Perspectives and implications in the use of artificial intelligence in healthcare

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Abstract

Advances in applications and research in creative operations have led to the emergence of artificial intelligence, which has developed from a nascent application to a major influence in almost all areas of business, research, or manufacturing, including the medical field. Thus in the medical field the first application with particularly good results was in surgery, i.e. laparoscopy. Subsequently, minimally invasive operations in cardiology, orthopedics, urology, etc., as well as in minimally invasive operations on the unborn fetus, when certain congenital malformations were identified. It is expected that artificial intelligence will also be able to perform minimally invasive interventions on the Central Nervous System (CNS), especially for recovery from progressive neuronal degenerative conditions with multi-level damage (dopa and non-dopa). As a result artificial intelligence challenges specialists to create appropriate instrumentation, through new technologies and the creation of specialists in collateral fields (chemistry, welding, composite materials, microbiology, etc.), as well as new systems of micro-visualization without radioactive effects. This requires collaborations and cooperation between researchers in various fields and major investments in research laboratories and information of specialists. Artificial intelligence has also created opponents in terms of fears that it would replace some medical professionals and that some negative consequences of artificial intelligence applications in the medical field may not be predictable. Artificial intelligence is proving to be an evolutionary stage as a result of the emergence and development of technologies, types of management, the creation of niche researchers, with competitive aspects between laboratories and states and with state and private investment, especially as it also has applications in the military. Artificial intelligence-related discoveries are secret and top secret due to investments recoverable from licensing profits. Romania benefits from the National Strategy for Research, Innovation and Smart Specialization with funds from the PNRR, with the remark that national research institutions have lost specialists attracted by developed countries from the European Union, the USA, etc. In order to cope with the competition Romania should allocate substantial budgetary funds both in national research institutions and in the creation of co-invested specialists, as well as encourage private initiatives. Applications already practiced from the use of artificial intelligence in the medical field highlight the benefits for society as a whole with recognized positive results for the health of patients and by decreasingrecovery time and lowering the costs of hospitalizations and treatments. Romania as a member of the European Union and NATO has the advantages of cooperation and collaboration in the field of artificial intelligence, with similar institutions, as well as through participation in scientific sessions and specific topics. Romania as a member of the European Union and NATO has the advantages of cooperation and collaboration in the field of artificial intelligence, with similar institutions, as well as through participation in scientific sessions and specific topics. It is undeniable that artificial intelligence is proving to have an impact in most areas of social economics, manufacturing, healthcare and the military. The necessary investment and the applicable results of artificial intelligence create value and added value for society.

Keywords: non-invasive interventions, effective treatments, training of staff, investment.

1. Introduction

The implementation of digital technologies in health is widely recognized as an important condition for the effective functioning of health services as well as for ensuring citizen acceptance (C. Pisarenco, "PhD in law," Constantin PISARENCO, Associate Professor).

Classical medicine, both as diagnosis and intervention for various treatments, has been and is being complemented by artificial intelligence technology, starting with the use of SMART phones, through which a patient can make instant contact with a medical

specialist, the use of Holters for measuring and recording heart rate, the use in angiography and scintigraphy as well as drones for transporting samples to be analyzed ordrugs to hard-to-reach areas.

In all cases of the use of artificial intelligence in medicine, as in other fields, thereis the unresolved issue of civil and criminal liability for malpractice cases, as there is no adequate legal regulation for the various situations.

Within the European Union, procedures are currently being debated to identify fraud created by the use of Artificial Intelligence when the faces and voices of scientifically recognized personalities are used to recommend the use of drugs and/or treatments that are not scientifically proven, at advantageous prices with disastrous consequences for the health of the population.

The newest development in the use of computers is Artificial Intelligence. It has found practical application in all fields of knowledge, implementable in social, civil, political and military life with, for the moment, immeasurable prospects.

Population health is an area where artificial intelligence is creating opportunities for ever-evolving involvement through intensive competitive, national and international research, for which major investments, including private ones, are being made.

Artificial intelligence in medicine also includes detailed research into the human genome, as DNA and chromosome structure, both as a prototype and customized for eachindividual, so that possible congenital, or evolving, diseases can be predicted based on environment, occupation, diet and habitat.

