Konteksty Społeczne | *Social Contexts*
2024, Tom 12, Nr 1(23), 64-86
http://doi.org/10.17951/ks.2024.12.1.64-86

IT Expenditures as a Component of Patient Treatment Costs in Hospital-Based Healthcare Providers: Evidence from Public Procurement Data (2011–2021)

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Abstract: The aim of this study is to examine the expenditure associated with the computerisation of the public healthcare system, the proportion of these costs within total treatment expenditure, the structure of such costs, and the trends underlying their evolution. The research was conducted using existing data derived from public sources related to the public procurement market in Poland. A total of four million documents published in the Public Procurement Bulletin and the Supplement to the Official Journal of the European Union (TED) between 2011 and 2021 were collected and analysed. Using CPV codes, purchases related to computerisation were identified and classified into appropriate procurement categories. The findings reveal an exponential increase in IT-related costs within the public healthcare system, as well as an exponential rise in their share of total medical expenditure. The results also indicate a transformation in the structure of purchases, demonstrating a growing emphasis on specialised information systems. The marked increase in computerisation costs in Poland's public healthcare system suggests that technology is assuming an increasingly significant role in healthcare delivery. The exponential growth in the proportion of these costs within overall expenditure implies that investments in technology may constitute a key component of future health system development strategies. Conversely, these changes may also stem from the disproportionate rise in the prices of IT sector products and services relative to those of other industries, influenced by factors such as economic conditions, geopolitical circumstances, or market monopolisation.

Keywords: computerization; costs of computeriazation; health care; health policy; public procurement.

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ISSN 2300-6277, https://journals.umcs.pl/ks

Introduction

The digitisation of Poland's healthcare system has been a significant focus in recent years, driven by the need to improve efficiency, reduce costs, and enhance patient care. This process entails multiple expenditures, including the development and implementation of electronic health (eHealth) solutions, the maintenance of digital infrastructure, and the training of healthcare professionals. These costs are considerable and may constitute a barrier to the widespread adoption of digital health technologies.

Over the past decade, there has been a noticeable increase in investment in eHealth solutions, particularly in response to the COVID-19 pandemic. This has included enhanced funding for telemedicine, electronic prescriptions, and other digital health tools (Placiszewski, 2022). There is also growing recognition of the need for sustainable financing models capable of supporting the long-term maintenance and development of digital health infrastructure. Consequently, a shift has occurred towards more innovative financing mechanisms, such as public–private partnerships (Kurczewska, 2023). As the digitisation of healthcare progresses, there is increasing emphasis on cost-effectiveness and demonstration of the value of digital health investments (Chojnacki & Gastecka, 2014). This has resulted in closer scrutiny of the costs associated with digitisation and a stronger focus on achieving measurable outcomes (Matera-Witkiewicz, 2024).

Despite the considerable progress made in digitising Poland's healthcare system (Centrum e-Zdrowie, 2022), several financing-related challenges remain to be addressed. A key issue concerns the financial sustainability of digital health initiatives. This requires not only sufficient initial investment but also continuous funding to support the maintenance and further development of these systems (Kurczewska, 2023; Romaszewski et al., 2024). Another challenge relates to inequities in access to funding for digitisation efforts, which may arise not only from differing needs or financing opportunities, but also from variations in the managerial competencies of healthcare institutions' administrative staff (Karlińska, 2013). Smaller healthcare providers and those operating in rural areas may encounter difficulties in securing the resources necessary to implement and sustain digital health solutions (Rój, 2022). Furthermore, the complexity of existing financing mechanisms in place can constitute a barrier to the effective implementation of digitisation initiatives which require navigating multiple funding sources and ensuring the efficient allocation of resources (Placiszewski, 2022).

The digitisation of Poland's healthcare system is a complex and costly process that demands substantial investment and careful strategic planning. Although notable progress has been achieved in recent years, challenges related to financing the process remain. A comprehensive understanding of the costs, financing mechanisms, and their evolution over time can enable policymakers and stakeholders to work towards establishing a more sustainable and equitable digital health system.

This study addresses these challenges by providing a detailed analysis of the costs associated with the digitisation of healthcare in Poland, encompassing trends over time, the distribution of expenditures by category, and the proportion of digitalisation costs within total healthcare spending. By elucidating the structure and dynamics of these expenditures, the findings offer valuable insights for policymakers and stakeholders, supporting evidence-based decision-making and the formulation of more effective and sustainable strategies for the digital transformation of healthcare.

Methodology

The research aimed to examine the costs incurred in the computerisation of the public healthcare system, assess the share of these costs in the provision of medical services, analyse their structure, and identify trends in their evolution over time.

The study is based on an analysis of secondary data derived from the Public Procurement Bulletin (Biuletyn Zamówień Publicznych, BZP), that is, the outcomes of procurement procedures published by the Public Procurement Office[1], as well as from the European Union's Supplement to the Official Journal (TED)[2], covering the period from 2011 to 2021. The documents were compiled into a database and, to enable their analysis, were parsed and parameterised[3]. In total, 4,031,296 documents were collected and analysed for the examined period, categorised into separate sections containing the results of public procurement procedures, of which 112,062 related specifically to IT supplies and services.

