Deconstruction of a Multi-Embedded Supply Chain Coordination Problem Using Mixed Methods

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Abstract: It is without doubt that there are many overviews of mixed methods research in supply chain management. However, there is relatively little research and representation on the application of robust methodological approaches and techniques that take into account the dynamic nature of a multi-embedded and specialised medicine supply chain coordination (SCC) problem. In Uganda, the distribution of artemisinin-based combination therapies (ACTs) involves a multi-embedded supply chain that runs across the macro, market, and micro levels of stakeholders. The multi-embedded levels have created a coordination challenge tied to stock-outs and unavailability of ACTs to the detriment of the patients. This study aimed to: 1) demonstrate how a mixed methods approach facilitated a better understanding of a multi-embedded and specialised supply chain coordination problem, and 2) reveal the major factors for coordinating a multi-embedded supply chain that can improve the availability of ACTs in the general hospitals of Uganda. An exploratory sequential mixed method approach was employed to disentangle the problem. In the first phase, focus group discussions were predominantly used to collect qualitative data, the findings of which acted as the foundation for the quantitative survey questionnaire. A Confirmatory Factor Analysis was used to determine and validate the market and macro supply chain dimensions that emerged from the survey results. The results showed that the most influential supply chain market environment dimensions that affect the availability of ACTs include information sharing with external stakeholders and supply chain interdependence. The results from the macro-environment showed that the socio-cultural, economic, technological, and legal dimensions influence the availability of ACTs. The contribution of this paper advances the use of mixed methods in deconstructing a complex embedded supply chain problem with implications for supply chain academics and practitioners and government bodies.

Keywords: mixed methods, coordination, supply chain management, malaria therapies.

1. Introduction

The availability of medicine in health facilities is a substantial contributory factor to quality health care. However, achieving quality care presents a significant challenge, especially in low-income countries (Khuluza and Heide, 2017). Malaria has remained one of the oldest and deadliest diseases of humankind (Shretta, et al., 2017), especially among children under five and expectant mothers (Damien, et al., 2018). Currently, international efforts focus on malaria eradication by rolling out new technologies, and through substantial growth in the political and financial commitment by countries, regions, and their global partners by 2050 (Feachem, et al., 2019), especially in Africa (Alonso, 2016). However, before this ambitious plan can be attained, the supply and distribution of Artemisinin-based Combination Therapies (ACTs) must be efficient. ACTs are the most affordable effective option to treat uncomplicated malaria in many sub-Saharan countries, where widespread malarial parasite resistance to medicines is rife (Khera and Mukherjee, 2019).

As it is difficult to ascertain the number of deaths attributed to the unavailability of ACTs, this may have far-reaching consequences on patients' lives. It is also regrettable that empirical interventions to improve ACT stocks in Uganda that might reduce eventual mortality rates have also not yet succeeded, as the applied supply chains are perceived to be notably inept (Uganda Bureau of Statistics, 2015). Similarly, the National Planning Authority Uganda (2015) reports that in spite of the significant investments in malaria control, the malaria burden remains high with rampant stock-outs of ACTs.

The growing importance of curbing the occurrence of malaria in the developing world is evidenced by the current research seeking possible solutions to making ACTs available for the treatment of malaria cases in the developing world (Spisak, et al., 2016; World Health Organisation, Malaria Report, November 2017). A common issue emerging from the empirical evidence related to the supply and distribution of ACTs shows a highly embedded

SCC problem that cuts across both macro and market levels (Nagitta and Mkansi, 2015). The embedded complex coordination problem is tied to the unavailability, understock, and or overstock of ACTs in some hospitals (Jahre, et al., 2012). Although previous studies have provided platforms for understanding the factors affecting the levels of medicine stock, unfortunately, there is recognition in the discipline that SCM studies are skewed towards either the positivist paradigm (Ntayi, et al., 2010; Kumar, Singh and Shankar, 2013) or normative (literature reviews and theoretical models) and quantitative (modelling and surveys) (Flint, et al., 2012).

At the same time, the environment in which the supply chain phenomena are located is becoming increasingly complex, especially in the public health sector (Yadav, 2015), necessitating balancing the different conflicting goals and interests of politicians, health workers, patients, and citizens (Singh, Kumar, and Kumar, 2016). Hospitals often face the dilemma of designing new appropriate decision-making models that try to find a balance between the different supply chain players (Saltman and Duran 2015) without compromising quality standards through policy shifts, if one research approach is used. In order to accurately describe, truly understand and begin to explain these complex phenomena (such as market and macro supply chain coordination dimensions (SCCD), research streams should include more studies using multiple methods.

Researchers who exclusively choose one approach seriously delimit the scope of their inquiry, and thereby, their ability to contribute to the body of knowledge. Henceforth, there is a need for a more balanced approach to research using inductive research methods (qualitative approach), in addition to deductive methods (quantitative) in supply chain management to reduce incidences of stock-outs, which this study intended to assess. Some scholars have ascertained that literature on the medicine Supply Chain Management (SCM) in the public sector is still very fragmented and under-researched, especially in the context of developing countries (Jain, Dangayach, Agarwal, 2010; Msimangira and Tesha, 2014). Therefore, mixing research approaches may be seen as a candid initiative, where critical thinking, interest, reasoning, experiences and expertise are combined with the purpose of discovering the truth, so as to find solutions to the problems confronting the health supply chain through investigation and analyses.

The mixed approach complements rather than competes: "*the limitations of one method can be offset by the strengths of the other method, and the combination of quantitative and qualitative data provide a more complete understanding of the research problem than either approach by itself*" (Creswell and Clark, 2011, p.45). The essential purpose of mixing methods in this study was to get the best measurement of SCCD, using the strengths of each of the methods proposed. Babbie and Mouton (2010) claim that the mixed design is appropriate when the problem is persistent and can be used for developing more focused questions. The mixed methods approach was convenient, since neither a qualitative nor a quantitative approach was adequate to fully answer the research questions (Tashakkori and Teddlie, 2010). However, the two methods are irreconcilable because each has its own unique procedures of gathering and analysing data, despite the fact that they have different strengths and logic (Saunders, et al., 2016).

Therefore, this paper aimed at answering the following questions: i) How does the mixed methods approach enable the understanding of a multi-embedded supply chain coordination problem from the general hospital perspective? and ii) What are the major dimensions that hospitals should consider when coordinating a multi-embedded supply chain at the market and macro environments?

This investigation contributes to the SCM literature related to overcoming stock-outs in the hospital contexts in three aspects: (i) the application of a mixed methodology for making a diagnosis, and following from this (ii) the identification of critical dimensions for state interventions, and (iii) the use of the study findings for policy uptake at the local level.

In section two, we present a brief review of the theoretical and literature on SCC. Thereafter, we provide a contextual background to the medicine supply and distribution problem. In section three, we provide an introduction to mixed methods to contextualise this discussion with reference to SCM issues, while providing the steps to deconstruct the medicine chain, the attendant results, conclusion, recommendations and finally the limitations of the study.

