UNITED FOR GOOD: CENTRALIZATION OF THE PHARMACEUTICAL PROCUREMENT PROCESS IN UKRAINE

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AUTHOR'S DECLARATION FORM

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ABSTRACT

The area of public pharmaceutical procurement involves several agencies both at global and local levels that are responsible for launching effective mechanisms. Thus, as this process includes different actors and procedures it is very difficult to control its efficiency and check transparency and accountability in order to combat corruption. Centralized pharmaceutical procurement is considered to be one of the policy innovations that aims to improve indicators that are used to assess the efficiency of the procedure. Competitiveness and decision-making timelines are some of these indicators.

Ukraine introduced the centralization reform in the sphere of pharmaceutical procurement in 2020. It is expected to increase the competitiveness and the time period of decision-making process as it is proven to create a transparent and fair procurement system. Accordingly, the research question is how this change in legislation affects the level of two indicators mentioned above. The data for the analysis was extracted from the ProZorro e-system and contains information about tenders and expenditures from 2015 until 2022. Such methods as linear regression and propensity score matching were implemented to analyze the data.

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LIST OF ABBREVIATIONS

Abbreviation	Definition
ATC	Anatomical Therapeutic Chemical Classification System
CPV	Common Procurement Vocabulary
MPU	State enterprise “Medical Procurement of Ukraine”

INTRODUCTION

The provision of the population with an adequate supply of medication in accordance with their needs is one of the key objectives of public pharmaceutical procurement, which is a crucial part of developing an efficient healthcare system in any nation. Its implementation is a multi-stage process that incorporates a variety of institutions and methods. From clinical studies to the distribution of medications to hospitals, key players include international organizations, pharmaceutical firms, ministries, and public procurement bodies (World Health Organization, 2002). Accordingly, the risk of corruption, its perception, or actual incidents can happen at every stage of the medical supply chain. In addition, the pandemic of COVID-19 forced governments of many countries around the world to increase expenditures on healthcare, including pharmaceutical procurement. So, after 2020, average health spending in OECD countries grew quickly, reaching 9,7% of GDP, with a rise of 1% from 2019 (OECD Health Statistics, 2023). In this regard, there is a challenge for the policy-makers to increase the efficiency of healthcare procurement to provide the population of the country with high-quality medicines for a reasonable price.

The idea of centralized pharmaceutical procurement has become more well-known among these advancements (Albano, 2010). This strategy aims to address important performance factors like competitiveness and timeliness of decisions that are considered to be powerful tools for assessing the public procurement system (Cingolani, 2020). It is believed that centralization strives to increase supplier competitiveness, streamline operations, and hasten decision-making by consolidating the procurement process under a single authority. Beyond administrative efficiency, centralization is seen to have advantages for the development of fair and transparent procurement procedures which corresponds to the principles of pharmaceutical procurement (World Health Organization, 2009).

By implementing a coordinated approach to pharmaceutical procurement in 2020, Ukraine started the reform based on the experience of other countries (Vogler, 2020). This reform project has the potential to have a substantial impact on both how competitive the market for procurement is and how quickly decisions are made. Ukraine's reform aims to take use of the benefits of centralized procurement in order to create a more transparent and equitable procurement system.

With the recent introduction of the e-procurement system ProZorro, it became easier to control the transparency and accountability of public procurement. In this regard, this research aims to see the impact of centralization on the competitiveness and decision-making speed in the sphere of pharmaceutical procurement by using the information that was collected from the ProZorro platform.

CHAPTER 1: LITERATURE REVIEW

1.1. Health expenditures and its impact on quality of life

The healthcare sector has a significant impact on public policy challenges. This is happening due to the fact that indicators such as life expectancy and quality of life inevitably affect other social and economic spheres. Therefore, it is necessary to ensure that the capacity of the healthcare system allows it to be effective and equally accessible to everyone, so the population's quality of life is constantly improving (Asandului, 2014). Many governments of countries around the world face the problem of expanding medical facilities because very often the expenditures on healthcare reach a sizeable proportion of the country's GDP (Jacobs, 2011). For instance, average health expenditures in OECD countries have grown rapidly after 2020 and have reached 9,7% of GDP which shows a 1 % increase in comparison to 2019 (OECD Health Statistics, 2023). Meanwhile, in low-income and middle-income countries where the state covers all public medical goods and services this number on average amounts to 5,6% of the GDP (World Health Organization Global Health Expenditures Database, 2023). However despite the model that is being chosen for financing health spending the costs of healthcare systems are increasing annually for both high-; and low-income countries, so there occurs an enormous pressure that forces decision-makers to increase tax revenues as sources of medical system finance (Jacobs, 2011). Moreover, the pandemic of COVID-19 proved that the healthcare systems of many countries were shown to be vulnerable to extreme and fast changes and failed to set goals and priorities to some extent (Giannopoulou, 2020). Hence, there is still a need to build an efficient and money-wise healthcare spending system that will contribute to the benefit of society and avoid the pressure of budget expenses throughout the years.

Many studies are aimed to find an effective solution in order to reform healthcare spending system for it to achieve its goals. For instance, Heller (2006) introduced the concept of fiscal space. By this he describes the additional capacity of the government to provide additional resources from the budget while having a sustainable financial position. Yet, low-income and middle-income countries can experience difficulties in increasing the additional facilities (ibid.). Although such ways as allocating extra proportion from countries' GDP, seeking for donor's funds can be a possible solution, however, it does not give significant results and weakens the system in the long-term perspective (ibid.).

