A Kraljic and competitive rivalry perspective on hospital procurement during a pandemic (COVID-19): a Dutch case study

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Abstract

Purpose – Procurement professionals widely use purchasing portfolio models to tailor purchasing strategies to different product groups' needs. However, the application of these approaches in hospitals and the impact of a pandemic shock remain largely unknown. This paper aims to assess hospital purchasers' procurement strategies during the COVID-19 pandemic, the effects of factor-market rivalry (FMR) on strategies and the effectiveness of purchasing portfolio categorizations in this situation.

Design/methodology/approach – This qualitative study of hospital purchasing in the Netherlands is supported by secondary data from official government publications. Semi-structured interviews were conducted with 13 hospital purchasers at large hospitals. An interpretative approach is used to analyze the interviews and present the results.

Findings – The findings reveal that product scarcity forces purchasers to treat them as (temporary) bottleneck items at the hospital level. The strategies adopted largely aligned with expected behavior based on Kraljic's commodity management model. Adding the FMR perspective to the model helped to further cluster crisis strategies into meaningful categories. Besides inventory management, increasing supply, reducing demand and increasing resource coordination were the other common strategies. An important finding is that purchasers and governments serve as gatekeepers in channeling FMR, thereby reducing potential harmful competition between and within hospitals.

Social implications – The devastating experience of the COVID-19 pandemic is unveiling critical weaknesses of public health-care provision in times of crisis. This study assesses the strategies hospital purchasers apply to counteract shortages in the supply chain. The findings of this study emphasize the importance of gatekeepers in times of crisis and present strategies purchasers can take to assure the supply of resources.

Originality/value – No research has been conducted on purchasing portfolio models and FMR implications for hospitals during pandemics. Therefore, the authors offer several insights: increasing the supply risk creates temporary bottleneck strategies, letting purchasers adopt a short-term perspective and emphasizing the high mobility of commodities in the Kraljic commodity matrix. Additionally, despite more collaboration uncovered in other studies regarding COVID-19, strong rivalry arose at the beginning of the pandemic, leading to increased competition and less collaboration. Given such increased FMR, procurement managers and governments become important gatekeepers to balance resource allocation during pandemics both within and between hospitals.

Keywords Pandemic, COVID-19, Factor market rivalry, Hospital procurement, Kraljic, Purchasing portfolio model, Kraljic matrix

Paper type Case study

Introduction

The world has experienced various natural disasters in the past decades, including floods, wildfires, hurricanes, earthquakes, tsunamis and pandemics. In 2020, the COVID-19 pandemic overwhelmed the world. As of the beginning of June 2021, over 177

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million people have been affected by the virus, up from only 1 million in April 2020 (ECDC, 2021). This overwhelmed health-care systems, especially at the beginning of the pandemic and the effective delivery of care to patients became a worldwide challenge (Leistner, 2020). Under these circumstances, the demand for critical medical equipment and supplies increased sharply. Besides higher demand, shortages resulted from production disruptions in the supply markets. The combination of increased demand and limited supplies caused a shortage of both key commodities in many countries, leading to poor health services in hospitals (Canada, 2020; Ivanov, 2020; OECD, 2020). Even in more advanced markets such as The Netherlands, the high demand and disrupted supply caused a shortage of personal protection equipment (PPE) and ventilators (Hart van Nederland, 2020; BNR Webredactie, 2020; De Volkskrant, 2020).

Equipment availability is directly related to the responsibility of public procurement professionals in hospitals and the difficulty of anticipating a pandemic (Raoul, 2007). Within the field, procurement professionals, including those engaging in public and private procurement, specialize in managing supply risk by establishing relations and using various risk mitigation strategies (Giunipero and Eltantawy, 2004; Zsidisin, 2003). Still, procurement departments were unprepared for such a rapidly growing competition for resources, a type of (hyper) competition termed factor-market rivalry (FMR) (Schwieterman and Miller, 2016; Ellram *et al.*, 2013; Markman *et al.*, 2009). Under the umbrella of purchasing strategies, this FMR has not been researched in either the hospital context or a pandemic supply shock. Hence, procurement strategies during the pandemic need to be analyzed in the context of factor market rivalry strategies, borrowed from the private sector. At the same time, researchers already argue that not all purchased materials should be managed similarly; purchasing usually requires differentiation and classification of the resources necessary for business continuation (Gelderman and Van Weele, 2003; Formentini *et al.*, 2019; Medeiros and Ferreira, 2018; Hesping and Schiele, 2016). The most frequently used model to capture this differentiation is the 2×2 Kraljic portfolio model (Kraljic, 1983). It categorizes products based on the profit impact (low/high) and supply risk (low/high) to deduce sourcing strategies, tactical recommendations and purchasing activities (Caniels and Gelderman, 2005; Van Weele, 2010; Kang *et al.*, 2018; Garzon *et al.*, 2019; Ghanbarizadeh *et al.*, 2019). However, the matrix's effectiveness in a hospital setting remains debatable, especially during pandemics. Portfolio models and related strategic differentiation of hospital products are scarcely researched, despite their wide application in practice, especially in The Netherlands. Therefore, the applicability of the Kraljic matrix remains questionable for hospital purchasers during times of high resource competition.

Accordingly, we analyze purchasing strategies in hospitals in the context of the pandemic's rapid impact and critically evaluate Kraljic (1983) in times of high FMR (Markman *et al.*, 2009) among hospitals. This leads to the following research questions:

RQ1. What procurement strategies are adopted by hospital purchasers during the COVID-19 pandemic?

RQ2. How do the Kraljic categorizations and strategic suggestions hold in a pandemic situation and in increased FMR?

This study makes three contributions to literature. First, the findings show that Kraljic's (1983) strategies hold up well during the pandemic. The results indicate that the "supply risk" dimension was considerably affected by COVID-19-induced scarcity, resulting mostly

in non-critical items becoming (temporary) bottlenecks. Second, applying the FMR perspective allowed us to understand hospital purchasers' actions more comprehensively in terms of influencing demand need and resource access via external- and internal-focused actions. The assumptions based mostly on the industry-sector resource rivalry matrix (Schwieterman and Miller, 2016; Ellram *et al.*, 2013; Markman *et al.*, 2009) appeared to be highly applicable to the purchasing of scarce resources by hospitals during a pandemic. Finally, this study found that both, the Dutch Government and the procurement professionals in hospitals, play an active role in reducing harmful competition and improving collaboration within and between health-care organizations during times of supply shocks. Thereby, we emphasize the importance of procurement authorities actively engaging as gatekeepers during pandemics. In this context, some previously non-critical items acquired a strategic character at the inter-hospital level due to government intervention and group-purchasing initiatives. Scholars studying group-purchasing organizations and collaborative procurement (Saha *et al.*, 2019; Yang *et al.*, 2017; Burns, 2014; DeRoeck *et al.*, 2006) are advised to continue studying the circumstances leading to these ad-hoc strategic collaborations and the role of gatekeepers in times of crisis.