The applications of artificial intelligence in the medical field can be taken from imaging by various equipment that used radioactive or other less invasive or side-effect based technologies, then followed by analysis of blood and human tissues subject to interpretation by computer algorithms, then followed by robotic surgery equipment that can guide the placement of medical devices during procedures such as catheters and stents, reducing the risk of complications and improving patient outcomes and shortening hospital stays.

There are already plans to use artificial intelligence in neuropsychiatric conditions by implanting miniaturized chips into the central nervous system (CNS), classified as robotic-assisted surgical devices (RAS) by the FDA, which allow surgeons to perform operations using a console through surgical arms, cameras and other instruments.

In 2021, a draft law, the first of its kind, has been proposed in the EU Commission to regulate the risks associated with the use of artificial intelligence in order to harmonise AI regulation at national and EU state level in all areas except military technology.

It has been noted that artificial intelligence programs have been developed and implemented for diagnosing diseases, developing treatment protocols, monitoring patient condition, etc. The introduction of artificial intelligence may have mixed consequences in healthcare, especially in possible “medical errors”, e.g. IBM Watson Health AI [1].

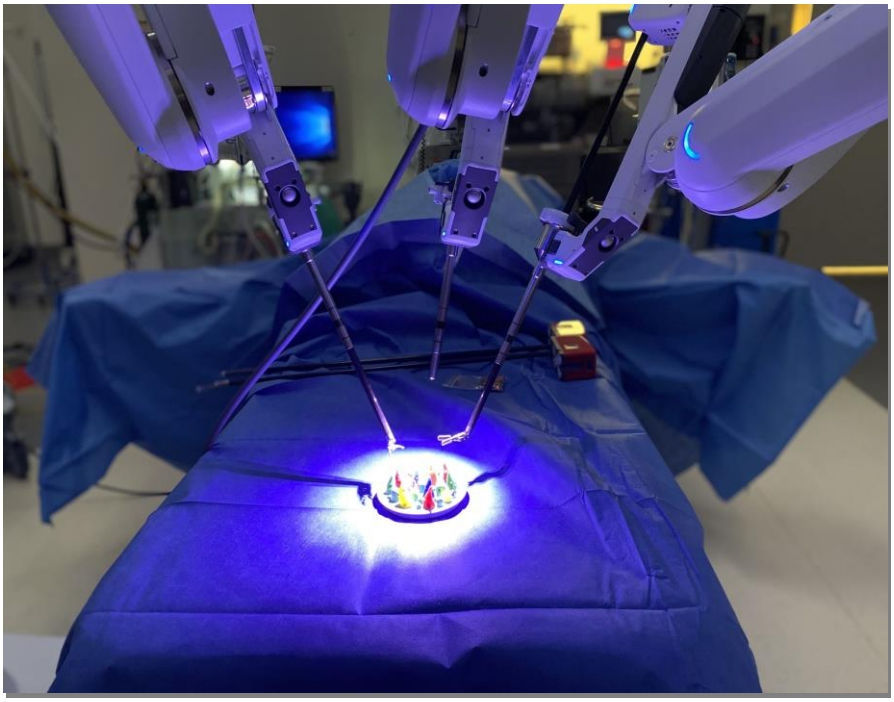

Fig.1. Minimally invasive surgery with the da Vinci Xi robot
Source:
https://www.anthc.org/news/anmc-purchases-da-vinci-xi-surgical-system-adding-critical-technology-to-the-or/