As budgeting in the healthcare sector remains a complicated process and one that is influenced by various factors, there is a need to focus on the "technical efficiency" of healthcare budgeting (Seidman, 2017). This term is defined as a number of outputs that can be generated by inputs such as cost (ibid.). The author claims that the increase in fiscal space can be possible by stimulating the "technical" efficiency of the healthcare system (Ibid.). This may create a potential room for maneuvering public resource allocation to overcome public policy issues in low-; middle-; and high-income countries. In this case, public pharmaceutical procurement is considered one of the outputs where the budget assigned for purchasing medical goods is an input. Therefore, improvement of pharmaceutical procurement policy can lead to cost savings.

1.2. The concept of pharmaceutical procurement

Providing the population with medicines and hospitals with the necessary equipment is a significant share of the healthcare budget which remains the second largest expenditure in many countries around the world (Seidman, 2017). A significant part of this budget is allocated annually for pharmaceutical procurement. As was mentioned above, in low-income and middle-income countries, where governments mostly guarantee a free healthcare system, spending on pharmaceutical procurement accounts varies from 7,7 to 67,6 % of total health expenditures

(Seidman, 2017). Hence, to ensure that a significant part of the healthcare budget is being distributed rationally, strict control of this process is needed.

The area of pharmaceutical procurement is extremely complicated because it involves various institutions and mechanisms on regional and global levels (Kohler, 2016). International organizations, pharmaceutical firms, ministries, and public procurement agencies are just a few of the major players in charge of managing the processes from clinical trials to distributing medications to hospitals (ibid.). The government, which creates an annual budget for the healthcare system, works in conjunction with local and national committees within the Ministry of Healthcare to decide on the type and quantity of drugs to be purchased while allocating available funds as efficiently as possible (ibid.). Local hospitals are also involved in the pharmaceutical procurement process (World Health Organization, 2002 and UNODC, 2017).

The World Health Organization established operational principles for good pharmaceutical procurement that are based on transparency and accountability, good governance, ethical and quality standards, best value for money, sustainability, and partnership (World Health Organization, 2009). Moreover, the development of robust data management and information systems became even more relevant with the development of digital innovations in medicine (ibid.). Adherence to these principles is important to set up efficient and rigid standards to control the distribution of the government budget. Therefore, governments aim to create a transparent and sustainable procurement system to provide the population with a sufficient quantity of high-quality medicines according to their needs.

Thus, public management issues can occur at every level and cause inefficient functioning of the healthcare ministries' departments and hospitals and as a result the overpayment of goods and services. Bandiera et al. (2009) identify threats to government spending efficiency in the form of active and passive waste. In the case of active waste, the

violation of operational procurement principles is visible because the public decision-maker experiences direct or indirect benefits, so corruption can be considered as one of the most common forms of active waste of state expenditures (ibid.). However, the public procurement system may be in danger because of passive waste where there is no benefit for a public decision-maker (ibid.). The malfunction of the whole system due to passive waste arises from public management issues that government institutions face. For instance, decision-makers cannot minimize the costs of goods because of the necessary skills or incentives absence (ibid.). In addition, the regulations required for the distribution of the budget may create an excessive burden (Bandiera, 2009). Accordingly, in order to efficiently allocate the resources provided by the state, policymakers should focus not only on combating active waste, including corruption but also on passive waste while establishing mechanisms for effective and transparent procurement.

1.3. Centralization policy in healthcare procurement

Centralized procurement can be one of the possible solutions to establish a transparent, sustainable, cost-; and quality-efficient pharmaceutical purchasing system. Many studies show that the centralization of the procurement process has a tendency to a price reduction (Baldi, 2015). This is evidenced by the fact that many countries are moving from a decentralized to a centralized model of public procurement. The extent to which centralization can be implemented varies significantly (Albano, 2010). In different cases, procurement may be the responsibility of a single national agency, or it may be a collaboration between regional, national, and international institutions. Thus, there are advantages and disadvantages that depend on the degree of centralization.

The establishment of a single national agency or networking among several public institutions can increase the transparency of the system due to the stricter control of the central

procurement body (Aboelazm, 2019). In this regard, it can lead to an increase in transparency and robustness of purchasing mechanism (Baldi, 2015). In addition, government institutions receive more power but also more responsibility to cover the population's needs (Aboelazm, 2019). Moreover, with thoughtful implementation, an established agency may have the capacity to perform specific tasks that relate to pharmaceutical procurement (ibid). Therefore, there occur prerequisites to rationalization of government spending to avoid active and passive waste (ibid). Vogler et al. (2022) prove that central pharmaceutical procurement contributes not only to significant economic and social benefits such as lower prices and savings for the public sector but also transparency, equity, and effective governance.