After this short introduction regarding the context, research question and intended contributions, the paper continue with the theoretical background on portfolio management and FMR.

Theory: Kraljic matrix and factor market rivalry framework as relevant research lenses

The purchasing portfolio approach: Kraljic (1983) as the most predominant portfolio model to determine procurement strategies

A purchasing portfolio model is an analytic and diagnostic tool of a prescriptive nature used to identify different items and categories (Kraljic, 1983; Olsen and Ellram, 1997; Caniels and Gelderman, 2005). The analysis of categories and the resulting strategies are reflected in securing supply, managing the relationship with suppliers more efficiently and improving bargaining strategies (Kraljic, 1983; Olsen and Ellram, 1997; Caniels and Gelderman, 2005; Kang *et al.*, 2018). The most popularly applied portfolio model is the Kraljic (1983) model, also known as the Kraljic matrix. Several different purchasing portfolio models have been developed based on the Kraljic matrix (Olsen and Ellram, 1997; Drake *et al.*, 2013; Segura and Maroto, 2017; Ghanbarizadeh *et al.*, 2019). For example, Ferreira (2014) applied it in civil construction, Ghanbarizadeh *et al.* (2019) in commercial construction and Medeiros and Ferreira (2018) in health care. An overview of studies applying a version of the Kraljic (1983) model can be found in Table 1. Nevertheless, the Kraljic matrix remains the dominant portfolio model and helps classify procurement professionals' strategies in various settings (Gelderman and Semeijn, 2006; Caniëls and Gelderman, 2007; Knight *et al.*, 2014). Due to its scientific prominence, the Kraljic (1983) portfolio model has been actively promoted for decades in practice. Especially in the later-discussed context of The Netherlands, guidelines and training material have been published by various institutions, for example, by the ministry of economics (PIANOo, 2009) and the Dutch municipalities' association (VNG, 2014).

In Kraljic's purchasing portfolio model, products are categorized according to two dimensions: profit impact and supply risk (Kraljic, 1983). Profit impact is defined "in terms of the volume purchased, percentage of total purchase cost or impact on product quality or business growth" (Kraljic, 1983, p. 112). In contrast, supply risk is defined "in terms of availability, number of suppliers, competitive demand, make-or-buy opportunities and storage

Table 1.
Studies on purchasing portfolio models (a selection)

Paper	Goal	**Difference from original Kraljic (1983) matrix**
Ghanbarizadeh *et al.* (2019)	A purchasing portfolio model for the commercial construction industry	Examines the relations among the criteria and determines the degree of influence and permeability of each of them. This extended portfolio model offers more realistic solutions to today's projects than the previous ones did
Medeiros and Ferreira (2018)	An approach to managing a purchasing portfolio for a large Brazilian hospital, using Kraljic's model	A tool that analyzes purchasing objectively and avoids considering only economic measures, identifying different item categories requiring special management
Segura and Maroto (2017)	Developing a system for qualifying providers and segmenting suppliers	New strategic and critical dimensions to classify suppliers using historical and reliable data needed in a system to support decision-making at operative, tactical and strategic levels
Ferreira (2014)	Application of the Kraljic (1983) model	Classifying construction items in the Kraljic (1983) matrix
Knight *et al.* (2014)	Investigating purchasing skills' importance for distinct purchase situations	Knowledge and skills on purchasing portfolio management and its application in the strategic development of purchasing in an organization and on human resource management in the purchasing function
Drake *et al.* (2013)	Portfolio model to classify products into agile and lean, agile, lean, non-critical	Two new dimensions: lean and agile
Padhi (2012)	Methodology to classify and position commodities in the Kraljic (1983) model	Mapping works and services in the quadrants of Kraljic
Lee and Drake (2010)	Portfolio model based on Kraljic (1983) model to evaluate the dimensions of competitive priorities and company size	Two new dimensions: risk in the supply market and value
Park (2010)	Portfolio model based on Kraljic (1983) model and Olsen and Ellram (1997) to support the management of relationships with suppliers	Relative supplier attractiveness, relationship attractiveness
Olsen and Ellram (1997)	Portfolio model for evaluating the relationship with suppliers, considering the dimensions of the supplier's attractiveness and the intensity of the relationship	Supplier attractiveness and intensity of the relationship

risks and substitution possibilities" (Kraljic, 1983, p. 112). The two dimensions create four distinct quadrants: non-critical, leverage, bottleneck and strategic items. Each quadrant offers detailed descriptions of the best strategies applicable to the corresponding product groups. This typically implies forming partnerships for strategic products, ensuring supply for bottleneck products, exploiting power for leverage products and ensuring efficient processes for non-critical products (Caniels and Gelderman, 2005; Kraljic, 1983). Table 2 presents an overview of the matrix and the strategies per quadrant suggested by Kraljic (1983).

Even though the Kraljic matrix might, at first sight, suggest a static approach in approaching product groups, products can change in classification by either external influences or purchasers' actions (Gelderman and Van Weele, 2003). For instance, standardization of products can change them from a bottleneck commodity to a non-critical commodity, as more suppliers can be approached with standardization. Similarly, products can be bundled, increasing their profit impact and changing non-critical items to leverage items. Resultantly, buyers often try to shift product classification in their favor (Gelderman and Van Weele, 2003). Therefore, until now, scholars have addressed changing product classification most often in the context of creating advantages for purchasers (Cousins *et al.*, 2008; Gelderman and Van Weele, 2003; Monczka *et al.*, 2010) instead of sudden changes in demand/supply induced by external events such as a pandemic. Thus, the impact of the COVID-19 pandemic offers a unique natural experiment to assess the impact of a large-scale event inducing rapid changes in the Kraljic (1983) classification of products and the related strategies used by purchasers. Yet, an analysis through the lens of the Kraljic matrix might not be sufficient in an environment with high resource competition, as will be further discussed in the next section, introducing the FMR framework.