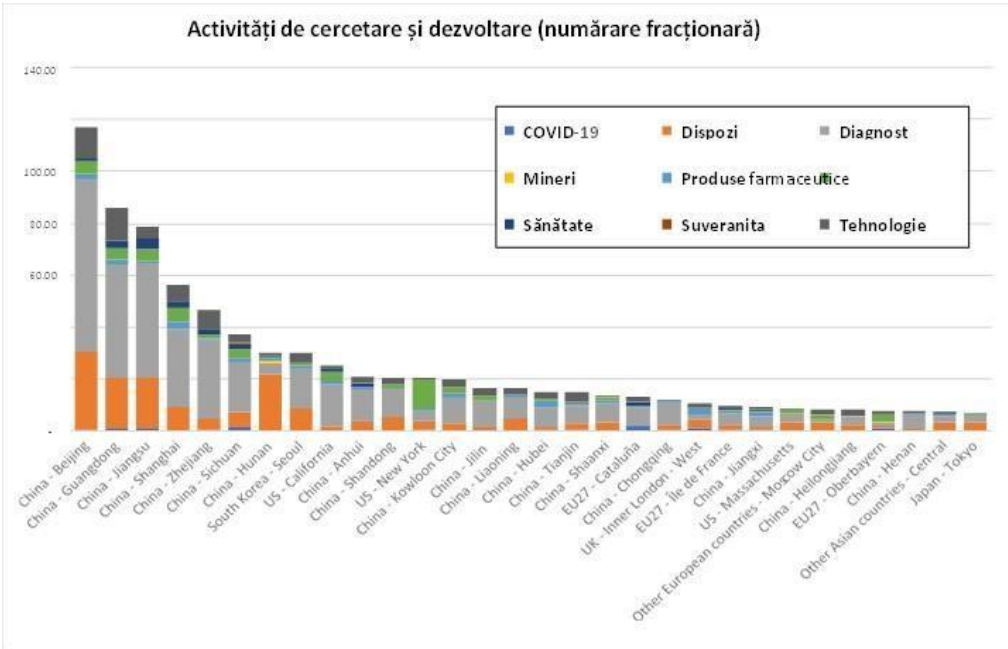

Fig.2. Research and development activities by region and by theme AI and health
Source: https://publications.jrc.ec.europa.eu/repository/ [2]

IBM has actively promoted Watson Health as a decision support tool for physicians, primarily to help the oncology branch determine the best treatment regimens. However, in 2018, it was reported that the Watson supercomputer was often making erroneous recommendations for cancer treatment, to the extent that medical professionals and the company's customers were identifying "referrals of dangerous and wrong treatment regimens/procedures" [3].

As a result, there are also opponents to some applications in the medical field, distrustful of the benefits of artificial intelligence, defenders of traditional medical treatments, interested either in keeping their jobs, or conservative towards modernity.

Artificial intelligence in the medical field requires collaborations with various specialties and specialists in the fields of biology, high technologies, microbiology, pharmacology, civil and military research institutions, etc., so that congresses in the field and communication sessions of common interest are organized periodically at national and international level.

According to expert estimates, the global healthcare artificial intelligence market was worth $8.2 billion in 2021, rising to $10.1 billion in 2022 at a compound annual growth rate (CAGR) of 23.5%, and is expected to grow to at least $49.1 billion by 2026 at a CAGR of 48.4%. [4].

The applications of artificial intelligence in the medical system also require specialization of staff at university level and regular training in line with new developments.