On the other hand, in some cases, centralization leads to a decrease in the flexibility of purchasing options (Baldi, 2015). Aboelazm et al. (2018) warn about the potential monopolization of the pharmaceutical market when talking about centralized medical procurement as only one agency on the national level has full control over tender mechanisms. In addition, if the degree of centralization mechanism allows the involvement of more than one main party there can occur potential waste of public resources as the process is complex, it requires the involvement of different stakeholders that vary from international organizations and pharmaceutical companies to ministries and public procurement agencies (Aboelazm, 2018). Furthermore, Greer et al. (2022) determine the centralization between and within governments as an important condition in the response to public health issues, including pharmaceutical procurement. The transition of power within core officials in the government or between central and local governments impacts the extent to which the executive bodies are ready to take responsibility for providing necessary goods and services for the population (Greer, 2022). Thus, the pressure of responsibilities that should be an essential component for procurement agencies in order for them to function effectively may disappear due to the shifting of liabilities between different stakeholders involved in the process (ibid.). That is why Albano

et al. (2020) claim that in order to reach success in effective and transparent pharmaceutical procurement the degree of centralization should be taken into account after evaluating the capacity of public institutions. China is one of the countries that included CPMP in healthcare reform as it was expected to bring down the results (He, 2022). However, there is no evidence that centralized procurement was an effective way to reduce the price and increase competition among bidders.

Despite the controversial positions of researchers on centralization in pharmaceutical procurement, there is currently a tendency to create single state agencies responsible for providing medical institutions with the necessary materials and medicines. In this regard, the relevance of this issue remains high. Ukraine as a country that was chosen as a case study had introduced the centralization with establishment of the relevant government body in 2020. Therefore, it is important to understand the procurement system.

1.4. Ukrainian pharmaceutical procurement system

In most post-Soviet countries there was a tendency for public procurement to be controlled by the country's elites and present their financial and political interest (European Bank for Reconstruction and Development, 2017). This state of affairs has created significant issues such as nepotism, shadow funding, and other forms of corruption that led to a huge loss of taxpayers' money since a large part of the funding for government spending is coming from taxes. For instance, public procurement spending involves from 10 to 20 percent of GDP on average (Ibid.). According to the World Bank data (2015), the loss of state money allocated for procurement amounted to approximately 1,74 billion euros annually as of 2015.

After the revolution in 2014 and the choice of a course towards European integration, the EU conditionality became one of the main factors in reforming the public sector in Ukraine. It concerned the sphere of public procurement as well since it is an effective instrument for

reconsidering national strategic goals and fostering innovations (Baranovsky et al, 2020). For a lot of years, e-procurement has been a promising tool to increase the accountability and transparency of the system (Gelderman, 2006). In order to achieve the goal of the public procurement process – transparent and fair determination of the winner the system for the evaluation of tender offers should be developed using both price and non-price criteria (Vaidya, 2006 and Baranovsky, 2020). As mentioned above the EU conditionality has led to the enactment of the Ukrainian law on public procurement No. 922-VIII in 2015 that allowed the state buyers to look for the best bidder with the most cost-effective proposal using different indicators (Baranovsky 2020). To fix every decision that has been made on the governmental level a pilot of the project ProZorro was launched in February 2015 that has pushed to the public procurement reform. This platform presents an e-procurement system and involves not only government regulators but also civil society and businesses in a "golden triangle" of partnership for an effective and equal procedure (EBRD, 2017). It became even more relevant with the rise of the Europe 2020 strategy which has set an objective for public procurement to mitigate climate change by more conscious choices thus reducing greenhouse gas emissions and increasing energy efficiency by 20% (Baranovsky, 2020). This has added a new value approach to procurement and its impact on social and economic capital (ibid.).

Ukrainian law on public procurement that was introduced in 2015 regulates the main principles of procurement considering recommendations for building an effective mechanism from the international organizations (Kohler, 2016). These principles are competitive procedures, electronic procurement, thresholds, transparency and accountability, prohibition of discrimination and unfair competition, conflict of interest, complaints and dispute resolution, procurement planning, responsibilities of procuring entities, and exemptions (Ukrainian Law on Public Procurement, 2016). Hence, the following law regulates and determines steps to find the winner by evaluation of its tender offers based on the criteria established by the law

(Baranovsky 2020). Therefore, understanding and interpreting public procurement tenders is essential for good public resource management (ibid.).

1.5. Steps of centralization in Ukrainian pharmaceutical procurement

In order to optimize the system of public procurement in the medical sphere and save money that was allocated for the needs of the healthcare system the centralization of pharmaceutical procurement was introduced (Medical Procurement of Ukraine, 2020). The main aspects of this policy are similar to the international practice of creating a united organizational body, e-procurement systems development, assortment improvement, and quality assurance, by which corruption risks and spending can be reduced (Kohler, 2016).

This reform was implemented to save time and public funds. Until 2020, after the introduction of the ProZorro e-procurement system, all procurement plans had to be drawn up by individual medical institutions. Instead, with the advent of centralization innovation, centralized procurement organizations form teams of the best procurers, category managers, analysts, and lawyers. This approach has allowed for the distribution of responsibilities, so doctors are not involved in the bureaucratic issues of the hospital. Consequently, it allows to save state money and time which contributes to a more effective public healthcare system.

In this regard, two key executives were introduced during the policy implementation. These are the Ministry of Healthcare of Ukraine and the State Enterprise "Medical Procurement of Ukraine". Together they created a logistic cycle for distribution of medicine among the state hospitals.