2. Theoretical and literature review

A multi-embedded SCC problem is recognised within the existing literature and remains unexplored in developing countries (Singh, Vaish and Singh, 2014; Yadav, 2015). While the complexity of embedded supply chains has been greatly acknowledged in the health care sector, complementary scientific methodological approaches for addressing such a challenge remain unexplored. This study is guided by the coordination theory advanced by Malone and Crowston (1994). The theory posits that every organisation should continually identify tasks with their interdependencies (referred to as coordination dimensions) among the different actors. It presupposes that coordinating the supply chain is a critical element that ensures that all activities are systematically glued together for the achievement of joint supply chain performance. The insights and conclusions drawn from these articles have gone a long way in terms of mapping 'what we know and don't know' about SCC, but have fallen short in terms of a more nuanced analysis of how SCC exhibits itself in developing markets, and moreover, in the public sector using a mixed methods approach.

Supply-chain coordination is defined variously. What is common to most of the definitions is that it is the process of managing interdependencies, the flow of products, resources, and information among channel partners to end users (Huo, Zhang and Zhao, 2015). Despite the burgeoning interest in SCM by scholars in the private and manufacturing sectors, its application in the supply and distribution of medicines in Africa remains sparse, offering no empirical validation (Msimangira and Tesha, 2014), and yet hospitals are one of the major weak points in the healthcare SCM (Dobrzykowski, et al., 2014).

Typically, the hospital supply chain includes the internal chain (patient care units, hospital warehouse, patients, etc.), while the external chain consists of distributors, vendors and manufacturers. Hospitals are bolstered by a range of health care SCM activities, such as forecasting, quantification, procurement, storage and dispensing (USAID | Task Order 1, 2011). Investigating how hospitals coordinate with their external partners in the market and macro environments through the application of a mixed methods approach may improve the efficiency of these activities, and can provide opportunities for health systems to increase the quality of care and improve the availability of medicine (Office of the Auditor General, 2015).

In Uganda, the medicine supply chain starts with individual hospitals that forecast, quantify, plan, procure and place orders with National Medical Stores (NMS), which is responsible for delivering all medicines and supplies to all public health facilities on a bimonthly distribution schedule under the pull system. The importance of exploring the context interdependence of SCC has been accentuated in recent years with calls for closer attention to the peculiar institutional arrangements, or national business system configurations of developing countries, which may ultimately lead to a different understanding of SCCD (Nagitta and Mkansi, 2015).

In a multi-purpose study, Gao, Li, and Kang (2018) attempted to classify SCCD (e.g. price discount, information sharing, collaboration through activities, such as vendor-managed inventory and consignment stock, and supply chain integration. Other scholars considered collaborative working and joint planning, the mutual exchange of information and integrated information systems, and cross-coordination at several levels in the firm's supply chain (Ramanathan and Gunasekaran, 2014; Soosay and Hyland, 2015). Although these examples demonstrate some of the processes of supply chain coordination, the scholars do not explicitly describe all the dimensions of coordination mechanisms from a hospital perspective. From these studies, it appears that gaining insight into the other dimensions requires the use of robust methodological approaches and techniques that take into account the dynamic nature of health supply chains.

To deconstruct a multi-embedded SCC, an exploratory sequential mixed research design was adopted to gain a profound understanding of the phenomena in the SCCD of the medicine supply chain through the balance of the rich data that was gained from the qualitative approach and tested through the quantitative approach. For this to occur, we adopted the exploratory sequential mixed methods within the research stream. The mixed methods paradigm fits together with the insights provided by the quantitative and qualitative research into a "workable solution" to answer the multifaceted research questions (Tashakkori and Teddlie, 2010) and offers a practical solution in the 'real world' (Feilzer, 2010). Most notably, there seems to be no tool to measure supply chain coordination (Kaur, Kanda and Deshmukh, 2015).

Based on the research questions stated above, we first adopted the qualitative techniques. Similarly, to validate the developed instrument, we used a post-positivist philosophical paradigm, which called for the use of

quantitative methods (Creswell and Clark, 2011). The remainder of the paper discusses the procedures involved in collecting and analysing data using mixed methods.

3. Research approach: Sequential mixed application to the embedded problem

This study used Lee's (1991) model because it details twelve (12) clear steps that were followed in carrying out research using the mixed methods approach, unlike the one proposed by Creswell and Clark (2007), which seemed more summarised.

3.1 Stage 1: Defining of the strategy context

Nagitta and Mkansi (2015) affirm that it is crucial to have a clear understanding of the environment in which a supply chain operates, as well as the external forces influencing its level of service delivery. Within a country, the medicine supply chain may operate at different levels, namely the central, regional/district, and service delivery points. Besides, various vertical supply chains may be working within a country, with many aspects of intersection and overlap, and a diverse set of stakeholders. Therefore, the inclusion of factors external to the hospital, may complement public sector health-based treatment channels.

In support, Fahey and Narayanan (1986), perceive the market and macro-environments as being instrumental and part of the significant management environment. From these environments, businesses are influenced by several variables emanating from one environment, or sometimes a combination of them all. From the market environment, there are stakeholders (employees, shareholders) and role players (customers, suppliers, competitors, new entrants, opportunities, and threats).

Lastly, the macro-environment factors that were considered include: political, economic, social-cultural, and technology and legal. These factors were examined in the current study. From the results, we note that the coordination frameworks for the supply and distribution of ACTs demonstrate the interplay of all the business management links that describe and analyse the supply and distribution of ACTs.

3.2 Stage 2: Review of literature

To address the SCC gap, the paper firstly, systematically reviews the literature on the SCC determinants; secondly, it argues for the use of mixed methods research to address the questions related to medicine coordination. However, the market and macro settings are ignored in many coordination frameworks. Therefore, it was presumed that if correctly done, SCC may facilitate the integration of chain activities, resulting in better performance (Shukla, et al., 2013).

Several authors, such as Singh (2011) and Kaur, Kanda and Deshmukh (2015), tried to examine the role of coordination in SCM from the private sector perspective. The first author attempted to answer the question, "what are the major factors for coordinating the supply chain?" To do this, the author first explored the literature, then eventually, a coordination index was developed and evaluated using the interpretive structural modelling (ISM) approach. Ultimately, the fundamental relationship among the different factors of coordination and responsiveness in the supply chain was highlighted, which aids strategic decisions. The framework was further tested using a case study. Hence, the inductive method. From the literature, a total of 32 enablers for coordination in a supply chain were identified. These were further grouped into six categories, such as top management commitment, organisational factors, mutual understanding, the flow of information, relationship and decision-making, and responsiveness. All six elements had a strong mutual linkage, although top management commitment was the primary driver for improving the coordination among these factors. Arshinder, Kanda and Deshmukh (2011) conducted a systematic literature review on the importance of SC coordination. The resultant conceptual model helped to highlight the various surrogate measures of SCC.

However, these studies fell short on specifying the market-and macro-factors to be considered in managing the interdependencies in the context of a multi-embedded supply chain. From the above discussion, it can be concluded that there was a need to broaden the theoretical domain of SCC within the medicine field. The general hospital focus with a holistic orientation, including the macro and market environment, creates a superior supply and distribution of ACTs in developing countries, given the dynamics in the broader economy (rooted in national, regional, and international contexts).

A content analysis was conducted by exploring journals from 1960 to 2017. Within the specified period, this study analysed coordination frameworks originating from organisational scholars such as Thompson (1967) and Malone and Crowston (1994). The rationale was to demonstrate how the dependencies have been coordinated in SCM, and also to find out whether they aptly addressed linkages between the market and macro environments. Leading journals were consulted, as these are believed to impart current trends and are held in high esteem (Üsdiken, 2014). The focus of this study is Africa, as it falls within the developing countries' classification (Nielsen, 2013). Therefore, from a critical realist stance, this study examined previous studies that have applied coordination frameworks within the African context, with implications linked to the market and macro environments. The purpose of this qualitative approach was to identify only those studies that were concerned with the ACT supply and distribution in Africa. Therefore, the focus of this study was to use the coordination theory as a basis for making generative models.