Beyond Kraljic: a factor-market rivalry perspective on COVID-19 strategies of hospital purchasers

As already described earlier, the COVID-19 pandemic increased the competition for valuable resources in the health-care sector (Canada, 2020; Ivanov, 2020; OECD, 2020). In literature, this type of resource competition has been mainly researched in industrial contexts and is coined "factor-market rivalry" (Markman *et al.*, 2009; Pulles *et al.*, 2016; Ellram *et al.*, 2013; Schwieterman and Miller, 2016). The unit of analysis in FMR research is the resource itself such as raw material, human resource, service, product or component (Schwieterman and Miller, 2016). Therefore, it is immaterial whether the competition entails actual upstream

Profit impact	High	**Leverage items** *Purchasing approach:* Exploitation of full purchasing power. Vendor selection. Product substitution. Targeted pricing strategies/negotiations. Contract/spot purchasing mix. Order volume optimization	**Strategic items** *Purchasing approach*: Accurate demand forecasting. Detailed market research. Development of long-term supply relationships. Make-or-buy decisions. Contract staggering. Risk analysis. Contingency planning. Logistics, inventory and vendor control
	Low	**Non-critical items** *Purchasing approach*: Product standardization. Order volume monitoring/optimization. Efficient processing. Inventory optimization	**Bottleneck items** *Purchasing approach*: Volume insurance (at cost premium if necessary). Control of vendors. Security of inventories. Backup plans
		Low Supply risk	High

Table 2. Kraljic strategies: classifying purchasing materials requirements (based on Kraljic, 1983, p. 112)

competition (direct competitors), meaning that organizations that are not competitors can still compete for the same resources. A common effect of active FMR is that an organization's financial performance is affected by raising the resource's costs. Another effect of FMR is that it can change the allocation of the suppliers' resources, especially in times of capacity constraints and scarcity (Lavie, 2006; Pulles *et al.*, 2014). Both circumstances have been described in the literature regarding COVID-19 (Cain, 2020; OECD, 2020), indicating that the pandemic is inducing strong competitive dynamics to certain products. With its special focus on these competitive dynamics and FMR perspective might add valuable insights not captured by the Kraljic matrix.

Similar to the Kraljic matrix, the FMR framework (Table 3) clusters and classifies strategies that purchasers can adopt in 2 × 2 matrices (Schwieterman and Miller, 2016). The two dimensions of the matrix focus on two characteristics: internal vs external domain of action and resource access vs demand-reduction focus. On one hand, the horizontal dimension of the matrix (Table 3) distinguishes between changing a firm's internal operations to fit the external environment better (Thompson, 1967) and modifying the external environment to fit the firm's operations better (Oliver, 1991). On the other, the vertical dimension (Table 3) distinguishes between improving access to the resource (Pulles *et al.*, 2014) and reducing the resource's importance (Pfeffer and Salancik, 2003) by changing the demand for it. As mentioned earlier, this analysis stretches beyond the Kraljic matrix, as the FMR assessment allows for a more fine-grained assessment of purchasers' strategies when facing increased competition for resources. A combination of the strategies described in Table 3 is expected to be applied in the COVID-19 crisis, yet the exact role of procurement managers in implementing and facilitating these strategies is unknown.

To summarize, next to the assessment of the Kraljic matrix strategies, the FMR framework will be used to cluster the purchasing strategies used by hospital procurement managers into different quadrants. The next section continues with the contextual analysis

Table 3.
FMR matrix (Schwieterman and Miller, 2016, p. 107)

Purpose of action	Domain of action: Internal	Domain of action: External
Improve resource access	*Internal resource enhancement* • Invest in employee training to enhance environmental scanning capabilities • Expand the scope of competitor analysis by including more diverse managerial perspectives • Develop an in-house capability to supply the resource (i.e. upstream or forward vertical integration) • Hold additional supplies of the resource if possible	*Crafting the resource environment* • Secure long-term contracts to guarantee resource access • Cultivate alternative sources of supply for the resource (i.e. identify alternative suppliers or distribution channels) • Work with supply chain members to improve the sustainability of the resource • Acquire a key resource provide
Reduce resource importance	*Internal resource replacement* • Identify a more available substitute for the resource • Alter internal processes to reduce the demand for the resource • Diversify product/services to reduce the importance of the customer segments using the resource	*Managing resource demands* • Convince customers that the products/services rendered from this resource are unnecessary • Work with supply chain members to develop an alternative to the resource • Work with other parties (e.g. universities, research centers) to find an alternative to the resource

of this study, which introduces the Dutch context and links this back to the theory described earlier.

Contextual analysis: the Dutch reaction to the scarcity and the potential influence on hospital procurement

The Dutch health-care system and the Dutch Government's influence on critical product management

The Dutch are known for their consensus-based and cooperation-based approach, apparent in many sectors, including the national health-care system (Van De Bovenkamp *et al.*, 2010). This so-called "Polder model" focused on many stakeholders is supposed to lead to higher acceptance of interventions in a crisis, but Berg *et al.* (2004) warn that undertaking concrete action might be slow. Context-wise, Dutch hospitals are mostly privately owned, operating on a not-for-profit basis to promote competition in the hospital market (Figueras *et al.*, 2005). The consequences of the consensus-based approach and the competition between privately owned (non-profit) hospitals are apparent in the Dutch approach to fighting the pandemic.

To understand the situation of hospitals during the pandemic, it is crucial to know the actions taken by the Dutch Government (on a broader scale) in fighting the effects of the pandemic. This context will be described chronologically. On January 24th, the Dutch Government undertook the first (public) action in response to COVID-19. On that day, the national "outbreak management team (OMT)" first met. In this meeting, the OMT requested both PPE usage for corona infection prevention and an inventory check of PPE by the ministry (van Dissel, 2020a). A week later, on January 31st, the minister of Health care spoke publicly about the Dutch preparedness for COVID-19 to the house of representatives for the first time: "As I informed you earlier, The Netherlands is well-prepared for any infections" (Rijksoverheid, 2020a, p. 1).

Two weeks later, on February 14th, the house of representatives first discussed a possible shortage of medical products. In the health-care industry, it was noted that "the demand for protective equipment has increased. With a few exceptions, suppliers are managing to meet the greatly increased demand, although some orders are sometimes delayed" (Bruins, 2020b, p. 1). However, according to the minister of health care, signs of shortages were immediately resolved: "In total, there is not yet an acute shortage of protective equipment for the whole of The Netherlands" (Bruins, 2020b, p. 2).

Another two weeks later, on February 28th, in response to the rising shortages and increasing demand, the OMT advised organizing regional distribution (through centers called the ROAZ) to assure the supply of mouth masks (van Dissel, 2020c). Two days later, the minister of health care emphasized the need for collaboration: "It is agreed that health-care institutions should first try to find a solution among themselves [. . .]. Only if a health-care institution is unable to solve the shortage, I can contact the relevant branch association and manufacturer to see if a solution is possible. However, the main thing is that hospitals first try to help each other" (van Dissel, 2020b, p. 1). Additionally, charts of the availability of PPE products were drawn and distribution plans were produced on a regional level (Bruins, 2020a). In the same week, the minister of health care consulted with the suppliers' representatives to promote cooperation with the Dutch health-care sector (Bruins, 2020a). From March 10th onwards, the regional coordination centers (ROAZ) were also purchased to meet the regional demand. A week later, on March 17th, an official national procurement call center for purchasing, redistribution and distribution of PPE was established (Rijksoverheid, 2020b). This constituted a central team of buyers from hospitals to serve as the central purchasing and distribution task force (Bruins, 2020c). In reaction to the media attention on shortages surrounding PPE, "the ministry has received hundreds of reports

from private individuals and companies that can supply protective equipment" (de Jonge, 2020, p. 2). Another week later, from March 23rd onwards, the national purchasing line was replaced with a national coordination center called the LCH, consisting of health-care professionals, purchasers, logistic suppliers, distribution partners, PPE suppliers and pro-bono consultancy experts (van der Kolk, 2020), thereby broadening the scope of coordination. Referring to the Dutch system's particularities, this response seemed to align with the consensus-based Polder model characterizing the Dutch health-care system.