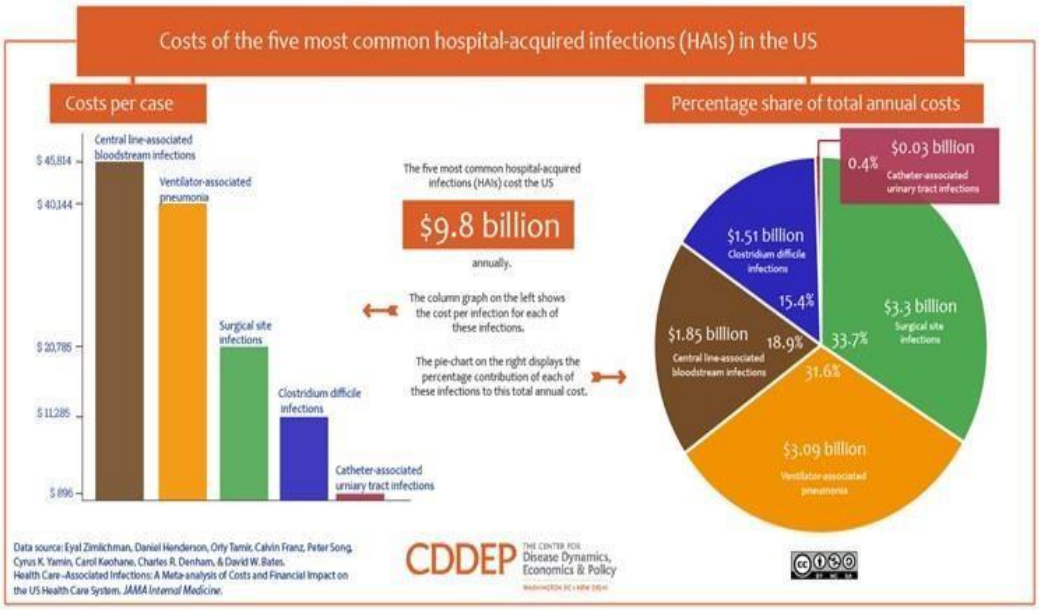

Fig. 3. Cost of the five most common hospitals using artificial intelligence [6]
Source: Centre for Disease Dynamics, Economics and Policy

Particular attention should be paid to controlling the instrumentation used by artificial intelligence to avoid malfunctions, errors as well as sterilization or reset operations, as sterilization is essential for hospitals. Hospital-acquired infections (HAIs) and surgical site infections (SSIs) in patients can increase length of hospital stay and create billions in additional costs each year, which is where robots providing cleaning services could help (according to CDDEP).

Purple Sun and Xenex are two companies offering cleaning robots, created throughartificial intelligence, that use UV light to reduce pathogens in some hospitals. A recent study found that UV light can eliminate nearly 98% of pathogens found in operating rooms. Xenex, which operates in more than 400 US hospitals, has developed a "germ zapping" robot that uses UV technology to clean hospitals and equipment, and New York-based PurpleSun recently partnered with Northwell Health to implement its UV sanitizing technology throughout Northwell's hospital system, but they will still have to consider factors such as regulations, pricing and the niche training of healthcare professionals – not to mention the emotional and ethical considerations in a field as sensitive as medicine.

Europe has lagged behind the US and China in terms of private investment in medicine-related AI. Without major efforts, the EU risks missing out on the opportunities offered by AI, facing a brain drain and being a consumer of solutions developed elsewhere. This is why the European strategy on AI in healthcare has set ambitious but realistic targets: more public and private investment in AI is needed in the EU to reach the target of €20 billion per year over the next decade. The EU strategy for AI in the healthcare sector corresponds to an annual investment of €7 billion achievable by the public sector (Member States and the Commission), on a relative par with investments made on other continents. For the next programming period 2021-2027, the Commission has proposed that the Union invest at least EUR 1 billion in AI for which the Horizon Europe and Digital Europe programme has been finalized [7].

Table 1. Romania's budget forecasts for research and application of artificial intelligence

No. Crt.	TOOLS FOR IMPLEMENTING SNCISI 2022-2027	ALLOCATED BUDGET
1.	National Recovery Plan and Resilience	approximately €259.43 million
2.	Operational Programme for Smart Growth, Digitalisation and Financial Instruments	approximately 1000 million euros
3.	Regional Operational Programme	approximately 2200 million euros
4.	National Research Development Innovation Plan IV	around €12000 million (*the estimated budget is based on a gradual annual increase in DC public expenditure of around 0.14% of GDP over the period 2022-2027 to reach the target of 1% in 2027)
5.	Romanian Academy Programs	approximately €400 million budgets (*cumulated during the implementation of the SNCISI)

6.	Operational Programme Transition Just	approximately 200 million euros
7.	Operational Programme Education and Employment	approximately 40 million euros
8.	Sectoral Plans of Ministries	approximately €120 million (*cumulative budget per the implementation period of the SNCISI)
9.	People's Academy Programmes of Science of Romania	approximately €12 million (*cumulative budget per the implementation period of the SNCISI)
10	Operational Programme Health	approximately 386 million euros

Source: https://s3platform.jrc.ec.europa.eu/map [5]

Romania's growing budget deficit has considerably reduced funding for research and applications of artificial intelligence in the medical field, so that many specialists have migrated to developed countries (USA, Canada) and the closure of research units in the field.