Also reviewed were published reports and scientific publications from *Malaria Journal*. The journal provides research on several drug-efficacy studies that have been conducted, with examples from Uganda, Tanzania, Kenya, Malawi, Sudan, Ghana, and Nigeria, among others, in Africa. For experiences related to policy implementation, we reviewed several reports and publications (e.g., United States Agency for International Development (USAID). The findings are presented in Table 1. These indicate that the hospitals' coordination frameworks for supply and distribution of ACTs should be inclusive of all forms of joint work from the market and macro environments.

3.2.1 Market environment dimensions

Due to the many actors in the market environment, there are many turning points hospitals go through to communicate and share information. Studies by Asamoah, Abor, and Opare (2011) and Watsierah and Ouma (2014) take us one step closer to understanding the actors involved in the market environment. These include suppliers, manufacturers, wholesalers, and retailers who need to proactively coordinate with each other.

In a related study undertaken in the health care industry in South Korea, Shou (2013) supports efficient coordination of the market environment if a steady supply of medicines were to be guaranteed. This study also indicated that there was a positive relationship between supply chain performance and customer satisfaction. Nonetheless, in high total buyer supplier relationships, it can be challenging when supply chain partners engage in opportunistic behavior and negative tactics or coercion (Eyaa, 2017). This practice is likely to disenfranchise the availability of drugs at health facilities. From the extant literature, the following dimensions were identified and published in the qualitative paper published by Nagitta and Mkansi (2019).

Table 1: Summary of market management environment dimensions

Dimensions	Characteristics/ brief description	Sources
Collaborative partnerships	Formation of strategic alliances with suppliers, agencies, donors.	Seiter (2010); Asamoah, et al. (2011); Watsierah and Ouma (2014).
Information sharing with suppliers, Ministry of Health (MoH), Donors	Sharing supply and demand information between the general hospitals, MoH and donors, etc.	Ongolo-Zogo and Bonono, 2010); Williams, Roh, Tokar, and Swink (2013).
Supply chain interdependence with suppliers	Managing supply chain interdependence (SCI)	Ferguson, Guide and Souza (2006)
Relationship among lower health units	Hospital's relationship with lower health units through redistribution.	Ministry of Health (2016)

Source: Nagitta and Mkansi (2019).

3.2.2 Macro-environment dimensions

Successful macro dimensions involve understanding the political, economic, social, technological and legal environment. There are many variations in analysing the macro-environmental factors in the realm of management (Sammut-Bonnici and Galea, 2015). However, most studies on macro environment analysis are limited to determining and categorising the factors (Sammut-Bonnici, 2015). Regrettably, the available literature revealed that scant efforts have been invested into investigating the excesses of macro-environmental dynamics

in the effective management of drug supply in the country. Partly, this prompted the consideration of an empirical or rational path in the proposed research. Table 2 provides a summary of the macro dimensions that can be used by hospitals to tackle ACTs problem.

Table 2: Summary of macro dimensions affecting ACTs

Dimension	Characteristics	Sources
Political dimensions	Power, politics, and interest relationships	Jan de Vries and Huijsman, (2011); Park, et al. (2017).
Economic dimensions	Donors' support and government subsidies	Tumwine, et al. (2010); Morris, et al. (2014).
Social-cultural dimensions	Social structures and social network, beliefs, and attitude.	Granovetter (2005); Cohen, et al. (2015).
Technological dimensions	Use of information technology tools such as phones; Rapid Diagnostic Tests (RDTs); m-Health; Use of Internet	Bhakoo and Chan (2011); Hossain (2016).
Legal dimensions	Medicine guidelines and policies.	MoH (2015); National Medicine Policy (2015); Iqbal, et al. (2017).

Nagitta and Mkansi (2019).

The findings were then schematised in a new framework as shown in figure 1, with the hope that it would address the interplay of interdependence among the two management links (market and macro environments). Figure 1 illustrates the stakeholders involved in the supply and distribution of ACTs and the attendant coordination dimensions, as used in this study and derived from the literature.

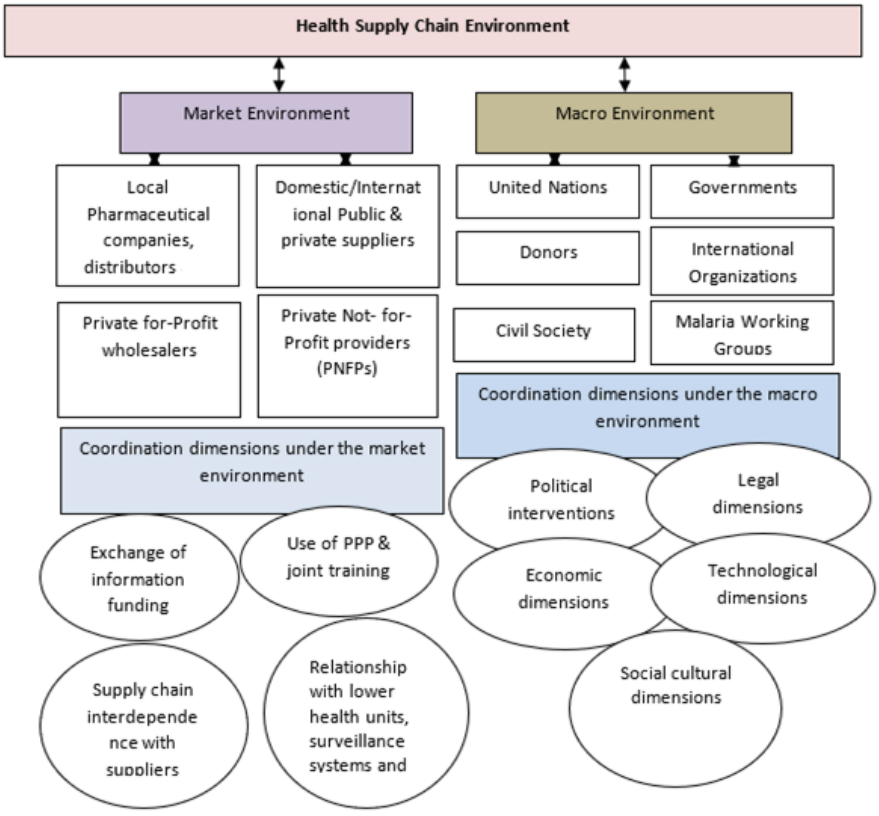

Figure 1: The market and macro dimensions of ACTs' market coordination

Source: Nagitta and Mkansi (2015)
The conceptual framework led to the following two hypotheses:
H1: The market dimensions used by general hospitals correlate positively with ACTs' availability.
H2: The macro dimensions used by general hospitals account for more variance in ACTs' availability.