As shown in the Dutch policy timeline on the COVID-19 crisis, it becomes apparent that the Dutch national response to the potential scarcity of products initially seems deficient. Only after widespread reports of scarcity was concise action initiated. Both consensus and cooperation among stakeholders in proceeding seemed important aspects in the response phase. Throughout the coordination initiatives, different stakeholders were combined to reach a consensus. Yet the warning by Berg *et al.* (2004) about the "Polder model" seemed accurate: the undertaking of concrete action appeared to be lagging while focusing on consensus and cooperation. It took the end of March to bring all relevant parties together comprehensively.

The actions presented above eventually led to creating new purchasing and coordination initiatives, which involved both ROAZ (translation: regional consultation acute care) and LCH (translation: the national consortium for aid). These pandemic-specific organizations were supposed to stimulate external collaboration in purchasing extra critical materials (LCH) and redistributing them (ROAZ).

Even though these initiatives seem successful at first sight, they offer little insights into the specific situation at Dutch hospitals and the manner in which hospital purchasers experienced the pandemic-induced supply shocks. The next section will link the previously discussed context to both the Kraljic matrix and the FMR framework in preparation for the empirical analysis.

Contextualizing and exploring Kraljic and factor-market rivalry in the hospital sector and the pandemic

Concerning the strategies proposed by the Kraljic matrix, recent publications on the COVID-19 pandemic emphasized the change of product category from the previously classified low-supply risk to high-supply risk (Cain, 2020). In this context, the OECD (2020) studied the consequences of the COVID-19 pandemic on a wider range of product groups, identifying several problems in supplying critical equipment to keep the hospital system running (OECD, 2020). Most prominently and in line with the previously described Dutch context, they identified an increased demand for PPE as problematic. These findings were supported by Cain (2020) and Baldwin and di Mauro (2020), who found that the increased PPE demand led to fewer imports/exports of equipment, more difficulties in transport, and thus an overall increased supply risk. The findings have been mirrored for other products and product categories such as disinfection products (Berardi *et al.*, 2020), ventilators (Grimm, 2020), oxygen supply (Kahn, 2020) and drug supplies (Roosmalen, 2020; Silverman, 2020) as well. With these findings so far, it is expected that the pandemic mainly increases the scarcity of products, influencing the "supply risk" dimension of the Kraljic matrix (Figure 1 and Table 2).

Regarding the pandemic's influence on the FMR matrix, a combination of the strategies described in Table 3 is expected to be applied by hospital purchasers when facing increased competition. Yet the exact role and degree of procurement managers, implementing and facilitating these strategies is unknown. It can, for example, be expected that certain strategies will be more strongly used than others.

As already described in the contextual discussions, the main strategy of the Dutch Government was to improve resource access for hospitals in response to calls for help by hospitals and health-care institutions to support them in this aspect. Correspondingly, it can

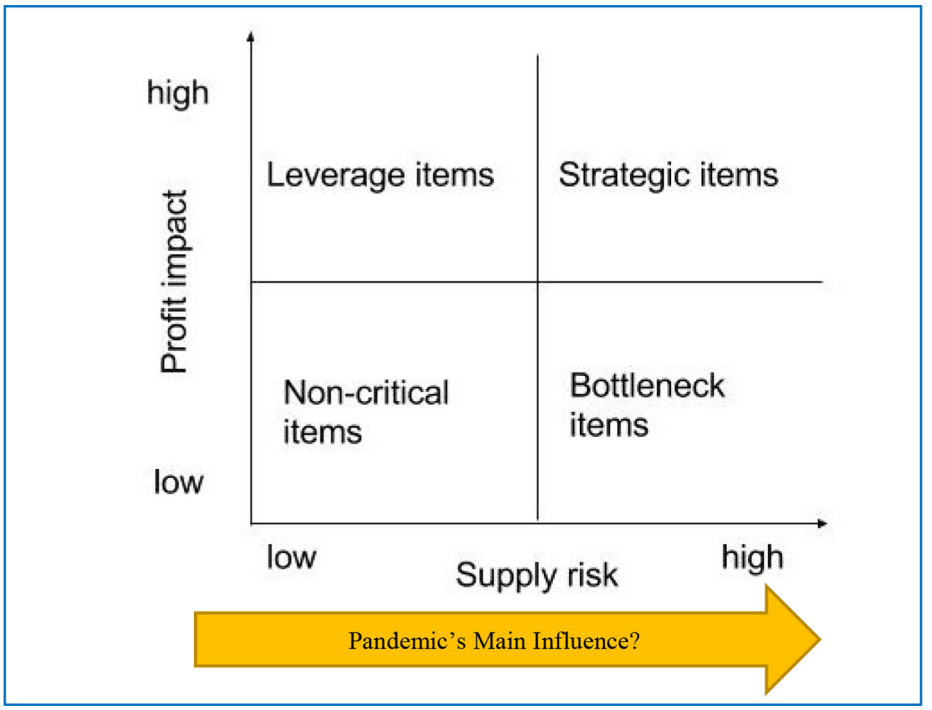

Figure 1. Potential impact of the pandemic on Kraljic matrix

be assumed that hospital procurement managers focused during the pandemic mostly on efforts regarding resource access (top quadrants of the FMR framework, Table 3 and Figure 2) and less on efforts to reduce the importance of the resource. Similarly, the contextual analysis showed that hospitals primarily focused on external domains of action, including the source of alternative suppliers such as the government. Accordingly, it can be assumed that hospital procurement managers focused mainly on the external domain of improving resource access (right quadrants of the FMR framework, Table 3 and Figure 2), compared to internally

Purpose of Action	**Domain of Action**	
	Internal	**External**
Improve resource access	*Internal Resource Enhancement*	*Crafting the Resource Environment*
Reduce resource importance	*Internal Resource Replacement*	*Managing Resource Demands*

Pandemic's Main Influence?

Figure 2. Potential impact of the pandemic on factor market rivalry (FMR) framework

improving resource access. With these findings so far, it is believed that the pandemic mainly increases strategies related to the quadrant "crafting the resource environment" (Figure 2 and Table 3).

Summarizing, as already explained before, even though we make suggestions regarding how the pandemic influences procurement strategies, how hospital purchasers actually changed their strategies upon the impact of the pandemic remains a "black box." Here, the interviews with purchasers at Dutch hospitals are supposed to bring additional insights. This empirical approach will be explained in the next section.

