verifiable way. It consists of a shared digital data storage, replicated and synchronised across multiple devices in a network. The main objective of DLT is to establish trust, accountability, and transparency, with no reliance on a single source of authority or on environments where there is a lack of trust between actors. It also promotes decentralisation and data integrity (ITU Report 03/2021 – Guidelines on Energy Efficient Blockchain Systems Assessment and Measurement of the Environmental Efficiency of AI and Emerging Technologies Working Group Deliverable).

The connection between energy and health can be hard to grasp at first glance. Nevertheless, the negative externalities resulting from the consumption of fossil fuels can be clearly identified. In January 2019, the World Health Organization (WHO) named climate change and air pollution as two of the greatest challenges to human health. Energy is now recognised as a foundation for well-being, while recent work has documented the link between access to energy services and health. For example, Mayer et al. (2019) discovered that concerns over energy security reduce subjective well-being, suggesting another avenue through which energy relates to human health. Millions of people rely on electricity to power critical medical equipment. This medically-vulnerable population is at risk of being left without access to critical medical equipment in the event of a power outage. Therefore, energy efficiency is a crucial issue for today and for future city sustainability, especially due to the growing emergence of smart cities (SC) and that of cutting-edge technologies. Some emerging technologies, for instance, including blockchain and its role in cryptocurrency and contracting, may not take sustainability into consideration during their development. These technologies often require a huge amount of energy, leaving behind significant environmental footprints. It is important to understand how to reduce the environmental impact of these technologies, because it will contribute to the well-being of the market economy as well as to the quality of life of citizens and the users of these technologies (ITU, 2019). In this regard, the definition of blockchain energy requirements and of the means that can enhance blockchain energy efficiency would be useful. Thus, this work aims to define the blockchain's energy efficiency model.

Up until now, no issues regarding health security have been found (Giacomuzzi, 2020)[2]. A disturbing survey recently quoted that the average person in the USA now spends around 5 hours per day on mobile devices. Think of all the life that escapes us? We need to incorporate habitual phone-free moments so that we do not allow life to escape us. At any red light or even whilst driving, we are more inclined than ever before to check our mobile phones. We have come to a point where we would place our tech obsession above our health and the health of others.

"*We cannot outsource the moral responsibility of our technologies to third parties*" (Google employees in an open letter to CEO Sundar Pichai). *Our task is not only to rein in the downsides of information and communication technologies, but to encourage human-centred innovation*" (Vienna Manifesto on Digital Humanism). Therefore, the digital humanism approach states that we must go back to the centre of technological developments and making people the benchmark

[2] Talk at the UN ITU online-conference December 2020: Digital humanism and human behaviour in businesses.

and rule for digitalisation processes (Carassai, 2022). Humanity needs to realise that every single human being is part of the humanitarian and ecological crisis (Malisova et al., 2022). The emerging digital world requires human-centric digital leadership[3]. This perspective is driven by the belief that technology is valuable when it allows people to spend less time on mundane, repetitive, and inefficient tasks. Businesses should seek to understand how our shared humanity can define the systems they create and control. Doing so not only allows people a sense of mastery over technology, but it also provides direct benefits to business that digital machinist-driven automation simply cannot deliver.

COVID-19 and accelerated digitalisation efforts

COVID-19 has created an urgent need for organisations to accelerate their digitalisation efforts. The pandemic demonstrated the value of digital initiatives in e-commerce, deliveries, supply chain virtualisation, process automation, and other activities, especially where physical activities were no longer possible. The rapid responses to the pandemic made accelerating digital business critical for the survival of a company. Unfortunately, however, they paid little attention to health security standards despite enhanced time in digital working activities. The vast majority of companies were unable to cope with the crisis in this regard (Gabryelczyk, 2020).

Synthesis and conclusions

Beyond achieving final clarity and openness in the definition of health security, what concrete steps must be taken to implement the health security concept in the national interest, and how can we combine Smart Cities, blockchain, and health security within the Revolution 4.0?