Firstly, the Ministry verifies the nomenclature before the deadline each year – until the 1st of July. After that, the procedure includes information gathering with a deadline each year and is done by both state enterprises and the ministry. During this step local departments of

healthcare collect information from the healthcare institutions regarding their request and send by the 1st of October to the central bodies via electronic system MedData (Medical Procurement of Ukraine, 2020). The expert groups that comply with the Ministry of Healthcare evaluate the requests. In 45 days the third step takes place where the Ministry of Healthcare and the Ministry of Finance approve the budget program passports. The Ministry consents to the amount of necessary pharmaceuticals and both executives agree on technical conditions for medicines that are about to be procured. After all the necessary technical details are agreed upon, the state enterprise "Medical Procurement of Ukraine" becomes the main regulator of the procurement procedure. It carries out all the necessary procurements according to the law and records the steps and components of the procedure in the system Prozorro. This process takes up to 2,5 months followed by the signing of the agreement between stakeholders in 1 month after completing the procedure (Medical Procurement of Ukraine, 2020). The enterprise controls the supply and quality of pharmaceuticals as well. It is worth noticing that first the drugs are coming to the storage that belongs to the enterprise and only after the creation of the decree on the distribution of medicines to the administrative units the drugs are coming to the corresponding healthcare institutions (Medical Procurement of Ukraine, 2020).

Given the approved mechanism, the pharmaceutical procurement procedure is supervised by an expert committee and regulated by law, so the funds are distributed according to the needs of local healthcare facilities. In addition, time is saved, as the ProZorro e-procurement system registers tenders for the entire country at once, so there is a chance to increase the number of bidders and save money through a favorable offer.

It is worth noting that the centralization process is not yet complete, as the list of areas has been growing annually since 2020. For example, in 2020, the Ministry of Health issued a resolution on the procurement of pharmaceutical products in 14 areas, including chemotherapeutic drugs, medicines for the treatment of cancer, and cardiovascular and

neurological diseases (Medical Procurement of Ukraine, 2020). In 2021, the number of areas for public procurement increased to 19, and in 2022 - to 26 (ibid.). Due to Russia's full-scale invasion of Ukraine in February 2022, the full cycle of the procedure was impossible and has not yet been restored in some regions of the country where fighting is ongoing (ibid.). Therefore, the number of directions in 2023 decreased to 23 (ibid.).

The system seems to be in order and the cooperation between two main bodies should be regulated and functioned if everything is submitted by deadlines that are provided by the law. However, there are still risks and challenges that relate to logistics and the supplement. In addition, there are different types of procedures on the national level therefore deadlines for the procurement process can vary. It creates room for maneuvers and development of corruption mechanisms since for instance in the case of reduced procurement it is hard to follow the indicators that are used to assess the efficiency of the procurement system.

CHAPTER 2: RESEARCH DESIGN

2.1. Purpose of the study, research question, and hypotheses

According to the literature, centralization policy can be seen as either a step forward or a step backward, depending on its implementation and the control exercised by the state. Consequently, the purpose of this thesis is to investigate the impact of the introduction of centralization policy on the process of public pharmaceutical procurement in Ukraine. Despite the fact that the procurement cycle is constantly controlled by the expert commission according to the law on Public Procurement of Ukraine, the efficiency of the process and the fair and equal distribution of the state budget can still be hidden. Therefore, the research question is to understand **how centralization influences the process of pharmaceutical procurement.**

In this regard, the previous studies propose different tools for measuring public sector efficiency, including the healthcare sphere. As a result, various indicators that help assess risks, analyze the trend of reforms and changes, and therefore study corruption in public procurement were introduced over the years. Cingolani et al. (2020) proposed some of the indicators. These are value-for-money, decision period timelines, and competitiveness of tenders (Cingolani, 2020). When evaluating value for money, it is possible to record information regarding the cost of the purchased goods (ibid.). The number of bids submitted to the tender demonstrates the tender's competitiveness (ibid.). Last but not least, decision-making speed demonstrates the effectiveness of the procurement process due to the fact that it has an impact on competitiveness and the result of the procurement process.

In order to do this I analyzed the data that was provided by the Associate Professor of the Department of Public Policy at Central European University Mihaly Fazekas for academic purposes only. The data was scraped from the Prozorro website. It contains information about

tenders that were registered in the following system from 2015 until 2022. The total number of observations is 52649. The main characteristics to describe the procurement process include the ATC product code, ATC product name, CPV names, and information about buyers and bidders such as country, name, and code. In addition, it consists of the price of the pharmaceutical good, as well as the number of bids that participate in the tender. The data provides details about the estimated and final price of each lot and the timeline of the tender process that can be calculated as a difference between the date of the first call and the deadline for bidders to participate in the tender.

So to study the impact of centralization on pharmaceutical procurement in Ukraine I looked at how the indicators that are known to be effective when looking at the purchasing process are changing over time. As was mentioned before, in the case of measuring value for money, the information about the price of the purchased products can be captured. Competitiveness for tenders shows the number of bids submitted to the tender. However, there are several limitations in the use of the dataset in this study. This includes the unit price. Since different pharmaceutical products that are about to be purchased are registered using different unit (e.g. package, box, single unit) such indicator as value for money was not considered in this research.

Considering the purpose, and the instruments to answer the research question that were mentioned above, two hypotheses were formulated:

H1: The centralization increases the number of bidders that participated in tender procedures;

H2: The centralization decreases the decision-making speed.

The increase in the number of bidders due to the introduction of centralization policy is considered to lead to more effective process of pharmaceutical procurement because it is believed that the higher competitiveness can bring wiser distribution of money due to the potentially favorable deal. The decrease in the decision-making speed can create an opportunity for more bidders to apply for a tender due to the complexity and size of the market. However, it is worth noting that there are other factors that can regulate the efficiency of procurement procedures. That is why, the low decision-making speed can create delays in some cases.