According to the figures published by the UN and WHO, the following tables show the ranking of the countries concerned, in terms of funds invested or attracted, in artificial intelligence in the medical field, influenced by the Russian-Ukrainian war and the war in the Middle East, as well as by the economic-financial crisis that has begun to manifest itself regionally and globally.

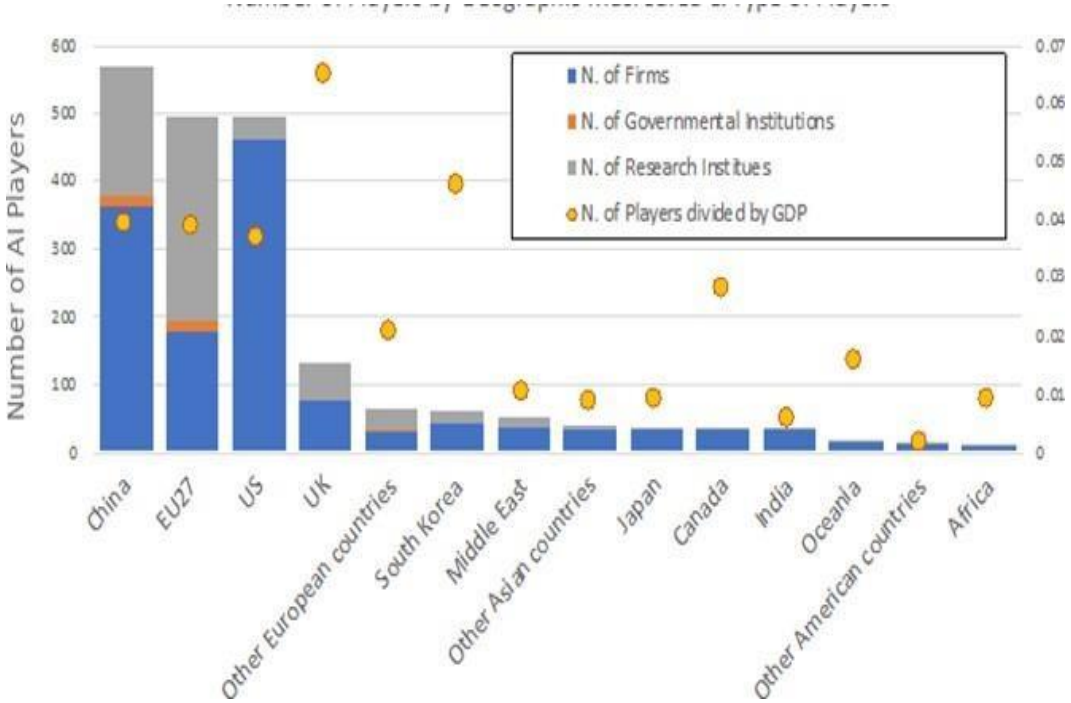

Fig. 4. Number of actors in artificial intelligence and health by geographical macro-area and type of actors
Source: https://publications.jrc.ec.europa.eu/repository/ [6]