Based on departmental codes assigned to entities in the Register of Healthcare Entities (RPWDL)[4] and the criterion of possessing a minimum of 20 beds[5], 743 active and 75 deregistered entities were identified which, during the studied period, provided hospital-based inpatient healthcare services, excluding those offering only spa, rehabilitation, or single-day services[6]. Among these entities (hospitals), 693 were identified as having procured products and services during the studied period

under the Public Procurement Law. Due to gaps in the data, which hindered the identification of unique entity records and their types[7], it was necessary to develop appropriate tools for searching, grouping, and merging individual entity records within the constructed database. Using these tools, 13,478 non-unique records of entities (contracting authorities) providing services within the healthcare system were identified. After merging the records, 1,723 unique entities were established. In the case of hospitals identified in the Register of Healthcare Entities (RPWDL), 5,254 non-unique records were found, which, after cleaning and merging, resulted in 693 unique hospitals.

Numerous factors influence the total expenditure on computerising the healthcare system. These can be grouped into several main categories:

- Computer hardware (computers, monitors, printers, peripheral devices, etc.),
- IT infrastructure (networks, server rooms, internet connectivity),
- Software (basic, office, administrative, registration, clinical, scientific, specialised, etc.),
- IT services (maintenance, technical support, equipment or software installation, development and implementation of dedicated systems, system integration, data migration, data analysis, business analysis, hosting services, cloud solutions, etc.),
- Salaries and contractual remuneration for IT staff or personnel performing related tasks,
- Associated services (legal services, construction services, training, development of procedures, certification),
- Associated infrastructure (computer furniture, separate electrical networks for computer equipment, and buildings or rooms adapted for the use of computer hardware).

A standard system for the codification of public procurement operates both in Poland and Europe. For each procurement and its parts, the contracting authority is required to assign the most specific possible code, referred to as the CPV code (Common Procurement Vocabulary)[8]. This classification system is quite detailed, although not always fully precise, which has often been the subject of criticism (Leukel & Maniatopoulos, 2005; Santos, 2022). While it is not possible to describe every purchased service or product using this vocabulary, it is sufficient for determining the scope of the studied public procurements.

IT expenditures were determined based on the value of public procurement outcomes in which the appropriate CPV codes were indicated. These CPV codes, together with their subcategories, were subsequently assigned to five categories of expenditure:

- Hardware supplies,
- Standard software package supplies (off-the-shelf software),
- Specialist software supplies,
- Infrastructure,
- IT services not related to software.

The CPV codes assigned to each category, additional exclusions, analytical conditions, and potential sources of error measurement are provided in the appendix to this text.

Results

IT-Related Expenditures

Market research on public procurement indicates a consistent increase in investment in information technology (IT). This trend is evident both in overall expenditure and in allocations specifically directed towards the healthcare sector. In 2011, IT expenditure within Polish public procurement amounted to PLN 2.668 billion. Over the following decade, by 2021, this figure increased exponentially to PLN 18.314 billion. The highest level of investment was observed in 2020, when as much as PLN 25.271 billion was allocated to IT.

A similar exponential increase in IT spending was recorded among entities associated with the healthcare system in Poland, including hospitals, outpatient specialist clinics (AOS), primary care providers (POZ), as well as the Ministry of Health, the e-Health Centre (Centrum e-Zdrowie), and the National Health Fund (NFZ). In 2011, expenditure by such entities amounted to PLN 357 million, and by 2021 this figure had reached PLN 2.112 billion. The most substantial spending on IT solutions during the analysed period occurred in 2020, amounting to PLN 2.588 billion. Specifically in hospitals, a steady, almost linear increase in IT expenditure was observed, rising from PLN 210 million in 2011 to PLN 946 million in 2021. The highest amount allocated to IT procurement in hospitals was recorded in 2019, at PLN 1.094 billion. Detailed data illustrating these changes are presented in Table 1 and Figure 1.

Table 1. The value of awarded public procurement contracts for IT solutions (PLN million) among entities within the healthcare system, 2011–2021.

YEAR	ALL CONTRACTING AUTHORITIES	HEALTHCARE SYSTEM ENTITIES	HOSPITALS
2011	2,668	357	210
2012	5,931	804	290
2013	5,003	600	261
2014	6,159	614	438
2015	6,770	629	431
2016	3,853	315	203
2017	6,304	622	379
2018	10,606	1,022	798
2019	18,661	1,687	1,004
2020	25,471	2,588	588
2021	18,314	2,112	946

Source: Author's own elaboration based on data from the BZP and TED databases.

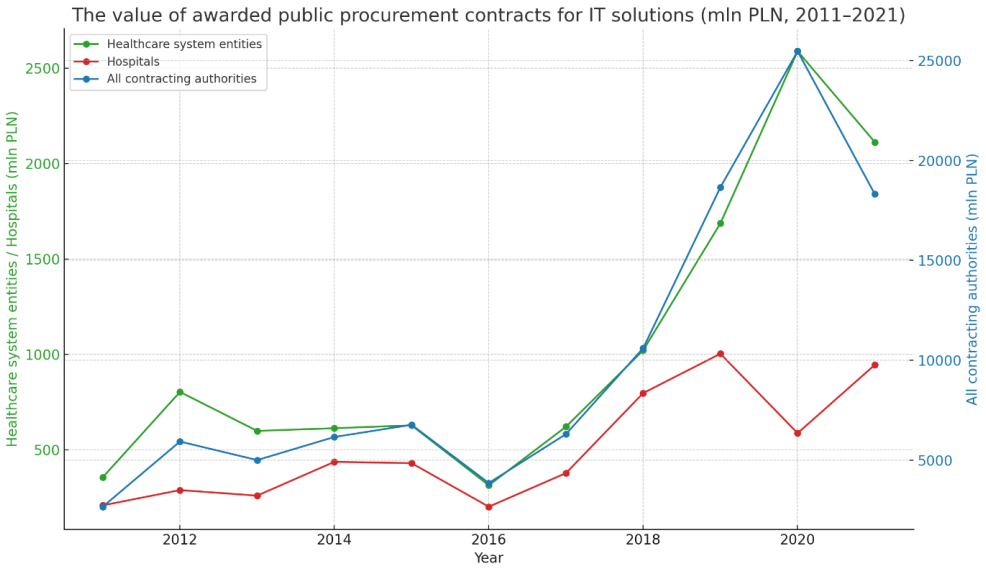

Figure 1. The value of awarded public procurement contracts for IT solutions (PLN million, 2011–2021). *Source:* Author's own elaboration based on the data presented in Table 1.