3.3 Stage 3: Developing a case study protocol

Case studies require one to plan for the research (Brereton, et al., 2007). Among these was the need to plan a series of case studies. For consistency, we decided to develop a case study protocol template with the aim of providing a common structure for our case study protocols and guidance on how to construct them. We reviewed some of the well-known case study papers and text books but did not find any existing template on either hospital supply chain nor the medicine supply and distribution, despite the fact that Yin (2013) provided an example of a case study protocol. For this reason we constructed our own template based on the basic case study methodologies described by Yin (2003). At a high level, most of the approaches to case study research are quite similar, in spite of the very different philosophical approaches taken by different case study experts. However, Stake (1995), like Eisenhardt and Graebner (2007), takes an interpretive approach to case study research, but is particularly concerned with "programme evaluation" which involves the evaluation of social or education policies. Overall, we adopted the approach described by Yin (2003), who takes a slightly more positivist approach to case studies. We started by defining the research questions and a priori. The data helped answer the preliminary research question, helped to develop the model and two hypotheses surrounding the phenomenon, and created items for the subsequent survey.

3.4 Stage 4: Conducting multiple case study research

Under the qualitative phase, multiple cases were used with the aim of exploring phenomena within its contexts using a variety of data sources. In order to first understand the meaning of SCC as it is experienced by Drug Therapeutic Management Committee DTMCs (in a new context), we conducted focus group discussions with 32 DTMCs from four general hospitals in endemically affected regions (northern and eastern regions) (Uganda Bureau of Statistics [UBOS], 2016). All the participants who took part in the study were selected purposively and were asked to describe their experiences in coordinating the supply and distribution of ACTs. This was appropriate, since we wanted to answer the 'how' and 'why' questions (Yin, 2003) and to explore the relevant factors applicable in a particular context describing the world of experience (Myers, 1997). However, the qualitative research process is largely subjective, even for the most seasoned of researchers (Myers, 2000). Using the pattern-matching technique, data was displayed in matrices to facilitate the comparison of patterns predicted in the hypotheses (Yin, 2013). Thereafter, verification was made before identifying common trends of agreement or disagreement, and drawing logical connections to inform conclusions.

Previous scholars, such as Giménez (2004) studied the relationship between internal and external coordination and their relationships with logistics performance. She first explored the integration practices in the context of a grocery supply chain using a multiple case study method. The results of this qualitative research helped in the design of a questionnaire. The instrument was then used to collect data in a survey. Subsequently, structural equation modelling was applied to answer the research question on the effect of integration on performance. She attributed her good results to using these two different, but complementary, methods.

Lee, Song and Cheong (2018) used a comparative study following a balanced approach, starting with grounded theory to gain an understanding of the coordination mechanisms involved in payback contracts. They then described a real-world case study in which coordination affects the supply chain from both the suppliers and retailers' perspective. Finally, they validated the vendor managed inventory (VMI) system with a base-stock policy as a means to coordinate the supply chain. For their part, Balcázar Camacho, López Bello and Adarme Jaimes (2016) proposed methodological guidelines for the coordinated planning of the supply chain in the context of the health care services, given the global benefits to its members by using primary information collected at several health service institutions. The study demonstrated a quantitative model to show how organisational coordination contributes to a reduction in the overall costs throughout the chain. However, the SCC phenomena described in the cases above did not fully document the medicine supply chain problem in general hospitals. Furthermore, the literature also did not identify contextual relevant variables to help understand the SCC problem in the market and macro environments.

Therefore, to further understand the SCCDs, four focus group discussions (FGDs) were held at four public general hospitals from four malaria endemic regions of Uganda to probe for detailed explanations up to the point of

theoretical saturation (Guest, Bunce and Johnson, 2006). Semi-structured questions were designed in such a way as to help the participants think about how the market and macro dimensions affect ACT availability. Permission to tape-record the sessions was also sought and granted. Participation was voluntary, and the participants understood that they had the right to decline to answer any questions and terminate the discussion at any time. Participants were informed that the purpose of the research was to explore how SCCD affects the availability of ACTs. Participants had assurance that pseudonyms would replace their actual names. The FGDs lasted from 90 minutes to two hours as supported by Cooper and Schindler (2014).

Data analysis from multiple cases: Qualitative data analysis took a three-phase approach, which included data reduction, data display, conclusions, and verification (Miles, Huberman and Saldaña, 2014). A computer-aided qualitative data analysis software program known as Nvivo was used to analyse the qualitative data. While there are many computer-aided software programs to analyse in-depth inquiry for case studies (Quinlan, 2011), we found Nvivo more user-friendly in analysing the emerging dimensions. The results from one hospital were replicated to the other general hospitals in Uganda.

The purpose of this inquiry was to develop an instrument that was subsequently validated. The strategy was inductive in nature, and specifically answered the first research question. The study explored how the management environment dimensions affect ACTs in general hospitals in Uganda. In addition, the approach helped to detect similarities and differences in SCC in the various general hospitals. Previous scholars, such as Singh (2013) posed the question, "What are the factors affecting a coordinated supply chain?" He then prioritised the different factors of a coordinated supply chain using the Analytical Hierarchy Process. However, the scholar focused on the micro level only. In this paper, we first prioritised the collection and analysis of qualitative data to assess the supply chain coordination of ACTs in order to gain a deeper understanding of drug availability or stock-outs. The results from this phase were used to develop a survey tool which was used in the quantitative analysis. The design permitted triangulation and clarification of the qualitative results with the qualitative data (Greene, Caracelli and Graham, 1989). The qualitative findings were published in a journal article by Nagitta and Mkansi (2019). Some of the results are displayed in tables 3 and 4.

Table 3: Emerging market dimensions

SC interdependence with suppliers	Regular communication with supplier (NMS); regular meetings with the supplier; use of e-mails with/ to the supplier; use of personal phone calls with NMS; routine regional monitoring with stakeholders; evaluation meetings with supplier; use of M-Track with other external stakeholders; use of the Rx tool; sharing of schedules with the supplier; regular correspondence with the supplier's representative.
Collaborative partnerships for training	Joint training with NMS; collaborative training with Drug Monitoring Unit; refresher training with Ministry of Health and collaborative training with NGOs.
Information sharing with suppliers, MoH, Donors	Online sharing of information; regular exchanges information, using hard copies of reports; use of IT tools (M-Track); sharing of weekly or monthly reports; holding of quarterly meetings with external stakeholders.
Relationship between lower health units	Hospital's relationship with lower health units; support for redistribution enhances ACT availability.

Table 4: Emerging macro dimensions

Political dimensions	Politicisation of ACTs; political publicity; politicians' interference; political support whenever need arises; awareness by politicians; verification of ACTs; advocacy by politicians, surveillance or monitoring.
Economic dimensions	Poverty within the communities; cost sharing; availability of donor funds.
Social-cultural dimensions	Cliques within the community; culture of self-medication; belief of keeping ACTs by households; public attitude towards the lower health facilities; compliance to dosage.
Technological dimensions	Use of personal phones; use of toll free lines; M-Track system; use of RDT and use of Internet.
Legal dimensions	Testing and dispensing policy; clinical guidelines; regulating consumption; pull policy change.

Source: Nagitta and Mkansi (2019).

We derived the findings by examining each case study independently and the key aspects of the SCC in the respective contexts, and then examining data and findings across the case studies. The assertions emerging from individual case studies were examined to ascertain their wider relevance. Secondly, the FGD data was examined for variables of interest or emerging key ideas, with relevant statements from interviews being grouped together using Nvivo. This was found to be a useful step in the analysis, as it synthesised evidence from the data around a concept of interest. We analysed the synthesised data by examining each of the research questions across the cases. Within each of the research questions, the variables of interest were examined individually, alternating between detailed analyses. Results from cross-case analysis were used to build a theory and an instrument with two primary hypotheses that were subsequently tested using a survey and Confirmatory Factor Analysis (CFA). These results were published in the *International Journal of SCM*. A conceptual model was eventually developed with the attendant hypotheses.