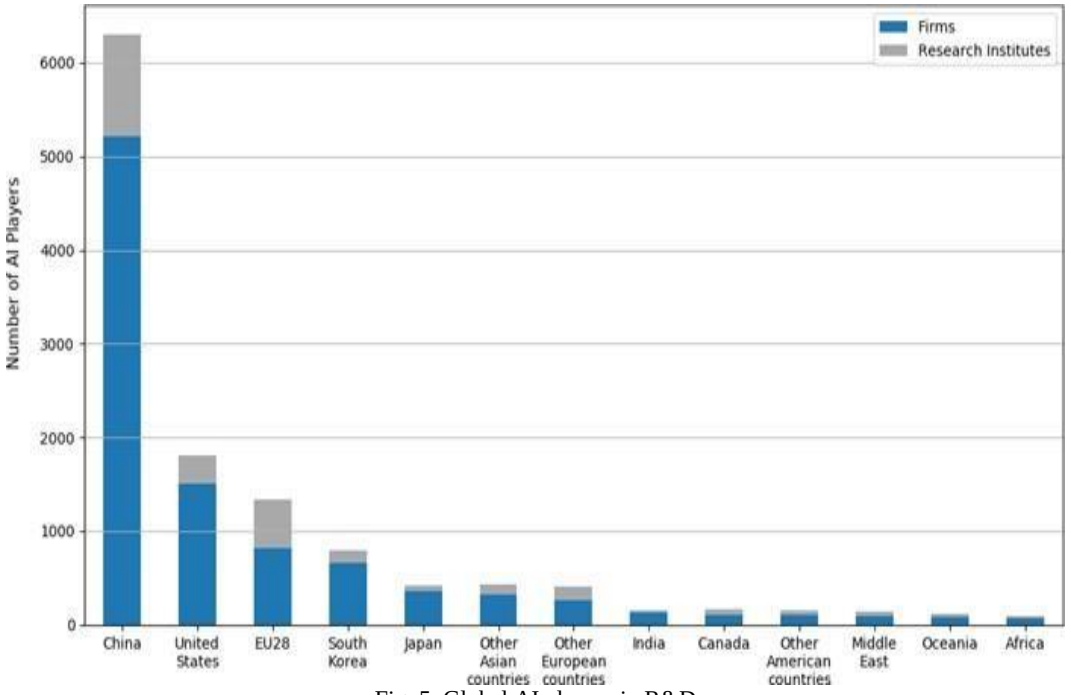

Fig. 5. Global AI players in R&D
Source: https://publications.jrc.ec.europa.eu/repository/

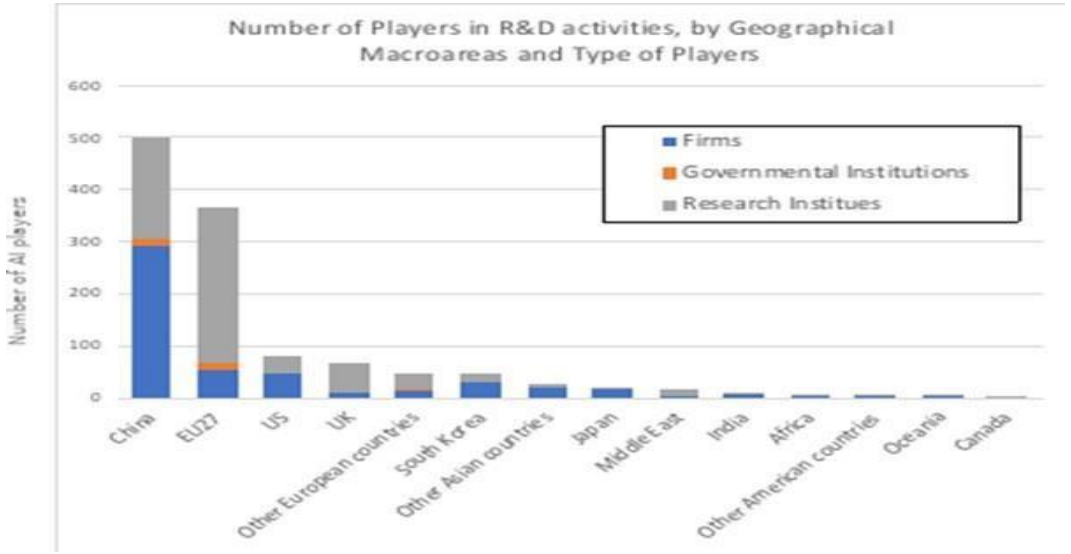

Fig. 6. AI and health players in research and development [7]
Source: https://publications.jrc.ec.europa.eu/repository/

In terms of the areas of involvement and activity of artificial intelligence in the field of medical diagnostics, the situation of countries that have developed application strategies is shown in the table below:

Table 2 Categories of applications in AI and health

Subject Health	Topics included (examples)
COVID-19	studies and activities related to pandemics and contact tracing applications
Sovereignty	cyber security, data governance, stakeholder engagement
HTA	health technology assessment
Prevention	wearable devices, hospital information systems, cardiac devices
Diagnostics	screening, diagnosis, image analysis, medical data analysis
Public health	big data analysis, social medicine
Devices	physical property modelling, device design and development
Pharmaceutical products	development of medicines and vaccines.