The Percentage Share of IT Expenditure in Total Spending

The absolute value of expenditure on digitalisation alone does not constitute an exclusive indicator of the significance of such spending. A key metric for evaluating changes in the IT solutions market is the percentage share of IT product and service costs in the total expenditure of entities on their operations.

In the overall public procurement market, the share of IT-related expenditure amounted to 3.9% of total spending in 2011. Following an exponential growth trend, this share reached 8.6% in 2021, while in 2020 it exceeded the threshold of 10.1% — the highest value recorded during the analysed period.

A similar exponential trend can be observed among all entities within the healthcare system. In 2011, the share of IT expenditure accounted for 2.9% of total spending, increasing to 6.4% by 2021. The highest percentage share was recorded in 2020, reaching 9.1%.

For hospitals specifically, the trend also demontrates an upward pattern. In 2011, the share of IT expenditure in total spending was 1.9%, rising to 3.4% in 2021. The highest percentage share was observed in 2017, at 4.3% level. It is also worth noting that in 2019, the share of IT expenditure relative to all expenditure reached 4.1%. Detailed data illustrating these changes is presented in Table 2 and Figure 2.

Table 2. Percentage share of the value of awarded public procurement contracts for IT solutions (in PLN millions), categorised by all contracting authorities, all entities within the healthcare system, and hospitals separately, 2011–2021.

Year	All Contracting Authorities	Healthcare System Entities	Hospitals
2011	3.40%	2.90%	1.90%
2012	4.90%	4.50%	1.90%
2013	3.90%	3.60%	1.80%
2014	4.40%	3.50%	2.70%
2015	4.70%	3.50%	2.60%
2016	3.40%	1.60%	1.20%

2017	4.40%	5.10%	4.30%
2018	5.10%	4.20%	3.80%
2019	8.90%	5.70%	4.10%
2020	10.10%	9.10%	2.30%
2021	8.60%	6.40%	3.40%

Source: Author's own elaboration based on data from the BZP and TED databases.

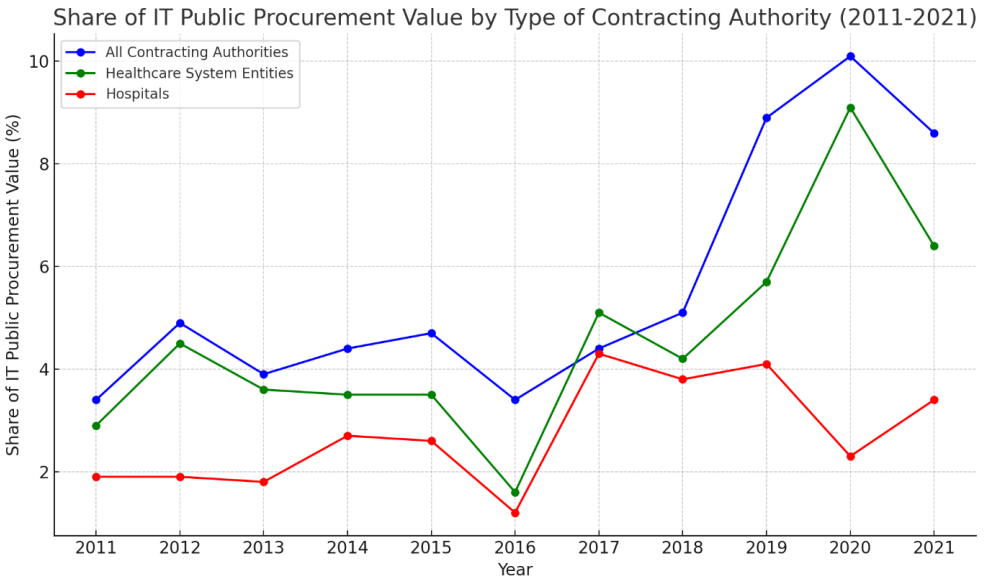

Figure 2. Percentage share of the value of awarded public procurement contracts for IT solutions (in PLN millions), categorised by all contracting authorities, all entities within the healthcare system, and hospitals separately, 2011–2021. *Source:* Author's own elaboration based on the data presented in Table 2.

Costs by Category of IT Expenditure in the Healthcare System

The study included an analysis of costs disaggregated by specific categories of IT expenditure within the healthcare system. The analysis focused on changes in the value of contracts and their relative shares across individual categories, examined separately for all entities within the healthcare system and separately for hospitals.

For all entities within the healthcare system, there is a clear exponential upward trend in expenditure, primarily related to specialised software, where the value increased from PLN 195 million in 2011 to PLN 1.775 billion in 2021. The highest amount spent on such solutions was recorded in 2020, at PLN 2.173 billion.