3.5 Stage 5: Pilot study and hypothesised model

The developed instrument had 135 items to represent the dimensions of supply chain coordination. Unlike Singh (2011) and Arshinder, et al. (2011), who did not pre-test their tools, this study pretested the instrument using 10 DTMC members from another hospital which was not part of the study. We revised the questionnaire on the basis of their recommendations. The Cronbach's coefficient alpha was used to test the internal consistency because it is the most common and widely used method (Mehrabi, Siyadat and Allameh, 2013). According to Hair, et al. (2010), coefficients equal to or greater than 0.70 indicate a high reliability of the measuring instrument. The data yielded a Cronbach's alpha of: Market (.815) and Macro (.855). The success of the theoretical model was attributed to the results of the qualitative study, which helped strengthen the hypotheses and survey items.

3.6 Stage 6: Conduct survey and sampling

The unit of analysis was the DTMC members from each hospital. A total of 320 questionnaires were issued to the DTMC members in 40 general hospitals. However, only 304 questionnaires were returned. Of these, 21 were discarded because they had incomplete data (more than 10% missing data). The remaining 283 questionnaires represented a response rate of 88.4%, which is regarded as high (Kothari and Garg, 2014).

The results indicate that 16.6% of the respondents were based in the central hospitals of Uganda, 26% in the North, 29.7% in the East, and 27.6% in the West of Uganda. This implies that all the regions were represented. The majority of the practitioners held a Diploma. Therefore, the information was collected from reasonably well-educated people who knew the medical systems in the country. At least 80% of the participants had experience of more than one year in the pharmaceutical sector. Therefore, the information was collected from well-informed people who knew the medical sector in Uganda.

We subjected the data from Phase Two to confirmatory factor analysis to establish content validity of the *priori* dimensions. Secondly, we used correlation analysis to test the four hypotheses concerning the relationships of the factors to ACTs' availability. Support for these hypotheses provided evidence of validity for the instrument, in the sense that the dimensions identified showed mostly the same relationship to the dependent variables of interest. Construct validity exists, according to (Salisbury, 1989), when different indices (in this case dimensions) show the same relationship to other measures as one would expect, based on the theory in which they appear.

3.7 Stage 7: Factor analysis using confirmatory factor analysis (CFA) and construct validity

CFA was used to confirm or reject the measurement theory. The conceptual model was tested using AMOS V 21.0 to get a better understanding of the relationship among the latent variables. The hypothesised model was analysed using AMOS 21.0 with the maximum likelihood estimation of the covariance of the items, which enabled us to test the empirical validity of the hypothesised model. We utilised several criteria to determine the inclusion of the items and model fit. The appropriateness of the initial model was assessed based on the recommended goodness-of-fit (GOF) indices. Where the overall fitness of the model did not meet the required standards, it was refined based on the logical modification indices provided by the software.

The following steps were observed: first, items had to have a primary factor loading of .50. Second, items had to be unidimensional as demonstrated by the tests of internal consistency and parallelism (Hair, et al., 2010). Internal consistency requires that the items comprising a scale have a similar statistical relationship to the

primary factor. Parallelism requires that the items of a scale have a similar statistical relationship to the other factors. Since AMOS does not directly test for internal consistency or parallelism, we removed items from the model that the modification option of AMOS suggested had a path to another factor. Virtually, this procedure assured that an item only loaded on one factor. For the final model, internal consistency and parallelism were tested using the product rules of internal consistency and parallelism (Hair, et al., 2010). Third, the items had to have homogeneous content. Fourth, the items needed to show an acceptable level of reliability (Cronbach's alpha). Bryman and Bell (2011) described the Cronbach-alpha test as a commonly used test to determine internal reliability.

3.8 Stage 8: Test model and hypotheses

3.2.3 Market environment

CFA was conducted to confirm that factors that were extracted converged as manifest variables of the global latent variable. The results of the CFA indicated that the two manifest variables significantly loaded on the organisation factors (OF), Information Sharing (IS) and Market management environment dimensions. The GOF indices of market dimensions after modification were: GFI= .930, IFI= .965, TLI= .957 CFI= .965, RMSEA = 057. The lower and upper boundaries at 90% confidence interval were .046 and .068, respectively. All the GOF parameters were above the recommended values. The results of the CFA indicated that all the variables significantly loaded on the global latent variable of Suppliers interdependence (SCI), Partnership training (CP), and Information sharing with donors and MoH (ISS). The findings confirmed the validity of the final model with excellent model fit statistics between the model and the observed data.

From the regression weights for the default model it can be stated that H_1 is supported. The availability of malaria treatment therapies strongly correlates with SCI (.59), followed by ISS (.28), while CP had no significant correlation (-.03).

Asamoah, Abor, and Opare (2011) proposed the need for a well-built coordination framework to tackle ACTs' complex partnerships and subnational programmes, hence the rationale for sharing critical information between the general hospitals and external stakeholders. Organisations should be in a position to gather data, organise it, analyse and report accurate, timely and appropriate information to decision-makers to evaluate how supplies flow, account for products, reduce supply imbalances and improve efficiency. Together with information technology and business practices, coordination becomes easier (Ebrahim-Khanjari, Hopp and Iravani, 2012). However, in Uganda, the existing information system is predominantly paper-based.

In support of partnerships, Kembro, Näslund, and Olhager (2017) assert that supply chain partnerships lead to increased information flows, reduced uncertainty, and a more gainful supply chain. Unfortunately, the accuracy of the supply and demand data is most often challenged, something that has negatively impacted the quality of services offered, rate of responsiveness, and operational efficiency.

3.2.4 Macro-management environment dimensions

Upon modifying the model base on the modification indices, the allowable GOF values were achieved: IFI= .976, TLI=.972, CFI= .976, and RMSEA= .039. Accordingly, failure to reject the null is a sign of a good model fit that is a reverse testing procedure in CFA (Blunch, 2017). To test the second hypothesis, standard regression weights were generated. The results indicate that the availability of malaria treatment therapies is mainly affected by legal dimensions (LF, .58) followed by socio-cultural (SC, .39), while political dimensions (PF) have no significant impact on the availability of ACTs.

While political dimension had no significance, politically, medicine attracts a high level of interest, owing to its high economic value, the broad public and private investment, and its impact on the health and well-being of society. As Williams, et al. (2013) assert, all organisations, irrespective of formality, size, or makeup, are made up of structured political aspects that must be understood and managed, and the supply chain is not an exception. Parenthetically, the health budget in most sub-Saharan African countries is still below 15% of the total budget for health, as required under the Abuja Declaration.

However, in Uganda, medicines are the single most expensive out-of-pocket health expenditure item, and therefore, constitute an enormous burden for the ordinary person. With limited financial support from the treasury and also from donors, there will always be a shortage of ACTs. This notion was reiterated by Morris, et

al. (2015), stressing that while ACTs are subsidised, and therefore, the recommended first-line treatment for uncomplicated malaria in most endemic countries, they are prohibitively costly in the retail drug. In determining the most critical SCCD that emerged from the qualitative phase, the hypotheses for making ACTs available in general hospitals in Uganda were adopted for this study.