2.2. Data pre-processing

Considering the limitations of the dataset and the desire to concentrate on the impact of the centralization policy on procurement that has been characterized by the indicators mentioned above, the data has been pre-processed. Since the price is introduced for different units it made it challenging to analyze over time. In this regard, it was decided to focus on competitiveness and decision-making timelines.

In order to study centralization policy that was introduced in 2020 I decided to make a comparison of two groups – before and after centralization. Firstly, the variables of interest were filtered in the new dataset, thus it consisted of ATC code, buyer and bidder information such as name, location, tender year, number of bidders, the date of tender first call, and deadline, type of the tender national procedure.

Moreover, two additional variables were created – centralization and number of days. Centralization was introduced in the form of a dummy variable where 0 means no centralization policy and 1 – the introduction of the latter. As the following policy was introduced in 2020, all tenders that were processed before that were considered as the ones without centralization implementation. Thus, two groups – control (before the centralization) and treatment (after the centralization) were formed where the control group contained data from 2015 until 2019, and

the treatment group was presented with data from 2020 until 2022. The control group consisted of 16248 observations. The treatment group – from 2020 until 2022 contains 34233 observations. As can be seen, the clear and significant imbalance in the size of the groups is present. It can be explained by the step-by-step development of the ProZorro database since each year the number of tenders that were registered increased. In addition, the COVID-19 pandemic had a major impact on the amount of requests from local healthcare institutions and consequently pharmaceutical procurement system itself. As before-after comparison was chosen to be the main method there was a need to reduce the impact of COVID-19. For this, drugs that were used in the protocol for COVID-19 treatment were removed from the dataset. The identification of the following medicines was made by using the ATC (Anatomical Therapeutic Chemical Classification System) code – an international classification system of pharmaceuticals. The list of the drugs that were deleted in order to reduce the COVID-19 factor can be found in Annex 1. It is worth noticing that the common procurement vocabulary (CPV) code that was present in the initial dataset as well, was not used because the following variable consisted a lot of errors.

In addition, in order to look at the decision-making speed the variable that shows the number of days of tender procedure was added. It was computing as the difference between the tender bid deadline and the first call for tender. It is worth noting that there were a lot of missing values for the bid deadline so additional cleaning of the data was made.

As was mentioned above, according to the legislation of Ukraine there are several types of tender national procedure. There were eight types of the national procedure which included: *open biddings, open biddings with publication in English, pre-threshold procurement, simplified procurement procedure, negotiations, negotiations on the urgent basis, tender report regarding the Ukrainian war* (introduced in 2022), and *tender report procedure*. Thus, in order

not to receive biased information regarding the competitiveness and decision-making timeline, I stratified the data based on the procedure type and thus received eight groups.

After the cleaning of the data by removing the COVID-19 factor, two groups for before-after comparison were formed. The group with no centralization consisted of 5795 observations and the group with the introduced centralization policy had 5840 observations.

2.3. Data analysis

Groups that were previously stratified were visualized with the purpose of seeing the outliers of the number of days and the number of bidders who participated in the tender. After capturing outliers and distribution of the observations, data that was previously divided into before and after groups based on the presence of the centralization policy was analyzed. Firstly, I compared the average values for the dependent variables in both groups and compared them using a t-test. Secondly, the linear regression was run to see the relationship between the centralization and the number of days and bidders.

In order to address confounders, and estimate the causal effects, the non-parametric method such as propensity score matching was implemented. This type of matching was chosen because it shows the balance between the treatment and control group in addition to the probability of being treated based on the individual's covariate.

CHAPTER 3: RESULTS AND MAIN FINDINGS

R was used as software for the analysis and visualization of observations of interest in the pharmaceutical procurement dataset. The goal of this research was to see the difference in the number of bidders that participated in tenders and the number of days from the first call until the tender bid deadline between groups with and without centralization. For this the following steps were made: firstly, the means of two variables of interest were compared in two groups and the t-test was performed. Secondly, in order to see outliers and the impact of the national procedure type the data was stratified and visualized. After that, the linear regression was run to build the model that shows the relationship between dependent variables (number of days and bidders) and explanatory variable (centralization) including control for covariates. Finally, the difference-in-difference was used to compare changes in the outcome variables over time.

3.1. The comparison of means and the t-test

As was mentioned before, there were a lot of missing values in the date of the deadline for bidders. In this regard after creating the "days" variable Nas occurred. In order to calculate the mean of days variable the NAs were removed. As a result, with the average number of days 16,89093 for the group before the centralization and 18,45312 for the group after the introduction of centralization, there was a statistically significant difference in means with a p-value close to 0. At this stage, it can be assumed that there is a relationship between centralization and decision-making speed.

As for the number of bidders that participated in the tender process the average for the group without centralization is 1,930453 and 1,31459. The results of Welch two-sample t-test show a statistically significant difference in competitiveness between the two groups.

However, considering the complicated nature of the procurement process it is important to take into account different types of procurement procedures. In this regard, the data was stratified based on the national procedure type.

3.2. Stratification

As it was mentioned above, it is crucial to evaluate several procurement procedures given the circumstances under which the procurement process is being taken. In this case, the data was divided into groups according to the national procedure type.

As for the distribution of the number of days four groups were formed based on the national procedure type – open biddings, open biddings with publication in English, pre-threshold procurement, and simplified procurement procedure. The graph below shows the distribution (figure 1).