Methods

Research design

This study uses two main sources of information: secondary data and interviews. On one hand, we collected publicly available data on the government decisions on the COVID-19 pandemic concerning Dutch hospitals and their procurement, which was presented in the previous section. As such, the secondary data was used for supporting the main analyzes and providing a richer context for the problem at hand (Brewer, 2012). Additionally, it provides a frame of reference for the context in which hospital purchasers acted during the first wave of the COVID-19 pandemic (from February 2020 to May 2020).

On the other hand, multiple informant qualitative interviews with hospital purchasers were used as the primary source for empirical analysis, as it supports the investigation of a multifaceted phenomenon in real life and helps unravel its complexity (Baxter and Jack, 2008). What is especially important concerning COVID-19 is that interviews help us understand how informants experience the problem at hand and provide us with a deeper understanding from their perspective (Longhurst, 2009).

Sampling and data collection

In this study, purchasers at Dutch hospitals were identified as the target group. To identify these potential participants, the network of the Dutch purchasing cooperation called NEVI was used. Furthermore, the network of COPPA, a Dutch procurement consultancy agency, was used to invite further participants for the interviews. A total of 13 purchasers responded positively to be included in this study, corresponding to insights into about 13% of all Dutch hospitals during COVID-19, as there are 101 general hospitals in The Netherlands. Consequently, 13 in-depth semi-structured interviews with hospital purchasers from different Dutch regions were conducted. They worked at major hospitals with full emergency and critical care units. One respondent was also a coordinator at ROAZ, an agency coordinating the government efforts in the pandemic to streamline hospital efforts. All the interviews were conducted in July and August 2020, focusing on the pandemic's first wave. An overview of the interviews can be found in Appendix 1. The interview duration ranged from 22:14 min to 50:59 min and included purchasers from all parts of The Netherlands.

Interview protocol and analysis

The interview protocol was split into three main sections: introduction and background information, main interview part and outro part. During the first section, this research aimed at identifying purchasing strategies focusing on the pandemic's influence was explained to the participants. To determine whether the respondents had enough knowledge about hospital purchasing and whether they experienced the COVID-19 pandemic, their background and work-field were assessed briefly. If the purchasers had indicated insufficient experience regarding commodity models or the pandemic, they would have been excluded. During the second part, the main part of the interview, the interviewees were first asked how the

COVID-19 pandemic impacted the hospital and their purchasing function. This provided general insights into the pandemic dynamics and identified affected product groups. Third, the interview focused on changes in product categorizations and commodity strategies. Afterward, the interviewees were requested to delve deeper into best practices and their specific reactions to the pandemic. These questions aimed to broaden the focus and let the interviewee add new insights that might have eluded the previous questions. In the last section, the outro, the interviewees could provide any additional comments. An overview of the interview questions and sub-questions can be found in Appendix 2.

With the permission of the interviewees, the interviews were recorded and later transcribed. The transcripts were analyzed to develop concepts from qualitative data. After multiple iterations, different codes were assigned to each different strategy explained by the interviewees in the transcripts. Hence, an inductive approach was followed to create our coding (Fereday and Muir-Cochrane, 2006; Linneberg and Korsgaard, 2019). To check whether connections could be established, the codes were reviewed repeatedly (Bryman, 2012). Findings were interpreted and related to literature to discover potential theoretical clarifications for the patterns found. The results are explained in the next section.

Results

To answer the research questions, the applicability of Kraljic is assessed and the purchasing' strategies are further synthesized into theory by creating links to the FMR theory, including the surprise findings of the importance of gatekeepers during the pandemic's first wave to manage FMR in supply markets.

Assessing the applicability of Kraljic: many products switched from non-critical to (temporary) bottleneck classification

All the respondents were familiar with the Kraljic matrix and most use this model for their hospital purchasing. One respondent noted that: "No matter how old the model is, we still use the model to indicate where our changes lie, what the value of a product is and what the risks are for the organization. So certain product groups are still placed in the different quadrants" (Respondent 7).

The most important and frequently mentioned consequence of COVID-19 on the procurement department was the sudden scarcity of PPE: "once the coronavirus arrived in The Netherlands, there was a big shock effect. As a result, the shortage of personal protective equipment was underestimated and it became a core business very quickly" (Respondent 10). Respondents mentioned that PPE equipment usually is treated as a non-critical product because of many suppliers and no shortages. "Normally, we buy the products by negotiating with a certain supplier and we make agreements about the price and develop a contract [. . .]. We suddenly had to purchase personal protective equipment very ad hoc in very large volumes. That is very different from how we normally work" (Respondent 12). The respondents exemplified the fact that purchasers' main goal shifted from price optimization, efficiency and quality – strategies belonging to non-critical items – to product assurance. The products' origins did not matter if they were qualitatively good. Respondents did not apply the usual purchasing strategies but changed their behavior in reaction to the pandemic. As one purchaser mentioned: "make sure you get the products [. . .]. Just make sure you have it" (Respondent 11). This showed the pandemic's rapid changes and the focus on securing supply at (almost) any cost, a strategy in line with bottleneck items.

However, even though securing supplies remained a key focus for the respondents, no new long-term contracts with either new or existing suppliers were concluded. Instead,

respondents ordered only once or twice from the suppliers, as "it makes no sense to conclude contracts for several years at the moment because nobody knows how long the pandemic will continue for [. . .] we only have to make sure that we have enough stock now and no shortage." Hence, supply risk changes created a shift from non-critical items (optimization and standardization) to temporary bottleneck item strategies (volume insurance and inventory security). The interviews also indicated the strategies to be highly dependent on the pandemic's expected duration and, therefore, temporary, avoiding long-term contracts to allow a fast reversal of the items back to the non-critical quadrant as soon as the pandemic shock was over.

Summarizing, the results of this analysis demonstrate that the Kraljic (1983) bottleneck quadrant represents considerably well the actual combination of efforts by purchasers to react to product scarcity during a pandemic. Both volume insurance and inventory security were applied widely in the cases, yet they had a more short-term focus than that proposed by Kraljic. Nevertheless, despite the fit of the Kraljic strategies, the strategies of purchasers also went beyond Kraljic's suggestions – including perspectives on rivalry – and will be explained in more detail when applying the FMR perspective in the next section.

Adding the factor-market rivalry perspective: grouping specific purchaser actions and interventions in the factor-market rivalry framework and the importance of gatekeepers

As already indicated in the last section, aside from the general indication of bottleneck strategies applied by purchasers, the interviews revealed a plenitude of specific actions adopted by hospital purchasers to manage product demand or supply in reaction to market competition. Thus, even though Kraljic (1983) appeared applicable, it could not help organize these competitive strategies.