In other categories, an increase in the value of contracts is also evident, although it is not as substantial as in the case of specialised software. IT services other than those related to software increased from PLN 39 million to PLN 50 million (with the highest value of PLN 125 million in 2017). Computer hardware supplies increased from PLN 115 million to PLN 284 million (with the highest value of PLN 482 million in 2019). Software package supplies advanced from PLN 23 million to PLN 100 million (with the highest value of PLN 195 million in 2013). Infrastructure costs increased from PLN 53 million to PLN 67 million. However, this value is exceptionally low compared with the preceding three years: PLN 220 million in 2018, PLN 228 million in 2019 (the highest value), and PLN 166 million in 2020. Detailed data is presented in Table 3 and Figure 3.

Table 3. Value of awarded public procurement contracts by healthcare system entities for IT solutions (PLN million), broken down by cost categories, 2011–2021.

Year	IT Services Other than Software	Computer Hardware Deliveries	Software Package Deliveries	Specialist Software Services & Deliveries	Infrastructure -Related
2011	39	115	23	195	53
2012	27	170	38	565	55
2013	43	144	195	368	50
2014	29	239	81	348	60
2015	40	258	95	405	59
2016	42	87	24	168	29
2017	125	242	136	373	109
2018	63	352	81	464	220
2019	77	482	145	977	228
2020	54	316	117	2,173	166
2021	50	284	100	1,775	67

Source: Author's own elaboration based on data from the BZP and TED databases.

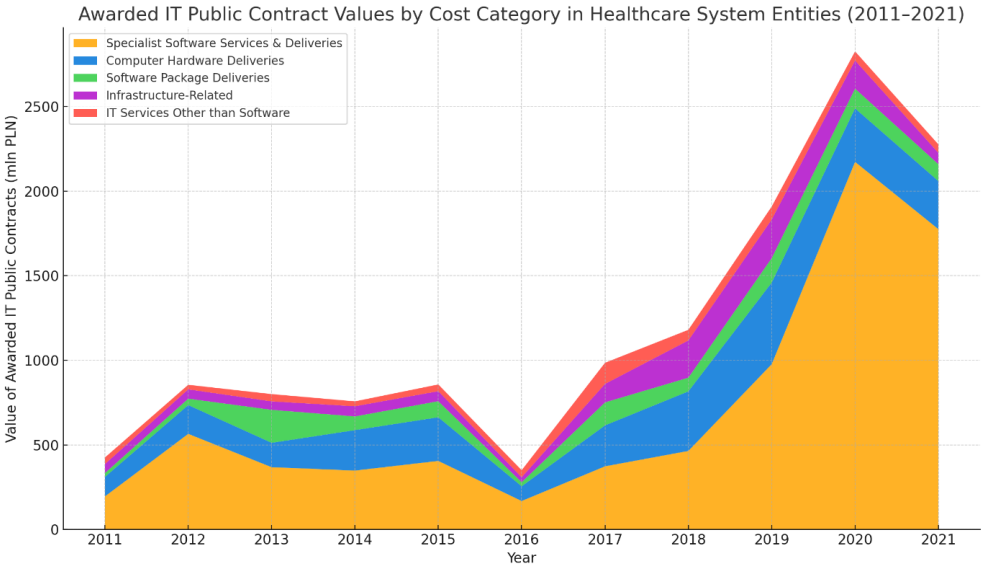

Figure 3. Value of awarded public procurement contracts by healthcare system entities for IT solutions (PLN million), broken down by cost categories, 2011–2021. *Source:* Author's own elaboration based on the data presented in Table 3.

An analogous situation is observed in the case of hospitals. In 2021, the largest share of expenditure was directed towards the purchase of services related to specialised software. Here, too, an exponential upward trend in such expenditure is evident, rising from PLN 91 million in 2011 to a peak of PLN 707 million in 2021, which is also the highest value recorded during the analysed period.

However, unlike the pattern seen across all healthcare system entities, hospital expenditure on specialised software was, for most of the analysed period roughly comparable to expenditure on computer hardware supplies, except in 2021. During this period, expenditure on hardware increased from PLN 80 million in 2011 to PLN 218 million, with the highest spending in this category observed in 2019 at PLN 419 million. Notably, this was the only year in which the value of hardware supplies exceeded that of specialised software expenditure (PLN 392 million).

It is also worth noting that a significant increase in IT infrastructure expenditure between 2018 and 2020 occurred. In this category, hospitals spent PLN 43 million in 2011 and PLN 57 million in 2021, while during the years of heightened spending, the amounts were PLN 211 million (2018), PLN 221 million (2019), and PLN 150 million (2020).

Expenditure in remaining categories was marginal. IT services unrelated to software increased from PLN 11 million in 2011 to PLN 21 million in 2021, with the highest value being PLN 48 million in 2019. Software package supplies amounted to PLN 15 million in 2011 and PLN 77 million in 2021, the latter being the highest value recorded for this category during the analysed period. Detailed data are presented in Table 4 and Figure 4.

Table 4. Value of awarded public procurement contracts by hospitals for IT solutions (PLN million), broken down by cost categories, 2011–2021.

Year	IT Services Other than Software	Computer Hardware Deliveries	Software Package Deliveries	Specialist Software Services & Deliveries	Infrastructure -Related
2011	11	80	15	91	43
2012	12	137	16	125	34
2013	11	104	21	119	36
2014	19	180	52	236	33
2015	17	218	32	270	47
2016	17	65	19	112	12
2017	27	131	37	181	87
2018	34	306	68	309	211
2019	48	419	56	392	221
2020	17	237	66	295	150
2021	21	218	77	707	57

Source: Author's own elaboration based on data from the BZP and TED databases.