From the results it can be concluded that the most influential supply chain market environment dimensions that affect the availability of ACTs are Information Sharing with external stakeholders and supply chain interdependence, among others. The macro-environment shows that the socio-cultural, economic, technological and legal dimensions influence the availability of ACTs more. The political dimension scored least and, therefore, was dropped. From the study, the following model was derived.

Market and macro SCCD framework for ACTs in general hospitals in Uganda

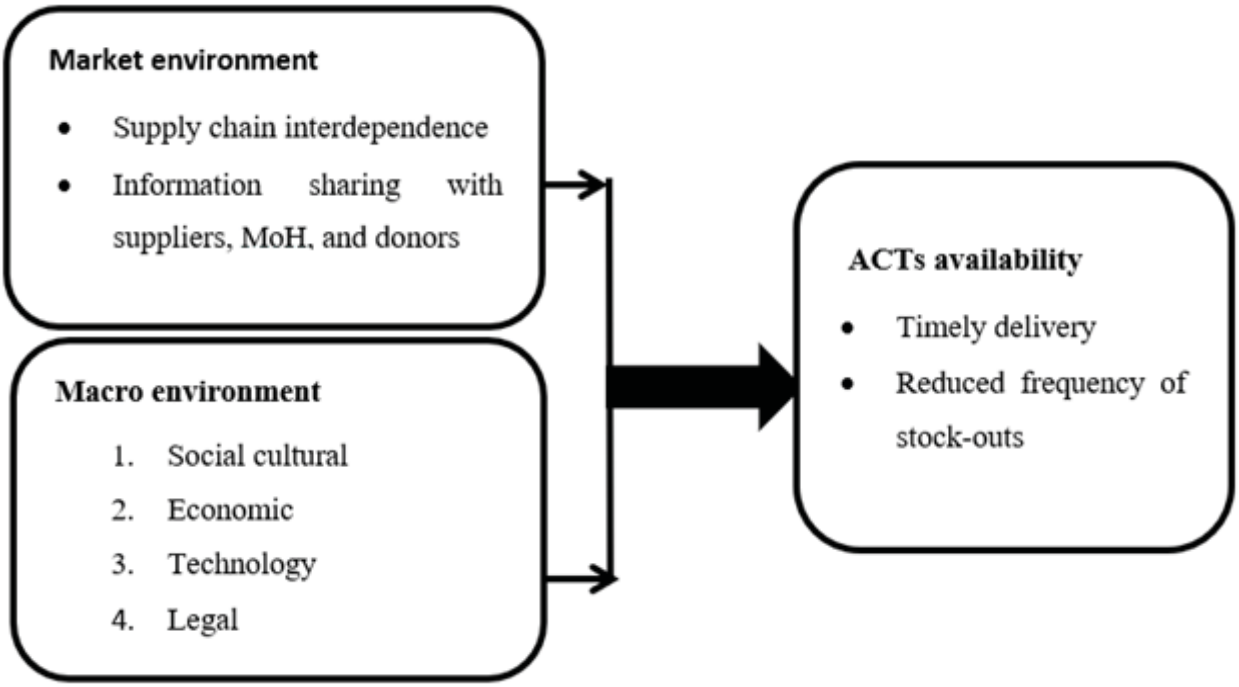

Figure 2*:* A SCC framework for malaria treatment therapies in general hospitals in Uganda

4. Discussion

Following the logic of a mixed methods approach to deconstruct a multi-embedded supply chain coordination problem appears to be the right strategy. In particular, the strength of both methods in refining theory and advancing the knowledge related to supply chain coordination in practice. For example, using both the qualitative and quantitative paths was pertinent for first understanding the coordination dimensions as used by the hospitals, and then explaining this phenomenon in the medicine supply chain context. The study adopted an inductive strategy and employed a multiple case study approach. The success of the theoretical model was attributed to the results of the qualitative study, which helped strengthen the hypotheses and survey items. By following different research approaches, it was critical to answer the various research questions accurately.

This study explored key dimensions from expert focus groups to assist in the development of an instrument that could be used for future studies. The study of the supply chain coordination of malaria treatment pills (ACTs) in selected general hospitals was reflective of the wider public general hospitals in Uganda in terms of content, samples and patterns as supported by Cohen, Lawrence and Morrison (2018). This is especially so, since the research approach included hypotheses testing (Lichtman, 2012) and can, therefore, be repeated at a later date or place and still get the same results (Shank and Brown, 2007). Notwithstanding, there are still some advantages and criticisms related to the efficacy of the mixed method approach. The problems and benefits associated with mixed methods approach are highlighted below.

4.1 Advantages of using mixed methods in the study

The technical advantages of using mixed methods are plentiful. Each approach has clear objectives that differ from each other and complement rather than compete: *"the limitations of one method can be offset by the strengths of the other method, and the combination of quantitative and qualitative data provide a more complete understanding of the research problem than either approach by itself"* (Creswell and Plano, 2011, p.45). The essential purpose of mixing methods in this paper was to obtain the best measurement of multidimensional coordination problem for the study population using the strengths of each of the methods proposed.

In the research presented here, the use of mixed methods was important for three main reasons: (i) allowing for a robust analysis following the triangulation of data, sequencing of data collection and research methods and methodological bilingualism, (ii) identification of priority areas for policy, and (iii) promoting policy uptake at the general hospital level.

From the study, mixed methods were particularly effective in gathering information that would not have been collected in isolation by either the quantitatively or qualitative approach. The integration of the methodologies was essential to develop a complete diagnosis of the ACTs' availability in public general hospitals in Uganda, where supply chain information is either fragmented or non-existent (Ntayi, et al., 2010).

Furthermore, the use of mixed method helped us better account for some of the criticisms of and weaknesses inherent to the qualitative and quantitative methods. For example, the issue of replicability associated with a qualitative research approach. Critics of this approach argue that the constructivist abandoned the scientific methods and procedures of enquiry and investigation (Cohen, 2012). It is alluded that users of the qualitative approach are said to write fiction because they have no means of verifying their true statements. Since the approach is characterised by feelings and personal reports, it is believed that the approach cannot give reliable and consistent data when compared to using quantifiable figures (Atkins and Wallace, 2012). For the purpose of the present study, the reliability of the qualitative data was ensured by considering the trustworthiness of procedures based on the following criteria: credibility, authenticity, dependability, and confirmation (Onwuegbuzie and Johnson, 2006).

For quantitative data, generally three methods were applied to ensure reliability: a) split-half technique, b) item analysis and c) Cronbach's alpha (Cooper and Schindler, 2011). Although the qualitative method is regarded as subjective, misleading, inaccurate and subjective because of the ontological and epistemological paradigms (Cohen, Lawrence and Morrison, 2011), the study triangulated the qualitative findings with the quantitative findings making them credible. Denzin and Lincoln (2005) contend that the constructivists' approach is purely exploratory and makes it difficult and impossible to simplify findings and observations. Qualitative researchers believe that the social world (phenomena and experiences) has many dimensions, hence explanations are based on the interpretations of the researcher (Leedy and Ormrod, 2015). In view of this, the study counteracted this argument by carrying out a survey to gain a proper explanation of the results without depending only on the explanations of the researcher. The implication is that the research can be repeated by another researcher at another place and still get the same results.