Based on the FMR framework (Table 3 and Figure 2), we organized the inductively identified actions and interventions by hospital purchasers into the four quadrants internal resource enhancement, crafting resource environment, internal resource replacement and managing resource demands. For each of these quadrants, we describe the actions and interventions found in the Dutch case interviews. Illustrative quotes of each strategy are presented in Table 4 and a summary of the findings is shown in Figure 3. Additionally, we found evidence for the importance of gatekeepers in managing competition between hospitals (also included in Figure 3):

- *Internal resource enhancement:* A multitude of strategies applied by hospital purchasers was aimed at increasing demand access internally. Figure 3 summarizes them. For instance, to increase demand access internally, almost all the respondents monitored their stock more during the pandemic than before, ranging from Excel files to newly equipped dashboards. Apart from monitoring stocks, almost every respondent mentioned daily consultation as a new strategy and shortening of the usual purchasing process to ensure fast access. Similarly, a hospital could obtain six more respirators because they converted existing anesthesia equipment to functioning respirators or reassembled resuscitation kits.
- *Crafting the resource environment:* Similar to improved internal resource access, external improvements (re)shaped the resource environment. Purchasers collaborated with alternative industries and suppliers such as a Dutch bed manufacturer, to increase resource access. Access was also improved through product specification changes and alternative products. Changes were made either in brands, suppliers, quality or functionality: "Sometimes, you just want something and you can find it via

Table 4. FMR actions were undertaken by respondents and illustrative quotes

Strategy	Domain of action	Purpose of action	Purchasers' action or intervention	Illustrative example
Internal resource enhancement	Internal	Improve resource access	1.Monitor stocks and predict stock coverage	"Continuously filling out the dashboard and acting on it. That was one of the most important steps that were taken for the bottleneck products"
			2. Consult daily	"Every day we discussed the stocks of the protective equipment We discussed what the consumption is of every department . . . and it may still need to be redistributed"
			3.Shorten the purchasing process	"It was a completely different way of working. We did not use the usual purchasing process. The only purchasing process was to purchase the products as quickly as possible"
			4.Reassemble (existing products)	"We had to order some parts separately and assemble them in the hospital. Because of that, the resuscitation kits remained in stock. It is, maybe, a bit unprofessional, but the product works the same"
Crafting the resource environment	External	Improve resource access	1.Collaborate with alternative industries	"We collaborated with people from a completely different industry such as suppliers based in the Netherlands who could get raw materials from China and produce the products we needed"
			2.Change specification, search for alternative products	"We have worked with plastic jackets instead of gowns. Surgical masks have a certain reference, but we got them from a different manufacturer with the same protection"
			3.Retrieve second-hand products	"We bought some infusions pumps second-hand from a bankrupt hospital. These were reset by our medical technology so that they could be reused"
			4.Prevent price gouging	"The first offer we received was 70 times higher than usual"
			5. Beware of the cowboy market	"It became a bit like being on a farmers market. You were suddenly approached by all kinds of people from all angles. If we first transferred 60% of the total price, we were offered guaranteed deliveries"
Reduce resource importance	Internal	Reduce resource importance	1.Change the specification or purpose of the product	"Depending on the activity, there was a shift in the different types of masks. From type 2 R to FFP2"
			2.Sterilize and reuse products	"At a given moment, we sterilized the 3 m mouth masks and could use them five times instead of once"
			3.Use older products	"The military has taken its own old equipment from the basements everywhere and left it with us. Huge Marines with enormous muscle mass with all boxes of equipment came into the hospital"
			4. Use products longer	"Certain respiratory products were no longer available and we had to start reusing them or use them for a longer time"
Managing resource demands	External	Reduce resource importance	No actions and illustrative examples found	

an alternative. However, sometimes there is no alternative and you have to accept that you can get a certain needle, not of 4 cm but 3 cm (Respondent 9)." Other respondents went beyond alternative products to second-hand retrieved products of a bankrupt hospital. Moreover, almost half of the interviewees mentioned that unreliable suppliers approached them. These suppliers were only money-oriented and did not follow any quality standards. Hence, the interviewees needed the ability to detect these potentially fraudulent cases. As an interviewee put it, purchasers must distinguish between these cowboys (unreliable suppliers) and reliable suppliers during a pandemic. Table 4 provides an overview of all actions and examples undertaken to increase resource access externally.

- *Internal resource replacement:* Complementary to increasing resource access, resource importance can also be reduced within the organization. For example, many hospitals developed alternative designs for masks suitable for interacting with non-COVID-19 patients in response to shortages. Besides changing products, hospitals used older products or sterilized and reused products. Two respondents mentioned that they used older technology products, whereas every respondent mentioned different techniques of sterilizing and reusing the products. In other situations, the quality requirements of certain products changed. Some could be used longer: four times or for multiple hours instead of one time or 3 h. Table 4 provides an overview of actions and examples undertaken to reduce resource importance internally.
- *Managing resource demands:* When assessing the purchasers' strategies for managing external resource demands – externally reducing resource importance – we could not find examples in the interviews. FMR argues that in this quadrant, organizations try to convince customers not to need a product or to find innovative substitutions (Schwieterman and Miller, 2016). Usually, both activities consume time and are not applicable in a rapidly changing context such as a hospital purchasing in a pandemic. Hence, strategies attributable to the "managing resource demands" quadrant of the FMR framework could not be found when the interviews happened at the hospital level (Schwieterman and Miller, 2016).

Purpose of Action	**Domain of Action**	
	Internal	External
Improve resource access	*Internal Resource Enhancement* • Monitor stocks and predict stock coverage • Consult daily • Shorten the purchasing process • Reassemble (existing) products Purchasing as gatekeeper	*Crafting the Resource Environment* • Collaborate with suppliers from a different industry • Change specification, search for alternative products • Retrieve second-hand products • Prevent price gouging • Beware of Cowboy Market Government as gatekeeper
Reduce resource importance	*Internal Resource Replacement* • Change the specification or purpose of products: • Sterilize and reuse products: • Use older products: • Use products longer/change quality requirements	*Managing Resource Demands* No clear hospital purchasing activities found

Figure 3.
Strategies found in cases matched to the FMR action matrix

Along with the strategies mentioned above related to the four quadrants of the matrix, we also analyzed the collaboration for resource access. The analyzes revealed the importance of gatekeepers in the pandemic. On one hand, *within hospitals*, all the respondents revealed considerably more collaboration with other employees during the pandemic to discuss the scarcity of products, despite working from home. Various working groups and crisis teams were developed and purchasing departments built new contacts and were involved in many different departments. "A crisis team was developed during the pandemic. The crisis team included purchasing, facility management and logistics employees. Everyone participated, including the warehouse department and the central warehouse" (Respondent 8). Likewise, appreciation for the purchasers of the organization increased – according to some. However, despite increased collaboration with other employees, respondents simultaneously experienced increased competition and rivalry between different departments on the amount of PPE. As Respondent 3 stated, "Every department scanned its supplies. Some departments manipulated this process, to get more than other departments of the hospital to be sure that their department is 'safe.'" This competition is harmful to cooperation and resource distribution. Only the intervention by the purchasing department reduced such opportunistic behavior of different departments within hospitals. Hence, the procurement managers emphasized the importance of gatekeepers in reducing competition and increasing collaboration within hospitals.