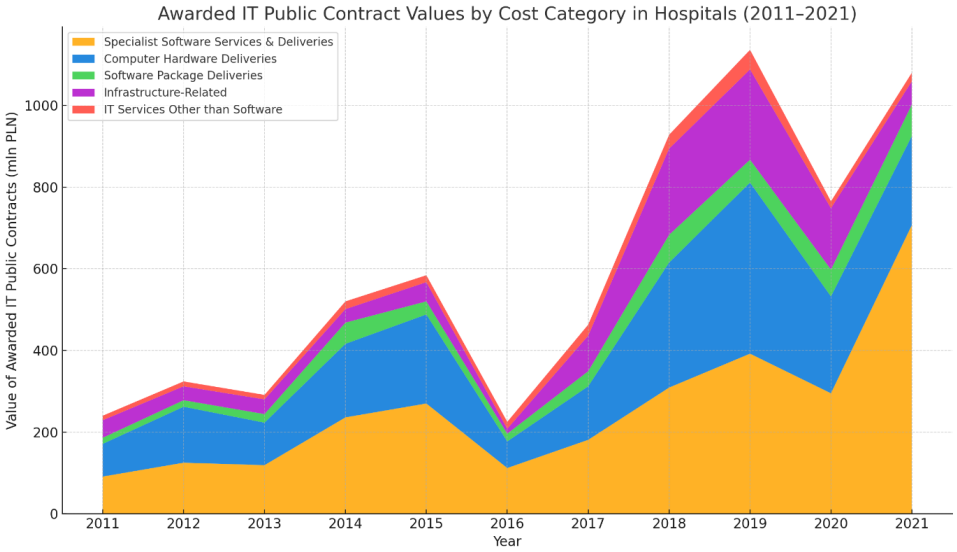

Figure 4. Value of awarded public procurement contracts by hospitals for IT solutions (PLN million), broken down by cost categories, 2011–2021. *Source*: Author's own elaboration based on the data presented in Table 4.

The Percentage Share of Individual IT Cost Categories in the Healthcare System

A crucial analytical perspective is to consider the costs of individual categories in terms of their percentage share of total IT expenditure during the analysed period. This approach enables the identification of general trends, indicating which categories of expenditure are gaining importance and which are becoming less significant.

For all entities within the healthcare system, as with the absolute values, a marked increase in the share of specialised software costs in overall IT expenditure can be observed. Since 2011, spending in this category increased from 46% to 78% of total IT expenditure by 2021.

Consequently, all other IT expenditure categories, despite experiencing nominal growth in spending, saw a significant decline in their relative share of total costs. IT services not related to software fell from 9% in 2011 to 2% in 2021. Computer hardware supplies decreased from 28% to 13% over the same period. The share of software package supplies declined from 5% to 4%. However, it is worth noting a substantial increase in the share of these expenditures in 2013, 2014 and 2015, when the values reached 24%, 11%, and 11% respectively, and again in 2017, when the value was 14%. Meanwhile, the share of infrastructure expenditure

decreased from 12% in 2011 to just 3% in 2021. Detailed data are presented in Table 5 and Figure 5.

Table 5. Percentage share in the total value of awarded public procurement contracts for IT solutions by healthcare system entities, broken down by IT cost categories, 2011–2021.

Year	IT Services Other than Software	Computer Hardware Deliveries	Software Package Deliveries	Specialist Software Services & Deliveries	Infrastructure-Related
2011	9%	28%	5%	46%	12%
2012	3%	21%	4%	66%	6%
2013	5%	19%	24%	46%	6%
2014	4%	31%	11%	46%	8%
2015	5%	30%	11%	47%	7%
2016	12%	25%	7%	48%	8%
2017	13%	24%	14%	38%	11%
2018	5%	30%	7%	39%	19%
2019	4%	25%	8%	51%	12%
2020	2%	11%	4%	77%	6%
2021	2%	13%	4%	78%	3%

Source: Author's own elaboration based on data from the BZP and TED databases.

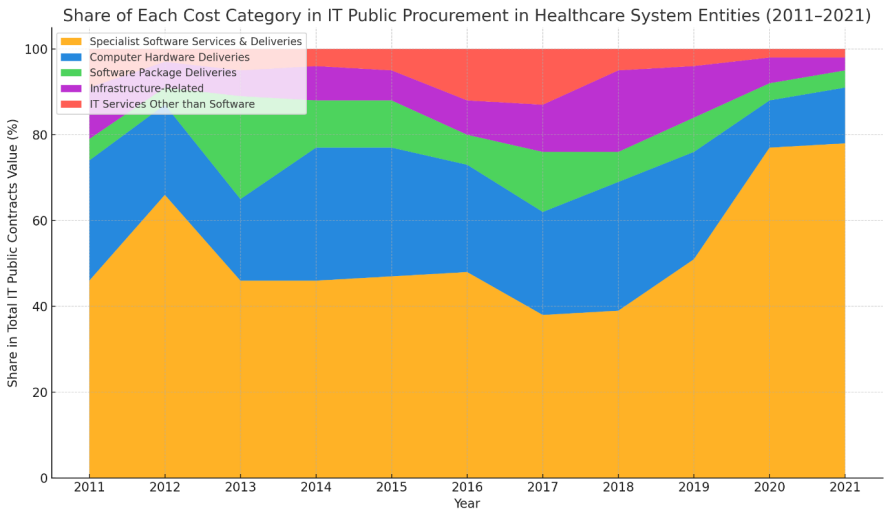

Figure 5. Percentage share in the total value of awarded public procurement contracts for IT solutions by healthcare system entities, broken down by IT cost categories, 2011–2021. *Source*: Author's own elaboration based on the data presented in Table 5.