Figure 6 compares the profile of the three key macro domains based on the health sub-domains in Table 2, looking at the activities in which actors were involved.

An activity can be research and innovation processes, industrial production, trade and marketing, specific services related to artificial intelligence, business financing (venture capital funds or other types of investments). These activities may be explicitly stated, e.g. in the description of the company's activities in business registers, or they maybe derived from the analysis of the company's R&D activities, e.g. from texts of conference proceedings, research projects or patents. In addition, the number of activities includes:

- Industrial capacity: number of activities related to firms (production, trade, investment),
- Innovative potential (disaggregated): number of patents filed by individual applicants – which have a "potential" for development,
- Internal innovation network capacity: number of internal collaborations (in the same geographical area) for patent filing – shows the efficiency of the internal innovationnetwork,
- Research and development potential (disaggregated): number of single-author research publications at top AI conferences,
- R&D network capacity: number of internal collaborations (in the same geographical area) for publications in top conferences in the field of artificial intelligence efficiency of the internal research network,
- Global strategic network influence: number of external collaborations indifferent geographical areas measures the degree of centrality of individual macro-domains and their ability toinfluence the overall network of the AI and health ecosystem,
- Knowledge accumulation (with/without Horizon 2020 projects): access to information and knowledge for individual macro-areas through their own activities andthrough all types of collaborations [7].

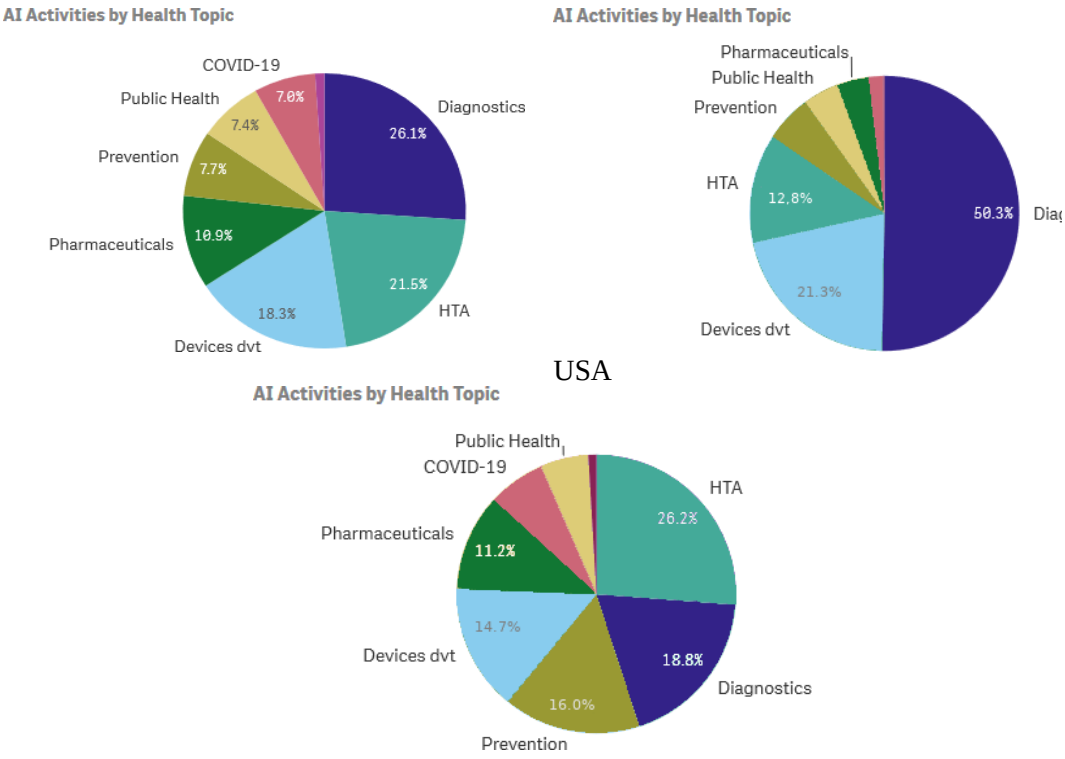

Figure 6: IA activity on health topics

Artificial intelligence is assimilated in the medical field with any device andequipment that replaces the hands of a specialist, so the use of lasers as scalpels in surgery, which also sutures instantly, is also an application of artificial intelligence. Romania has benefited from these practices with great delay and at great budgetary expense.