On the other hand, *the respondents indicated more collaboration between hospitals* only at the start of the pandemic outbreak, consisting mainly of knowledge sharing. As the pandemic's impact on scarcity intensified, some respondents reported stiff competition between different organizations. "Even if Hospital A had the capacity for 1 or 2 weeks, they did not deliver to hospital B. Hospital B had to solve their problems. The solidarity was there in theory, but not in practice" (Respondent 3). Accordingly, respondents encountered more and more competition instead of collaboration as the scarcity of resources progressed. Ultimately, as already presented in the national context of the COVID-19 response, the government stepped in, created national bodies to coordinate resources and obliged hospitals to share stocks among health-care organizations through regional and national coordination centers (LCH and ROAZ). Most of the respondents responded positively to the establishment of the LCH and ROAZ. However, some were also negative, stating that the "national consortium did not always deliver the products. They are not reliable enough. Or the products did not meet our quality standards" (Respondent 12). Nevertheless, the respondents appreciated the benefits of these gatekeeper initiatives: "If a hospital had a hundred thousand gloves and another hospital had nothing. The hospital had to show solidarity and loyalty: the gloves were redistributed between de organizations" (Respondent 7). As a side effect, a large part of this collaboration also consisted of knowledge-sharing between hospitals, which was facilitated by the LCH and ROAZ workgroups.

In summary, next to the strategies of hospital purchasers (explained in the first part of this section), the latter part of the section showed that both, the purchasing departments (within hospitals impact) as well as the government (between hospitals impact), operated as gatekeepers for rivalry and competition during the pandemic. Without their intervention, competition would have further worsened, potentially leading to red queen market effects (Derfus *et al.*, 2008; Barnett and Hansen, 1996). Figure 3 visually represents the strategies and the gatekeeper roles.

The implications of these findings for theory and practice will be discussed in the next section.

Discussion

This pandemic offers a unique opportunity to analyze the impact of a crisis in hospital procurement in a real-life experiment. Alongside the pandemic's general impact on the "supply risk" dimension of the Kraljic matrix, this study identified and classified different hospital purchasers' strategies during a pandemic into the FMR framework (Schwieterman and Miller, 2016). Among the specific actions used were sterilizing and reusing products, increasing monitoring stocks, searching alternative industries/products, shortening purchasing processes, being aware of cowboys, using products longer and securing supply at almost any cost. Additionally, we discovered important gatekeeper roles of procurement professionals and the government. In the following sub-sections, first, the implication of the findings for theory is discussed. Then, three propositions for practice are presented to guide procurement managers in handling similar crises in the future. Finally, this section concludes with a discussion on the limitations of this study and avenues for future research.

Implications for theory: Kraljic remains relevant and factor-market rivalry is a valuable addition; procurement's and government's roles as gatekeepers need more theoretical scrutiny

This study has three main implications for theory, related to the applicability of Kraljic (1983) in a pandemic; the applicability of the FMR perspective on health-care resource competition during a pandemic and the importance of (public) procurement as a gatekeeper to reduce harmful competition.

Regarding the ***first implication***, purchasing portfolio models have already been assessed extensively during non-pandemic times and in production contexts (Park, 2010; Knight *et al.*, 2014; Segura and Maroto, 2017; Kraljic, 1983; Caniels and Gelderman, 2005; Andersson and Servais, 2010; Bildsten, 2014), yet this study is the first one to provide a better understanding of hospital commodity management during a pandemic. Not only is hospital procurement considered special in many ways (Medeiros and Ferreira, 2018) but also how the pandemic influences the sudden change of commodities remains a "black box." Regarding this lack of knowledge, we found that the majority of scarce products during the pandemic switched from non-critical to "temporary" bottleneck products. Especially, the perception that purchasers expect a return to pre-pandemic management of products (making them "temporary bottlenecks") is a new finding regarding the apparent mobility of certain products with the Kraljic matrix. Nevertheless, the overall findings show that the strategies proposed by Kraljic (1983) held up reasonably well during the pandemic. As explained before, the "supply risk" dimension was mostly affected by the pandemic and led to a change of non-critical items to bottleneck items, as can be expected based on literature (Gelderman and Van Weele, 2003; Caniels and Gelderman, 2005).

As a ***second implication***, this research found that competition among hospitals during the pandemic mirrors companies' FMR in the industry sector. The application of the FMR framework (Schwieterman and Miller, 2016) allowed us to understand the actions of hospital purchasers in two main dimensions, improved resource acquisition versus reduction of demand and internally focused versus externally focused actions, resulting in four distinct strategic quadrants. Our research contributed to theory by transferring the ideas derived from the FMR concept (Schwieterman and Miller, 2016; Ellram *et al.*, 2013; Markman *et al.*, 2009) to hospital purchasing of scarce resources during a pandemic. However, it remains to be seen how the "managing resource demands" quadrant can be managed within hospitals during a pandemic, as we could not find strategies fitting this quadrant. The reason for this lack of evidence could be a misfit between the activities linked to this quadrant (which suggests convincing customers not to need a product or finding

innovative substitutions through supply chain/university collaborations (Schwieterman and Miller, 2016)) and the characteristics of the context. It seems that the suggested strategies were either not applicable (PPE and ventilators must be used: consumers cannot be convinced to not need it) or not applicable in such a rapid-shock environment (as collaborations along the supply chain and with universities take more time than a few months). Subsequently, more research is needed on how the FMR strategies evolve and how/when new strategies are added after the initial shock of the pandemic.

Finally, as a ***third implication***, this study emphasizes the role of procurement as an important gatekeeper of resource allocation. Purchasers actively reduce harmful competition and resource-hoarding medical departments' behavior at the hospital level, thereby increasing collaboration and resource distribution within the whole hospital. Furthermore, on a larger scale, the government procurement institutions functioned as important gatekeepers in bringing hospitals together and coordinating the resource acquisition efforts for scarce materials. These results add new insights to literature that emphasize the important role of procurement (in general) as well as public procurement (in particular) in being important gatekeepers for collaboration within and between organizations, thereby also emphasizing the strategic nature of public procurement (Lau *et al.*, 2003; Hallenbeck *et al.*, 1999; Leenders *et al.*, 1994; Matthews, 2005). Additionally, these findings are interesting insights for research into group purchasing organizations and collaborative procurement (Yang *et al.*, 2017; DeRoeck *et al.*, 2006; Schotanus and Telgen, 2007; Hezarkhani and Sošić, 2018). Finally, our research showed that under certain circumstances, ad-hoc types of coordinated purchasing could rapidly evolve. In this context, further research regarding the circumstances leading to these ad-hoc collaborations, the effectiveness of these collaborations and the increase in their efficiency could be interesting future research avenues.

Next to these theoretical implications, this research also found several aspects relevant to procurement managers and policymakers in practice. The implications for practice will be discussed in the next section, leading to three propositions.