The WHO has stated unequivocally that 'functioning health systems are the bedrock of health security', but it remains to be seen whether development partners, including donors in the so-called developed countries are prepared to make the technical and financial commitments for the development of health systems which are necessary to ensure that poor countries benefit from the timely and open sharing of information in accordance with the global health security concept. The cost of these commitments should not be underestimated; it is much more expensive to develop and maintain a national health system than it is to introduce national communicable disease surveillance and outbreak containment alone. However, failure to do this may result in a breakdown of health security for the rich and the poor alike.

Simply put, a blockchain is a digital record of financial transactions that allows users to securely and transparently store and transfer data. It is a decentralised network of computers that share data in a distributed, immutable, and secure way. Smart cities are cities that use technology to improve the quality of life for citizens by providing better services, improved infrastructure, and increased efficiency. Smart cities can therefore use blockchain to store and share data, allowing them to create systems that are secure, transparent, and efficient. BCT can be used to help improve urban infrastructure, public safety, energy efficiency, and access to services. For example, in the transport

[3] Digital humanism is the notion that people are the central focus in the manifestation of digital businesses and digital workplaces. Businesses who embrace digital humanism use technology to redefine the way people achieve their goals and enable people to achieve things not previously possible. Digital humanism stands in contrast to digital mechanism – a view that sees the minimisation of human involvement through automation as the central focus of technology.

sector, blockchain technology can be used to track the movement of vehicles and goods, help manage traffic congestion, and to provide secure payments for public transport.

In addition, blockchain technology can also be used to help manage public records, issue digital identities, store data securely, and facilitate the sharing of resources between public and private entities. Smart cities can also benefit from blockchain technology by using it to manage smart contracts and to ensure the secure transfer of data between citizens, businesses, and the government.

The Fourth Industrial Revolution is changing the way health is understood, transforming methods of treatment and diagnosis as well as the relationship between health professionals and patients while altering the management and organisation of health systems (Castroet al., 2020). The health sector is one of the sectors that is most exposed to technological evolution, so it is being impacted by digitisation, revolutionising the way healthcare is provided, from the actual interaction between patients and caregivers to governments and stakeholders (Schwab, 2017). Global health security is a global public good that is essential to the well-being of individuals, communities, and societies. The Industry 4.0, on the other hand, is the Fourth Industrial Revolution, which has transformed and revolutionised the use of technology in manufacturing and production.

While the global health security and the Industry 4.0 are very different in their nature, they have much in common. For example, both emphasise the importance of collaboration and data sharing in order to maximise efficiency and reach the desired outcomes. Furthermore, the Industry 4.0 technologies can be used to enhance global health security, such as through the use of artificial intelligence and machine learning to detect and respond to disease outbreaks faster. Additionally, new digital technologies can be used to monitor the compliance with global health regulations and to better coordinate global health initiatives. Finally, the Industry 4.0 can help to improve access to healthcare services, including telemedicine and remote monitoring technologies, which can be particularly beneficial in the so-called developing countries. Furthermore, AI can be used to track the spread of disease and identify potential outbreaks before they become pandemics. Robotics can be applied to assist with medical procedures and improve healthcare access in remote areas. Also, the Internet of Things can be employed to monitor the environment and detect potential threats to global health. By utilising the Industry 4.0 technologies, global health security can be improved, which will benefit everyone in the world.

Finally, the global health security can be thought of as a global public good, meaning that it benefits everyone in the world. The Industry 4.0, also known as the Fourth Industrial Revolution, is focused on creating digital solutions for businesses and governments to improve efficiency and productivity. This can be applied to global health security as well, as digital solutions can be used to help monitor, respond to, and prevent health risks on a global scale. Digital solutions can also be used to create secure systems for sharing health data, which can help ensure that health risks are addressed in a timely and effective manner. Additionally, the use of blockchain technology can be applied to create secure and transparent systems for managing health data, which can help facilitate better communication between countries and organisations regarding global health security.

By making these solutions accessible to everyone, we can help ensure that everyone is aware of the importance of global health security. To implement health security in the national interest, concrete steps must be taken to ensure that citizens have access to accurate and up-to-date information on health risks. Therefore, there is a strong need for a re-definition of global public health because of new challenges propelled by these new technologies. Furthermore, there is also a need to educate the public, policymakers, and providers about the impending transformation,

to modernise the existing governance systems and structures, and to develop a coordinated and collective framework[4].

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