Digital solutions and artificial intelligence in healthcare are no longer ancillary IT systems; in terms of safety and efficiency, they are increasingly similar to drugs or medical devices. But while pharmaceutical corporations conduct and publish research, comply with standards and are subject to rigorous scrutiny, such practices are just beginning to emerge for artificial intelligence systems.

All developed countries have a strategy for implementing artificial intelligence in the medical field, which includes:

- Research centres
- Framework training
- Secrecy in military applications
- Collaboration with other institutions in different countries.
- Digitalization on health cards for each personIn current medicine, artificial intelligence has already proven its usefulness in the following conditions:
- Identifying and treating breast cancer
- Identifying and treating lymphatic cancer

- Identification and treatment of cholecystitis
- Identifying and treating osteoporosis
- Identifying and treating congenital diseases
- Identifying and treating pandemic diseases
- Identification and self-expanding aortic valve prosthesis, etc.

Each of these conditions listed above have a specific approach, analysis, diagnosis and intervention that are in the stage of experimentation, diagnosis, intervention and treatment, which have already proven to be much more effective and less costly compared to the practice of conventional medicine.

2. Conclusions

It follows from the above that the emergence and development of instrumentation and procedures from the evolution of artificial intelligence discoveries is and will be a breakthrough in the diagnosis and treatment of certain conditions, with particularly favourable consequences for the efficiency of medical care, with cost efficiencies and increased life expectancy.

In the field of population health, the practical applications of artificial intelligence represent a breakthrough incomparable to all previous discoveries and practices, starting with the discovery of virology and vaccines.

Each application of the progress of artificial intelligence, of interest to the medical field, is based on substantial investments from the state and private budget sector, the licensing of research results, the realization of profits on this basis, the horizontal and vertical development of interdisciplinary research relationships, all to the benefit of the welfare of society, all the more so as it can also be applied to agriculture and animal husbandry.

The emergence and development of artificial intelligence applications has required the emergence of new specializations in higher education, both in medical and technological fields. Thus most developed countries have had to develop strategies that take into account artificial intelligence and its applications in related fields. All the applications and effects of the emergence and evolution of research in the field ofartificial intelligence require significant financial efforts, even if the secrecy and competition of research institutes in developed countries reach the same breakthrough.

Communication sessions as well as congresses on the subject can help to eliminate identical research. However, it is not within the reach of all poor and developing countries to have access to the latest medical discoveries and applications of artificial intelligence, either due to lack of funds or lack of specialist staff.

Romania, either for lack of instruments or specialists, is forced to send patients to countries that have equipped applications and hospital units, with the related costs.

Proposals

Romania's governments over the last two decades have provided for a strategy of developing research institutes and training specialists sent to educational establishmentsin developed countries, but the growing budget deficit has blocked the projects of some research institutions in this field, so that many researchers have left Romania.

Government policy has come to be the determining factor in Romania in the case of the strategy of applying the use of artificial intelligence in the medical field in the medical system, by not making the necessary funds available, namely the establishment and proper equipping of regional hospitals, or of specialist departments in large existing hospitals through the lack of interest of specialists in foreign universities and hospitals, which is detrimental to the health of the population. Thus, Romania ranks 'top' in the European Union in terms of deaths due to various forms of cancer, children born with disabilities, the rural population without access to diagnostics, chronic lack of medicines, lack of modern regional medical units, lack of education and prevention methods, etc. As a result, for all these shortcomings, the political factor is responsible and must draw up appropriate legislation.

As a result, the Romanian population is still unable to benefit from the discoveries and latest applications of artificial intelligence in healthcare. Special attention should alsobe paid to the salaries of health professionals, so that the rural and small town populationshave access to specialist health professionals.

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