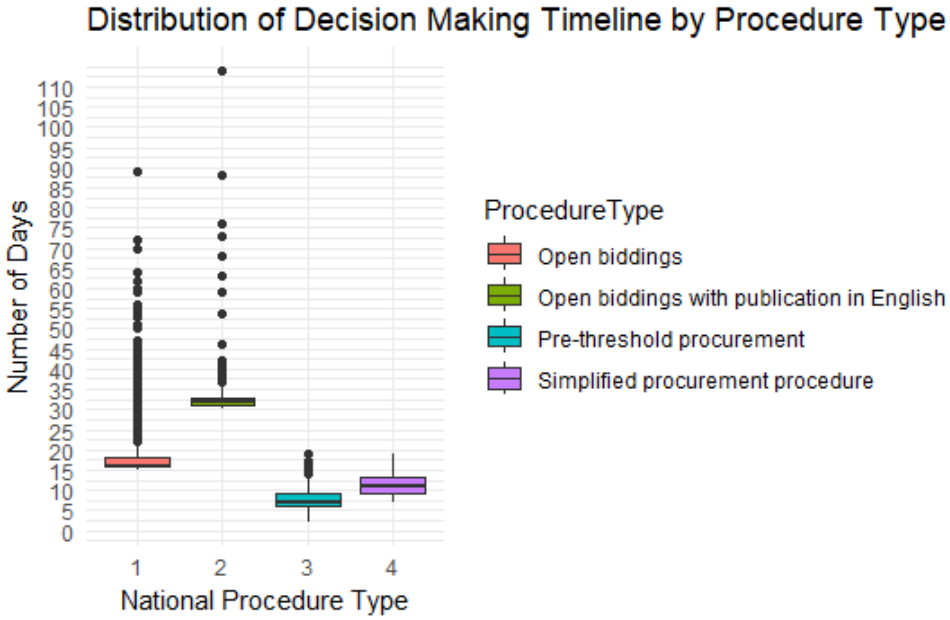

Figure 1. The distribution of the number of days in procedure-type groups

Source compiled by the author

As can be seen in the graph above, there are outliers in the number of days that relate to the specific national procedure type – open biddings and open biddings with publication in English. This can be explained by the fact that these types of procedures include a lot of requests and usually are done according to the procedure with indicated deadlines and with the Ministry of Healthcare and state enterprise in charge. Meanwhile, the average decision-making speed in the pre-threshold procurement and simplified procurement procedure groups are lower and have fewer outliers. It can happen due to the fact that these types of procedures are happening on an urgent basis.

In order to define outliers for the number of bids the graph that shows the distribution of the number of bids by the national procedure type was built.

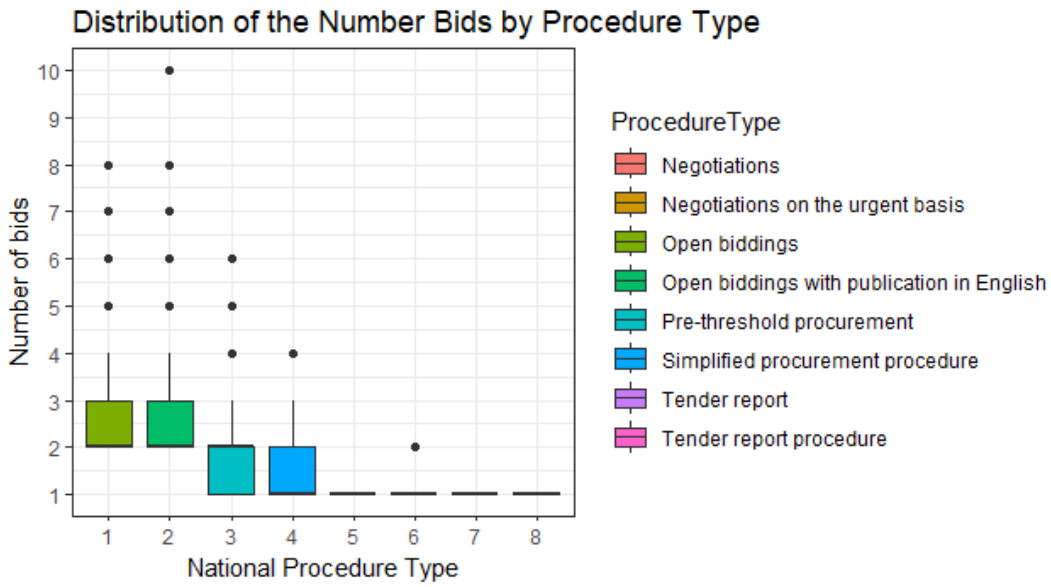

Figure 2. The distribution of the number of bids in procedure-type groups

Source compiled by the author

The graph of the distribution of the number of bids in the procedure-type groups shows several outliers as well as in the case of the day distribution. As can be noticed, there are additional strata that occur in the form of tender reports, negotiations, and negotiation

procedures on an urgent basis besides open biddings, open biddings with publication in English, pre-threshold procurement, and simplified procurement procedures. Like in the earlier instance, the outliers are mostly present in the procedures with open biddings and open biddings with publication in English. This can be also explained by the fact that these processes involve numerous requests and are completed in accordance with the procedure, with dates specified and the Ministry of Healthcare and the procurement agency in control. In addition, there are a high numbers for the number of participants in the tender procedures with pre-threshold and simplified procurement procedures. In this regard, it can be justified that despite the fact that the decision-making timeline is shorter for these types of national procedures than for open biddings, the competitiveness level still is considered to be comparatively increased. As for other types of national procedures, the number of bidders remains low almost in every case because some of these procedures are not finalized yet.