Propositions for practice: use Kraljic and factor-market rivalry framework in a crisis, as well as act as a gatekeeper during the pandemic to enable more collaboration

The analysis of the pandemic's impact on commodity management when products are changing rapidly in quadrants (due to external impact on both upstream and downstream supply chains), is a new addition to the field of commodity management (Akkermans and Van Wassenhove, 2013; Ivanov, 2020), as it was unclear whether Kraljic (1983) can hold up during a pandemic. When comparing the interview findings with the pandemic's expected impact, the strategies explained by Kraljic (1983), especially for the bottleneck quadrant, appeared very similar to the actual reaction of purchasers to the sudden scarcity of products in hospitals. Even though the purchasers indicated this shift to be temporary, the bottleneck strategies matched the cases well and reflected similar strategies proposed in the literature (Hesping and Schiele, 2016; Gelderman and Mac Donald, 2008; Gelderman and Van Weele, 2003). Additionally, adding the FMR perspective allowed us to cluster all additional strategies of the cases in an easily digestible overview of strategies (Figure 3). Accordingly, this study proposes for practice the following propositions:

P1. During a pandemic, the increasing supply risk shifts non-critical items to the (temporary) bottleneck quadrant and its corresponding strategies (Table 2). In combination with the strategies identified in the FMR framework (Figure 3), both frameworks can be used in the future as indicators of suitable crisis strategies.

Even though some research indicated more collaboration during the COVID-19 crisis (Bohmer, 2020), the interviews revealed very little actual collaboration. Within hospitals, even though the purchasing department and the other functions collaborated more, emphasizing procurement as a contact person in resource scarcity times, competition between medical departments increased steadily. At this time, procurement often engaged in pro-active inventory management and resource allocation coordination. In this context, hospital procurement managers assumed a gatekeeper position on resource allocation to assure a fair distribution of resources and avoid harmful competition for resources within hospitals. This leads to the second proposition for practice:

P2. When resources are shared among departments in the organization, procurement managers need to proactively coordinate resources and engage with stakeholders to avoid harmful competition within the organization.

Beyond the single hospital level, instead of collaborating, hospitals, with other health-care organizations, engaged increasingly in competition for resources as the pandemic progressed. As the context descriptions revealed, the government already pro-actively anticipated the need to coordinate during the pandemic. Eventually, it stepped in and coordinated the distribution of resources among hospitals and health-care institutions, reducing competition. In this Dutch example, the government developed special bodies (the LCH and ROAZ), through which the different demand and inventory levels were balanced among health-care institutions. Thus, PPEs were distributed among hospitals more equally than before and hospitals started cooperating. The benefit of government coordination leads to the last proposition for practice:

P3. During a pandemic, the government needs to actively coordinate collaboration between hospitals and health-care organizations to avoid competition and foster active collaboration in the whole health-care system.

The three propositions presented in this section summarize this study's findings; however, they also need to be interpreted in the study's context. Therefore, the accompanying limitations and future research needs are discussed next.

Limitations and future research avenues: go beyond the Dutch case, analyze reaction to subsequent waves and study configurations of competitive actions

The qualitative nature of this research and the geographical location does not allow generalizing statements. The list of strategies and actions found might vary in other geographical areas or contexts. This study should, hence, be expanded to other countries and with more cases to validate the findings. Examining how hospital purchasers from other countries experienced the COVID-19 pandemic will also be interesting: Did they experience the same problems with the same products? How did other purchasers anticipate these high supply risk products and did they use the same strategies and tactics we mentioned?

Similarly, this research's timeframe allowed for evaluating strategies in the first wave of the COVID-19 pandemic. The adaptation of strategies for the second and third waves was not considered. Other studies could extend the timeframe to accommodate these waves. This could also consider potential familiarity and learning curve effects (Duffey and Zio, 2020; Knight, 2002) regarding procurement strategies in pandemics. Did procurement professionals learn from the first wave? How did they adjust their strategies based on their first-wave experiences?

Determining the influence of governmental organizations such as ROAZ and LCH, on how purchasing is done between hospitals, in the long run, will also be interesting. During the pandemic, intensive collaboration appeared suddenly and it is not evident whether it is "here to stay." What is the actual (financial) influence of governmental organizations created during the pandemic? Did the government intervention make purchasing easier or just more limited? How can the effectiveness of such interventions be increased?

Finally, future research could delve deeper into the configurational aspects of FMR strategies used by hospital purchasers (Schwieterman and Miller, 2016) and the respective effectiveness of these strategies. For example, are some hospitals acting more aggressively? What is the reaction of other market participants? What is the right combination of aggressive and defensive FMR strategies to bring the best value for money or do we perceive a "red queen effect?" This relates to the question of how hospitals can maintain a balance between competition and cooperation (also called "coopetition") (Tsai, 2002; Chen and Miller, 2015) in times of resource scarcity without endangering strategic collaborations with supply chain partners in the long run. The current study had a descriptive nature, describing the status quo at Dutch hospitals regarding resource competition. We encourage future studies to engage in more prescriptive approaches and assess different strategies regarding their efficiency and effectiveness in alleviating resource competition and increasing collaboration in health-care procurement.

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Appendix 1. Overview of interviews

Respondent	Location in the Netherlands	Function	Date
1	East	Purchaser	21–07-2020
2	East	Medical equipment coordinator/purchaser	18–08-2020
3	West	Purchaser	14–08-2020
4	Mid	Purchaser	17–08-2020
5	West	Purchaser	18–08-2020
6	South	Consulting partner/coordinator/purchaser	18–08-2020
7	West	Purchaser	19–08-2020
8	South	Purchaser	20–08-2020
9	West	Purchaser	21–08-2020
10	North	Purchaser	21–08-2020
11	West	Purchaser	28–08-2020
12	East	Purchaser	09–09-2020
13	East	Purchaser	14–08-2020

Appendix 2. Overview of interview questions

Part I – Introduction and background	Part II – Main interview	Part III – Outro
1. Introduction of the interviewee a. Opening b. Reassuring anonymity of the respondent c. Explaining the goal of the interview	3. How did/or does the coronavirus influence a hospital as a whole, specifically, the purchasing department? a. Can you give some examples? b. What were the main difficulties? Which products were the most difficult to purchase? Why? c. What are the reasons for these difficulties?	6. Space for comments
2. Personal questions a. Personal information of the respondent b. Can you describe your job? c. How long have you been working here?	4. Have you experienced any change in how to purchase product categories? a. Did you collaborate more with other hospitals? b. How did you purchase products with high supply risk?	7. Words of thanks and outro a. Can I contact you again if I have any more questions? b. Would you like to receive the results of my research?
	5. Can you tell me some best practices? a. How did your department anticipate the pandemic? b. How did you anticipate the pandemic? What are some behavioral changes you have adopted? c. Did you collaborate more internally and externally?	

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