Finally, Denscombe (2003) describes quantitative research as one where the researcher detaches himself or herslf. By using the quantitative approach in the second phase of the study, it was seen as a strength of quantitative research approach from one angle, yet from another angle it was seen as its weakness. The issue of the researcher being biased with either the data collection or data analysis was eliminated because we were not in direct contact with the participants, since data was collected using a questionnaire. There was full control for alternatives such as interpretations, explanations, and conclusions. Therefore, the objectivity of the researcher was not compromised. Secondly, this perhaps guaranteed respondents' anonymity.

4.2 Disadvantages of using mixed methods in the study

Despite the usefulness of a mixed method research approach for conducting research in the medicine supply chain, there are still teething problems. By using a qualitative approach, we viewed the social world as being dynamic and not static (Johnson and Christenen, 2014). In view of this, we limited the findings to the particular group of people being studied (DTMC members in public general hospitals). However, this meant that certain behaviour and characteristics observable in a dynamic multi-layered supply chain were not considered. Put simply, even with its best intention, there are limits to the nature of the phenomenological constructs that mixed

methods can uncover in a dynamic social context. Notably, the process of combining the two approaches in a single study is very laborious.

This study was also limited by the choice of research design. It was a cross-sectional study ignoring the importance of a longitudinal design, which can be useful in investigating the characteristics of supply chain coordination mechanisms over time, based on the study variables. Furthermore, since this study was cross-sectional, it could neither discuss nor come up with conclusions on the causality of critical supply chain coordination dimensions, management environment dimensions, and availability of ACTs. Therefore, it was difficult to claim that critical supply chain coordination dimensions, and management environment dimensions can cause changes in the level of ACTs over a long period of time. Although the cross-section limitation can be attributed more to the design than the methods, at best, it reveals some of the boundaries of what can and cannot be achieved through mixed methods, to pave the way for future studies as discussed in the next concluding section.

5. Conclusion

The study aimed to demonstrate the validity of the use of mixed methods in studying the medicine supply chain and its additional value for informing policy processes. Through the integration of information, methodologies, and experience in quantitative and qualitative approaches, we designed a mixed methods diagnosis of ACTs' availability in public general hospitals in Uganda. Through this methodological approach (an exploratory sequential mixed method), the current study contributes to our understanding of SCCD, explaining clearly ACTs' availability in general hospitals in Uganda, and creates an instrument for its measurement, which was subsequently validated using the quantitative procedures.

The qualitative approach (focus group discussions) transcripts enabled an understanding of SCCD in the availability of ACTs and led to the development of an instrument unlike that of previous studies conducted by Singh (2011) and Arshinder, et al. (2011). The quantitative approach allowed the discovery of reality through the statistical analysis of relationships between the independent and dependent variables. Therefore, the research design provided appropriate procedures for an inquiry into the existing phenomenon under study. The use of a mixture of techniques enhanced and refined the results. The reliability of items and construct/content validity of the measurement items were purified based on CFA, thereby confirming their usefulness in measuring the different variables under study. Therefore, this study provides evidence on the use of these measurement items for future scholarly studies. Finally, this study provides direction for further research, based on the empirical and theoretical concepts used.

5.1 Synopsis

In this study, which deconstructed a supply chain coordination problem, the mixed methods approach used an exploratory sequential research approach and methods that represented different research strategies, and which differed in terms of their theoretical, epistemological, and ontological issue. The use of the approach depended on the preference of the method of data collection and analysis. Researching and deconstructing the coordination problem required a focus on the way data was collected and interpreted.

5.2 Theoretical implications

Using a mixed methods strategy, this study made significant findings on the usefulness of the qualitative and quantitative research approaches in deconstructing the supply chain coordination issues in the public general hospitals in Uganda. Therefore, the application of mixed methods research should be enhanced because it serves the advancement of the supply chain management discipline, especially where little or scant information is available. The approach provides a richer understanding and more robust explanation of the phenomena, especially in instances of lack of literature and instruments. The implication points towards fully embracing mixed methods if the supply chain management phenomenon is to be fully understood, other than using a single approach which may not be sufficient for this task.

5.3 Practical implications

The results highlight key policy implications for hospitals. For instance, hospitals and governments should rethink investing in innovative information technology tools that will enhance real-time information exchange with key market and macro chain players. With regards to the macro environment, hospitals must manage the

interdependencies by working closely with the local communities through the creation of awareness, and embrace cheaper technologies while working within the legal frameworks and standard operating guidelines.

5.4 oLimitations

Our study is limited by a number of factors and we discuss the factors in this section and also recommend directions for studies in future. The study is limited to a multi-embedded health care supply chain for ACTs from a general hospital perspective. Specifically, the sample was composed of public general hospitals, leaving out regional, national referral hospitals, faith-based and other lower health centres in Uganda. Our findings cannot, therefore, be generalised across the spectrum of other hospitals. In the future, the instrument can be extended to other multi hospital levels in the country, because the results may vary.

The respondents were Drug Therapeutic Committee Members in charge of forecasting, quantification, procurement, storage and dispensing, and yet there are other people within the hospital, and external to the hospitals, such as suppliers, regulators, and donors, whose decisions affect the supply and distribution chain that were excluded from the study. This study, therefore, missed out on the vital information that these other groups of people would have provided. In future, multi-level studies should take into account all categories of supply chain partners to offer a comparable outcome, including investigating other medicines. In addition, in order to gain a true nature of supply chain coordination, a longitudinal study may be conducted in the future, since practices are gained over time.

References

Alonso, P. L., 2016. Strategic advisory group on malaria eradication assessing the feasibility of malaria eradication, (March). Available at: https://www.who.int/malaria/mpac/mpac-mar2016-strategic-advisory-group-presentation.pdf?ua=1 [Accessed on 20 July 2018].

Arshinder, K., Kanda, A. and Deshmukh, S. G., 2011.A review on supply chain coordination: coordination mechanisms, managing uncertainty and research directions. In: T-M. Choi and T.C.E. Cheng, eds. 2011.*Supply chain co-ordination under uncertainty.* Berlin, Heidelberg: Springer. pp. 39–82.doi: 10.1007/978-3-642-19257-9.

Asamoah, D., Abor, P. and Opare, M., 2011. An examination of pharmaceutical supply chain for artemisinin-based combination therapies in Ghana. *Management research review* [e-journal] 34(7), pp. 790–809. doi: 10.1108/01409171111146689.

Atkins, L. and Wallace, S., 2012. Analysing and reporting qualitative data, [e-book] In: L. Atkins and S Wallace, eds. 2012. *Qualitative research in education.* London, Thousand Oaks CA*:* Sage, pp. 207–228. doi:10.4135/9781473957602.n12..

Babbie, E. and Mouton, J., 2010. *Qualitative data analysis: The practice of social research,* in South African Edition, [e-book] pp. 489–516. Available at: http://books.google.com/books?id=QySynvetGQIC&pgis=1. [Accessed 12 May 2019].

Balcázar Camacho, D. A., López Bello, C. A. and Adarme Jaimes, W., 2016. Strategic guidelines for supply chain coordination in healthcare and a mathematical model as a proposed mechanism for the measurement of coordination effects. *DYNA*, [e-journal] 83(197), p. 203. doi: 10.15446/dyna.v83n197.55596.