3.3. Linear regression models

In order to see the relationship between the number of days as well as the number of bidders and the introduction of the centralization policy two linear regression models were built using the following formulas:

$$(1)\ \text{Number of days} = \beta_0 + \beta_1 * \text{Centralization} + \varepsilon$$
$$(2)\ \text{Number of bidders} = \beta_0 + \beta_1 * \text{Centralization} + \varepsilon$$

In addition, considering the results of the stratification the regression model that included number of bidders as a dependent variable and centralization and the number of days was built.

$$(3)\ \text{Number of bidders} = \beta_0 + \beta_1 * \text{Centralization} + \text{Number of days} + \varepsilon$$

The summary of the three regression models can be seen in the table below.

Table 1. The summary of 3 regression models

	Model (1)			Model (2)			Model (3)		
Predictors	*Estimates*	*CI*	*p*	*Estimates*	*CI*	*p*	*Estimates*	*CI*	*p*
(Intercept)	17.70	17.43 – 17.98	**<0.001**	2.08	2.06 – 2.11	**<0.001**	1.98	1.92 – 2.04	**<0.001**
centralization	1.86	1.41 – 2.30	**<0.001**	-0.51	-0.55 – -0.48	**<0.001**	-0.33	-0.37 – -0.28	**<0.001**
days							0.03	0.03 – 0.04	**<0.001**
Observations	5738			11635			5738		
R^2 / R^2 adjusted	0.012 / 0.012			0.069 / 0.069			0.100 / 0.100		

Source compiled by the author

From the first regression model it can be seen that there is a positive relationship (1,86) between centralization and the decision-making timeline. It means that during the centralized procurement, the difference between the dates of the first call of the tender procedure and the deadline for bidders increases. In turn, the second regression model that demonstrates the relationship between the number of bidders that participate in tender and centralization shows negative results (the coefficient is -0,51). It indicates that centralized procurement decreases the number of bidders. In addition, the regression model that include the number of days as an additional independent variable also demonstrates the negative coefficient (-0,33) between the competitiveness indicator and centralization. In all cases p-value is less than 0,001 which make the results of regression statistically significant.

The propensity score matching was additionally used in order to check the results of the regression analysis and control for confounders.

3.4. Propensity Score Matching

In order to control for covariates, the propensity score matching was implemented. Using the R package "*MatchIt*" two groups – before and after centralization, were compared. First of all, propensity scores including number of bidders as covariate were estimated. Since the number of obserbations in control and treatment groups were unequal even after removing the Covid-19 factor and there were fewer control units than treated, not all treated units (45) got a match.

Table 2. The summary of the matched data

Sample Sizes	Control group	Treated group
All	5795	5840
Matched	5795	5795
Unmatched	0	45
Discarded	0	0

Source compiled by the author

In order to compare the outcomes that are measured in the number of bidders participating in the tendering procedure the matched data was analyzed. For the analysis of the matched data the procedure type was added as an additional covariate.

$$(1)\ \text{lot\_bidsCount} \sim \text{centralization} + \text{ProcedureType} + \varepsilon$$

The results of the model are summarized in the table below.

Table 3. The summary of the analysis of the matched data

	lot_bidsCount		
Predictors	*Estimates*	*CI*	*p*
(Intercept)	1.08	1.03 – 1.13	**<0.001**
centralization	-0.18	-0.20 – -0.15	**<0.001**
ProcedureType [Negotiations on the urgent basis]	0.07	-0.13 – 0.28	0.483
ProcedureType [Open biddings]	1.41	1.35 – 1.46	**<0.001**
ProcedureType [Open biddings with publication in English]	1.75	1.68 – 1.81	**<0.001**
ProcedureType [Pre-threshold procurement]	0.78	0.72 – 0.85	**<0.001**
ProcedureType [Simplified procurement procedure]	0.41	0.33 – 0.49	**<0.001**
ProcedureType [Tender report]	0.10	0.01 – 0.19	**0.038**
ProcedureType [Tender report procedure]	0.04	-0.01 – 0.10	0.120
Observations	11590		
R^2 / R^2 adjusted	0.566 / 0.566		

Source compiled by the author

As can be seen from the table above, centralization still reduces the number of bidders as was shown in the regression model previously. However, the coefficient decreased from -0,51 as it was demonstrated in regression analysis to -0,18. Also, it can be seen from the summary that the dependence of number of bidders on centralization can change according to the procedure type. Hence, the highest number can be seen in the case of an open bidding procedure with publication in English (1,75) and the lowest can happen in the case of a tender report procedure (0,04).

3.5. Limitations

The results should be considered with some limitations. First, even after removing the covariate of covid by removing medications used under covid treatment protocols from the dataset, the final number of observations in the group with and without centralized policies was

still unbalanced. As a result, some of the treatment group was not matched to the control group. Second, because almost 50% of the cases in the updated cleaned dataset did not have a date for the application deadline, the comparison was not conducted taking into account the failure to submit a tender. In addition, it is worth noting that the dataset contains information collected since the launch of the ProZorro e-procurement website. Therefore, as the e-procurement system and mechanisms evolved, information on tenders was added over time. Moreover, it is needed to take into account the impact of type of the procedure as well as the Russian full-scale invasion in 2022 that could change the order of the pharmaceutical procurement.