A comparable situation can be observed in hospitals, although certain differences are apparent. The study reveals an almost linear increase in the share of expenditure on specialised software within overall IT costs, from 38% in 2011 to 65% in 2021. However, during the years 2017–2020, this linear growth was disrupted by significant investments in hospital IT infrastructure, with the share of IT expenditure in this category increasing to 19%, 23%, 19%, and 20%, respectively, during these years. In comparison, the infrastructure share dropped from 18% in 2011, to 10% in 2012, and reached only 5% in 2021.

For the remaining categories of expenditure, the share of software package supplies recorded a slight but stable increase, from 6% in 2011 to 7% in 2021. The other two categories, however, experienced a decline in their share of overall IT costs. The share of IT services not related to software decreased almost linearly from 5% in 2011 to 2% in 2021. Computer hardware supplies declined from 33% in 2011 to 21% in 2021. These changes can also be considered stable and linear until 2019; however, from 2020 onwards, there is a clear trend of a decreasing share of this category in overall IT expenditure in hospitals. Detailed data are presented in Table 6 and Figure 6.

Table 6. Percentage share in the total value of awarded public procurement contracts for IT solutions by hospitals, broken down by IT cost categories, 2011–2021.

Year	IT Services Other than Software	Computer Hardware Deliveries	Software Package Deliveries	Specialist Software Services & Deliveries	Infrastructure-Related
2011	5%	33%	6%	38%	18%
2012	4%	42%	5%	39%	10%
2013	4%	36%	7%	41%	12%
2014	4%	35%	10%	45%	6%
2015	3%	38%	5%	46%	8%
2016	8%	29%	8%	50%	5%
2017	6%	28%	8%	39%	19%
2018	4%	33%	7%	33%	23%
2019	4%	37%	5%	35%	19%
2020	2%	30%	9%	39%	20%
2021	2%	21%	7%	65%	5%

Source: Author's own elaboration based on data from the BZP and TED databases.

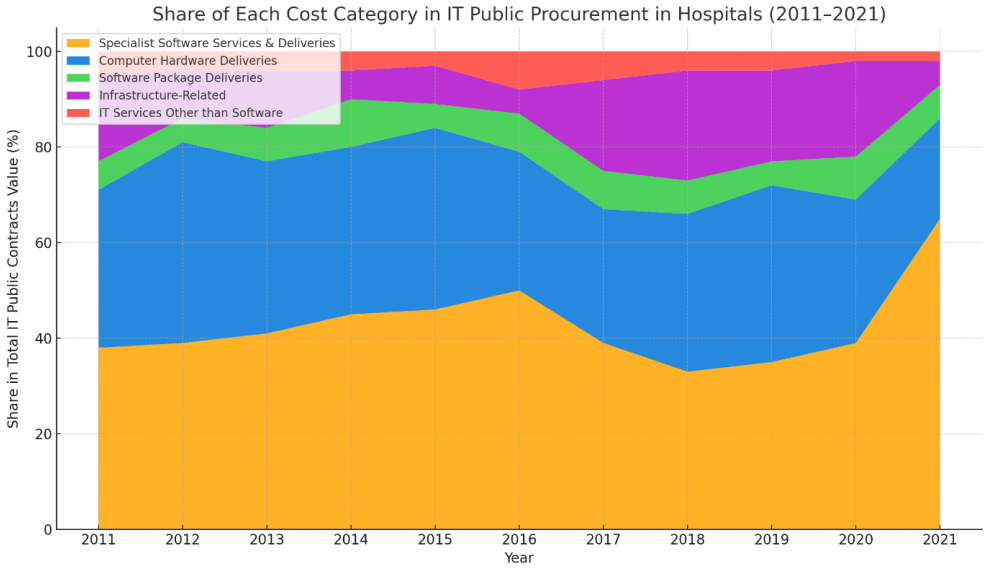

Figure 6. Percentage share in the total value of awarded public procurement contracts for IT solutions by hospitals, broken down by IT cost categories, 2011–2021. *Source*: Author's own elaboration based on the data presented in Table 6.

Discussion and Conclusions

The study results indicate an exponential increase in IT expenditure within the public healthcare system, as well as a corresponding exponential rise in its share of the overall costs of providing healthcare services. These findings also point to a shift in the purchasing structure, clearly showing that changes in expenditure within the healthcare system are now concentrated primarily on specialised telehealth information systems.

However, the research findings do not identify the direct causes of the observed phenomena. Recent developments suggest that the COVID-19 pandemic, which led to increased demand for IT services (Bhattacharyya & Kulkarni, 2022), and the geopolitical situation resulting from Russia's invasion of Ukraine, which caused economic disruptions and, above all, necessitated the protection of information systems against cyberattacks and disinformation (Калакура, 2021), have contributed to the rise in costs. Nevertheless, the data indicate that the upward

trend began prior to these events, and the results obtained give rise to several questions that warrant further investigation:

- Have expenditures on information technology become a significant component of the spending structure within the healthcare system?
- What risks are associated with the increasing share of IT in the overall costs of providing healthcare services, and what future consequences might arise for the healthcare system if the upward trend in IT expenditure continues?
- How are rising IT expenditures in healthcare being financed, and do they affect the level of public debt?
- Is there evidence that the COVID-19 pandemic and the conflict between Russia and Ukraine have contributed to the continued increase in IT spending in healthcare, even though the upward trend began earlier?
- Could the observed increase in the costs of selected IT services be a consequence of monopoly or oligopoly conditions within thas market?
- What other factors might be contributing to the exponential growth in IT investment in the public healthcare system?