CHAPTER 4: DISCUSSION

Thus, the results show that the introduction of a centralized policy leads to a change in the indicators used to assess the efficiency of the public procurement mechanism. The indicators analyzed – the number of days from the start of the tender procedure to the deadline for submission and the number of applications for participation in the tender - responded differently to centralization. In the case of the speed of decision-making, centralization had a positive impact on the number of days. Thus, the number of waiting days in the analyzed group increased with the introduction of the centralization policy. On the contrary, the innovation reduced the number of bids during a separate procurement procedure, which did not confirm our hypothesis mentioned above.

4.1. Too fast or too slow: Is the centralization helpful?

This question arises because as it was indicated in the literature review centralization brings the coordination from above to the procurement process. In the case of Ukraine, the process of collecting information from the local healthcare institutions took about half a year in peaceful times (MPU, 2023). In this regard, considering the amount of requests the larger number of days for the tender procedure can be helpful because it gives an opportunity to coordinate the process efficiently and establish standardized timelines and tasks. Moreover, the increased number of days can increase predictability for bidders in case if timelines are standardized. As a result, more bidders can participate in the procurement procedure. In addition, during longer decision-making process the negotiating period can be enhanced by involving more bargaining power (Stritch, 2020). In this regard, a longer negotiation period can bring advantages for both suppliers and buyers as it allows for more in-depth discussions, adjustments, and clarifications from the buyer's and supplier's side. It is happening due to the

well-developed and researched proposals which both sides have a chance to study and make win-win decisions. It is worth mentioning that there can be an improvement in regulatory and legal compliance from bidders and buyers because of the increased timeline. Besides, the principles of good procurement are promoted by expanding the period between the first call and the deadline as there is more equal access for suppliers to participate (World Health Organization, 2009). As a result, centralization can improve contract conditions by extending the decision-making process.

On the other hand, too long waiting time can lead to risks inherent in the public procurement process. For example, the plot that shows the distribution of the number of days based on the national type of procedure, shows that the longest waiting time was 107 days, which may pose a risk of disrupting the procurement procedure. It may also entail risks of corruption and nepotism in case of long waiting times (ibid.).

Therefore, to further evaluate the impact of centralization, it is necessary to consider in more detail the requests from local healthcare facilities and the percentage of different types of national procurement procedures. During the martial law, public procurement procedures stipulated by law may be modified and often accelerated, which complicates the process of assessing the risks of corruption in pharmaceutical procurement (MPU, 2023).

4.2. United in competition: the centralization and competitiveness

The findings in the study of the impact of centralization on competition, measured in terms of the number of bids, dispelled the hypothesis that centralization policies increase the number of bids for a tender. As noted above, such results may be related to different types of procurement. At first, it can indicate the negative impact of centralization on the procurement process. This may happen because of the limited competition as centralization can possibly reduce the number of bidders due to the complexity and size of the request that comes from the

centralized procurement body (Cagno, 2011). In addition, by increasing the size of the orders the automatic occurrence of barriers can happen (Ng, 2010). Potentially small pharmaceutical companies cannot enter the competition because of their capacity to supply the buyer with the required amount of pharmaceuticals (ibid.). As a result, market access and innovation are limited and the competitive landscape is tilted in favor of well-established industry giants. Consequently, there can be no place for the technologies and innovations as a limited number of bidders enter the competition. This lack of innovation may cause drug research (including national ones) and procurement procedures to stagnate, which will ultimately have an impact on the standard and diversity of pharmaceutical items on the market. All points mentioned above can lead to the monopolistic behavior of the pharmaceutical market which is very dangerous as it can cause high prices on medicines that are life-necessary. Like in the previous case with the impact of centralization on the decision-making speed, few participants in the tender procedure can be a threat to transparency and lead to corruption as the pressure on procurement officials to establish informal and unethical connections can be increased.

CONCLUSIONS

To conclude, public procurement in the sphere of healthcare remains a big part of the expenditures that are allocated from the state budget in both high-; and low-income countries. Accordingly, in order to efficiently allocate the resources provided by the state, policymakers are searching for effective interventions in order to control the budget and distribute medicines on a fair and transparent basis. Centralization was proved to be an evidence-based innovation for increasing the efficiency of public pharmaceutical procurement in many countries around the world.

Ukraine is not an exception. After the introduction of the Law on Public Procurement as a part of the EU conditionality and the development of the e-procurement system ProZorro centralization became the next step in improving the pharmaceutical procurement process. In addition, as a sign of progress, centralized pharmaceutical procurement has the potential to improve the procurement process's key performance indicators. The centralized reform that Ukraine enacted in 2020 was intended to promote openness and fairness while streamlining operations, increasing competitiveness, and speeding up decision-making.

To control the system and minimize corruption risks such indicators as value-for-money, decision-making speed, and competitiveness were proven to be informative. The results of this research demonstrated the impact of centralization on the competitiveness level and the decision-making timelines.

After the comparison of two groups using regression analysis and propensity score matching there was identified statistically significant difference in the number of days of the tender procedure. This means that centralization decreases the decision-making speed.

However, there was no positive impact of the policy on competitiveness which was introduced in the number of bids.

The increase of the period for the decision-making timeline due to the centralization can have both negative and positive effect on the efficiency of the pharmaceutical system depending on the procedure type and other circumstances. In contrast, the negative relationship between centralization and the number of bids can put the procurement system at the corruption risk since the limited amount of participants leads to monopoly, lack of innovations, and as a result higher prices for pharmaceuticals.

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