The World Health Organisation (WHO, 2021) report indicates that global health expenditure has at least doubled over the past two decades. In Poland, over the last decade (from 2011 to 2020), these expenditures increased by 57%. The findings of this study reveal that IT spending alone grew by 624% during this period, while its share of overall healthcare system costs increased by 213%. This represents a drastic change, indicating that IT solutions in the healthcare system are becoming one of the most significant factors determining the cost of care. However, there are no publicly available studies in Poland or other countries that analyse the cost components of healthcare provision with explicit consideration of IT costs, making it difficult to compare this trend in Poland directly with international developments. Publications addressing healthcare system costs usually aggregate information technology costs together with medical and diagnostic technology costs. Meanwhile, the persistent exponential growth of these costs as a proportion of total healthcare expenditure – now approaching 10% – suggests that, in the coming years, IT solutions will become, alongside demographics, one of the most critical components influencing the cost of healthcare.

Such a rapid increase in the share of IT within overall healthcare expenditure may, in the future, result in a significant financial burden for medical institutions and the entire healthcare system. Highly digitised entities will face numerous challenges that will increasingly need to be addressed by companies from the IT sector. These challenges include cybersecurity, interoperability, integration management, access to computing resources and storage, maintenance and development of specialised software, and the provision of personnel training. Growing investments in IT solutions are also making healthcare providers more dependent on technology vendors, which may introduce monopolistic risks, lead to long-term cost increases, and fuel a self-reinforcing price spiral. This presents a challenge for health policymakers, who should already seek ways to counteract these trends and identify solutions that can reduce the cost of digitalisation, particularly where increased IT costs do not translate into improved quality or accessibility of healthcare.

Public funds cover the majority of healthcare expenditure in Poland. The healthcare system is financed in more than 72% from the state budget (data for 2021), of which 86% is derived from mandatory health insurance (Central Statistical Office, 2022). Direct household expenditure accounts for 20%, and only slightly more than 7% comes from the private sector. Although the continuously rising healthcare expenditure (not only in IT) theoretically does not have a significant impact on the level of public debt, as it is mostly funded through insurance contributions, the burden of sustaining healthcare operations (including the purchase of IT equipment and services) falls primarily on healthcare institutions. Increasingly, these entities must resort to borrowing in order to meet regulatory requirements and keep pace with technological progress.

In many cases, low reimbursement rates from the National Health Fund (NFZ) and poor management of healthcare facilities result in hospitals having to finance their operations and investments through loans. Hospital debt between 2010 and 2015 remained around PLN 10 billion, but from 2015 to 2022 it rose exponentially, exceeding PLN 19 billion (Dubas-Jakóbczyk et al., 2020). In less than a decade, hospital debt has doubled, indicating the direct impact of these expenditures on public debt.

However, it is difficult to pinpoint the exact reasons why the prices of IT solutions are rising at such a rapid pace. The most immediately apparent causes are recent high-profile events, namely the COVID-19 pandemic, and Russia's invasion of Ukraine. At the onset of the pandemic

(even before the first cases were reported in Poland), a noticeable surge in IT expenditure could have been observed. Nevertheless, it is difficult to state unequivocally whether the pandemic itself was the principal driver of this increase, although some evidence supports this hypothesis. Both the pandemic and the war have contributed to inflation, a phenomenon extensively documented in numerous scholarly studies, as exemplified by the briefing to the European Parliament on 25 March 2022, which presented a list of dozens of recent publications on inflation (Grajewski, 2022). The medical market – like other public and private sectors – increased its demand for computer and server hardware, as well as for specific IT services, driven by the need to implement remote communication and work solutions. The collected data reflect this, showing increased expenditure in these areas in 2019.

On the other hand, a substantial change was already noticeable in 2017 and 2018 – that is, prior to the outbreak of the pandemic and the subsequent inflationary pressures. This challenges the thesis that the recent increases are solely the result of the pandemic or the war, suggesting that a more in-depth analysis is required. Among the factors that should be considered are, above all, the rise in salaries for IT specialists, particularly in software development and cybersecurity; the drastic increase in energy prices required to provide many IT services; the periodic shortage of computer components and hardware; and the monopolisation of the market, which negatively affects competitiveness and pricing.

It is also noteworthy that expenditure on IT solutions decreased significantly in 2021. Of particular analytical interest is the year 2020 in the medical market, when a substantial decline in hospital procurement was recorded. In the same year, however, there was a marked increase in purchases by central units and smaller healthcare entities. This may be partially attributed to hospitals' use of the so-called COVID Act[9], which enabled certain purchases to be made outside the standard Public Procurement Law. It may also reflect a reduction in hospital operations during this period, including the suspension of specific procedures and surgeries, as well as the transition of some administrative staff to remote work.

These suppositions remain inconclusive and were not the primary focus of this study. Nevertheless, this area is important and warrants further, in-depth analysis. The present research may thus serve as a foundation for future studies, particularly those aimed at identifying and explaining the underlying causes of these phenomena.

Summary

The conducted study and analysis of data from the public procurement market and expenditures on IT solutions in the healthcare system allow for several key conclusions:

- **Dynamic Growth in IT Expenditure**
  Over the decade from 2011 to 2021, expenditure on IT technologies in public procurement and within the healthcare system grew exponentially. This trend became particularly pronounced in the healthcare sector, where IT-related spending now constitutes an increasingly significant proportion of the overall budget.

- **The Importance of Specialised Software**
  The most notable increase was observed in the area of specialised software, both in absolute value and as a percentage of total IT expenditure. Specialised software has become the primary focus of IT investment within the healthcare system.

- **Changing Expenditure Structure**
  Although expenditure on other IT categories, such as hardware supplies or infrastructure, also increased, their relative share of total IT costs began to decline. This indicates a shift in technological investment priorities within the healthcare system and a substantial rise in the costs of implementing and maintaining telehealth information systems.

- **Hospital Investments in Infrastructure**
  Between 2017 and 2020, hospitals made significant investments in IT infrastructure, reflected in the increased share of these costs in total IT expenditure during those years.

- **Growing Importance of Digitalisation**
  The percentage share of IT expenditure relative to the total cost of patient care has been steadily increasing, underscoring the growing importance and strategic priority of digitalisation within the healthcare sector.

In summary, over the past decade, the healthcare sector in Poland has invested intensively in information technologies, with particular emphasis on specialised software. This growth reflects an increasing awareness of the necessity for digital transformation in the healthcare system and an effort to enhance the efficiency and quality of healthcare services through the adoption of modern technological solutions.

At the same time, a key finding from the analysis is that specialised software represents the primary category of IT costs in the healthcare system. This underscores the importance of individualised, medicine-oriented solutions that can contribute to the improved and more efficient functioning of the healthcare system.

Considering these findings, it is essential for both public and private decision-makers to recognise the growing role of technology in medicine and to invest in appropriate tools and solutions that will benefit patients and the healthcare system as a whole. The dynamic rise in IT-related costs as a share of the overall healthcare budget also signals the need for closer scrutiny of such expenditure, as well as for analysis of the origins and implications of these rapid changes. It is worth considering whether the observed increase in expenditure on information technologies within the healthcare sector results solely from growing demand and the necessity for continuous development, or whether it also reflects the influence of other factors, such as limited market competitiveness or the emergence of oligopolistic structures.

This issue remains open to further discussion, both in political and academic circles, particularly regarding whether the rising expenditure on teleinformation solutions is indeed accompanied by increased efficiency and improved quality of healthcare services in Poland. In other words, whether investments in IT solutions are adequate, optimal, and fulfill the functions attributed to them.

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Footnotes

[1] Public Procurement Bulletin - Biuletyn Zamówień Publicznych: https://www.uzp.gov.pl/biuletyn-zamowien-publicznych/biuletyn-zamowien-publicznych-zmiany-formularzy-w-zwiazku-ze-zmiana-ustawy-prawo-zamowien-publicznych

[2] Tenders Electronic Daily https://ted.europa.eu/TED/browse/browseByMap.do

[3] Between 2011 and 2021, documentation of procurement results in various systems was produced in different data formats and descriptive structures, which evolved over time. During this period, documents were made publicly available in XML, JSON, or simple HTML formats. Each type of document (results for different types of procedures) lacked standardisation and, for example, used different names for information units, descriptive structures, or value formatting (e.g. sometimes presented in tables, sometimes in lines), even when referring to the same information. Creating a consistent dataset suitable for analysis requires parsing—that is, reading the content or data from individual fields—and parameterising it by establishing equivalent information units and programming parsing mechanisms so that these units are extracted (for example, using text-mining tools) and placed into the appropriate information columns within the database. This process enables analysis across the entire collection of heterogeneous documents.

[4] Register of Healthcare Service Providers maintained by the e-Health Centre: https://rpwdl.ezdrowie.gov.pl/

[5] There are two dominant definitions of a hospital. The first is the normative definition set out in the Act of 15 April 2011 on Medical Activity, which states that a hospital is a healthcare facility of a healthcare entity in which the entity provides medical activity in the form of hospital services. Hospital services are defined as comprehensive 24-hour health services involving diagnosis, treatment, nursing, and rehabilitation that cannot be provided within other stationary and 24-hour health services or outpatient health services. Hospital services also include services provided with the intention of being completed within a period not exceeding 24 hours. The second definition is that proposed by the Central Statistical Office (GUS) for statistical purposes, which defines a hospital as a healthcare facility of a healthcare entity, or a separate organisational unit of such a facility, in which the entity provides medical activity in the form of stationary and 24-hour hospital health services, excluding healthcare facilities that provide only services intended to be completed within a period not exceeding 24 hours (so-called "one-day hospitals"). However, the RPWDL (Register of Healthcare Service Providers) database includes all entities performing medical activities, encompassing both large medical facilities and small care institutions. The RPWDL does not explicitly indicate which entities are hospitals and which are not. Some entities, even small ones, report hospital services as part of their activities, indicating that they have between one and a dozen or so beds, despite employing only a few people or operating as sole proprietorships. Therefore, for the purposes of this study, it was decided to limit the definition of a hospital to entities that report at least 20 beds.

[6] According to the definition of the Central Statistical Office (GUS), entities that have only one-day stationary care wards are not considered hospitals. https://stat.gov.pl/metainformacje/slownik-pojec/pojecia-stosowane-w-statystyce-publicznej/3908,pojecie.html, accessed on 12 September 2023. For the purposes of this study, entities providing only spa and rehabilitation services were also excluded from the research scope.

[7] An explanation of the low quality of the available data can be found in the Annex to this publication.

[8] Common Procurement Vocabulary (CPV) https://www.gov.pl/web/uzp/wyszukiwarka-kodow-cpv-cpc

[9] Act of 2 March 2020 on Special Solutions Related to the Prevention, Counteracting, and Combating of COVID-19, Other Infectious Diseases, and Crisis Situations Caused by Them.