Blunch, N. J. 2017. Models with only manifest variables, In: N.J. Blunch, *Introduction to Structural Equation Modeling using IBM SPSS Statistics and AMOS*. 2nd ed. Thousand Oaks: Sage. pp. 109–129. doi: 10.4135/9781526402257.n5. Research Methods. Ch.5

Bryman, A. and Bell, E., 2011. Business research methods: Social research. 3rd Ed. [pdf] Available at: https://www.uwcentre.ac.cn/haut/wp-content/uploads/2018/11/ok.cc.pdf [Accessed 20 April 2019].

Cohen, E. 2012. Flooded : an auto-ethnography of the 2011 Bangkok flood. *Journal of South-East Asia*, 5(2), pp. 316–334.

Cohen, L., Lawrence, M. and Morrison, K. 2018. *Research methods in education.* 8 ed. Research Methods in Education. [e-book] doi: 10.1111/j.1467-8527.2007.00388_4.x.

Cooper, D. R. and Schindler, P. S., 2014. *Business research methods.* 12th Ed. [e-book] Available at: https://www.academia.edu/37556923/ [Accessed on 5 July 2020]

Cooper, D. and Schindler, P. 2011. *Business research methods*, New York, McGraw-Hill.

Creswell, J. W. and Clark, P. V. L., 2007. Understanding mixed methods research (Chapter 1), In: J. W. Cresswell and V.L. P. Clark. 2007. *Designing and conducting mixed methods research*. Available at: https://www.sagepub.com/sites/default/files/upm-binaries/10981_Chapter_1.pdf. [Accessed 13July 2019.]

Creswell, J. W. and Clark, V. L. P., 2011. Choosing a mixed methods design. In: J. W. Cresswell and V.L. P. Clark. *Designing and conducting mixed methods research*. 2nd ed [e-book] doi: 1412927927.

Damien, B.G., Aguemon, B., Abdoulaye, D. A., Bocossa, D., Ogouyemi-Hounto, A. Remoue, F., and Le Hesran., J.Y., 2018. Low use of artemisinin-based combination therapy for febrile children under five and barriers to correct fever management. in Benin: a decade after WHO recommendation. *BMC Public Health*, [e-journal] 18(1). doi: 10.1186/s12889-018-5077-6.

Denscombe, M., 2003. *The good research guide for small-scale social research projects.2nd ed.*Buckingham: Open University Press. Available at: http://scholar.google.com/scholar. [Accessed 31 July 2018].

Denzin, N. and Lincoln, Y., 2005. Introduction: the discipline and practice of qualitative research. In: N. K. Denzin and Y. S. Lincoln. eds. *The Sage handbook of qualitative research*. Thousand Oaks: Sage. pp. 1–32. Available at: https://psycnet.apa.org/record/2005-07735-001 [Accessed 4 July 2020].

Dobrzykowski, D., Deilami, V. S., Hong, P and Kim, S., 2014. A structured analysis of operations and supply chain management research in healthcare (1982-2011), *International Journal of Production Economics*. [e-journal]147(PART B), pp. 514–530. doi:10.1016/j.ijpe.2013.04.055.

Ebrahim-Khanjari, N., Hopp, W. and Iravani, S. M. R. 2012. Trust and information sharing in supply chains. *Production and Operations Management* pp. 444–464. doi: 10.1111/j.1937-5956.2011.01284.x.

Eisenhardt, K. M. and Graebner, M. E., 2007. Theory building from cases: opportunities and challenges. *Academy of Management Journal,* [online], 50(1), pp. 25–32.

Eyaa, S., 2017. *Opportunism in exchange relationships in supply chains :theory development and empirical evidence.* (September). DEd. dissertation presented at the University of New Castle. Unpublished. Available at: https://nova.newcastle.edu.au [Accessed 2 June 2020].

Feachem, R.G., Chen, I., Akbari, O., Bertozzi-Villa, A., Bhatt, S., Binka, F., Boni, M. F., Buckee, C., Dieleman, J., Dondorp, A., Eapen, A., Feachem, N.S., Filler, S., Gething,P., Gosling, R., Haakenstad, A., Harvard, K., Hatefi, A., Jamison, D., Jones, K.E., Karema, C., Kamwi, R. N., Lal, A., Larson, E., Lees, M., Lobo, N.F., Micah, A.E., Moonen, B., Newby, G., Ning, X., Pate, M., Quiñones, M., Roh, M., Rolfe, B., Shanks, D., Singh, B., Staley, K., Tulloch, J., Wegbreit, J., Ju Woo, H., and Mpanju-Shumbusho, W., 2019. Malaria eradication within a generation: ambitious, achievable, and necessary. *The Lancet* [e-journal] pp. 1056–1112. doi: 10.1016/S0140- 6736(19)31139-0.[Accessed 17 December 2019].

Feilzer, M. Y., 2010. Doing mixed methods research pragmatically: implications for rediscovery of pragmatism as a research paradigm. *Journal of Mixed Methods Research*.[e-journal] 4(1), pp. 6–16. doi: 10.1177/1558689809349691.

Flint, D., Gammelgaard, B., Golicic, S.L., and Davis, D.F., 2012. Implementing mixed methods research in supply chain management. *International Journal of Physical Distribution & Logistics Management* [e-journal], 42, pp. 726–741. doi: 10.1108/09600031211269721.

Gao, Y., Li, Z., and Kang, D.S., 2018. Supply chain coordination: a review. *Journal of Advanced Management Science*, [e-journal] 6(4), pp. 213–217. doi: 10.18178/joams.6.4.213-217.

Giménez, C., 2004. Supply chain management implementation in the Spanish grocery sector: an exploratory study. *International Journal of Integrated Supply Management* [e-journal]. 1(1), pp. 98–114. doi: 10.1504/IJISM.2004.004600.

Greene, J. C., Caracelli, V. J. and Graham, W. F., 1989. Toward a conceptual framework for mixed-method evaluation designs. *Educational Evaluation and Policy Analysis* [e-journal] 11(3), pp. 255–274. doi: 10.3102/01623737011003255.

Guest, G., Bunce, A. and Johnson, L., 2006. How many interviews are enough ? An experiment with data saturation and variability. *Family Health International* [e-journal] 18(1), pp. 59–82. doi: 10.1177/1525822X05279903.

Hair, J. F., Anderson, R. E., Tatham, R. L. and Black, W.C., 2010. *Multivariate data analysis*. 7th ed. Englewood Cliffs New Jersey: Prentice Hall.

Huo, B., Zhang, C. and Zhao, X., 2015. The effect of IT and relationship commitment on supply chain coordination: a contingency and configuration approach, *Information andManagement*. [e-journal] doi: 10.1016/j.im.2015.06.007.

Jahre, M., Dumoulin, L., Greenhalgh, L. B., Hudspeth, C., Limlim, P. and Spindler, A., 2012. Improving health in developing countries: reducing complexity of drug supply chains. *Journal of Humanitarian Logistics and Supply Chain Management*, [e-journal] 2(1), pp. 54–84. doi: 10.1108/20426741211226000.

Jain J. K., Dangayach G.S., Agarwal G., B. S., 2010. Supply chain management: literature review and some issues, *Journal of Studies on Manufacturing* [online], I(I), pp. 11–25. Available at: Zttps://www.academia.edu/27435107/Supply_Chain_Management_Literature_Review_and_Some_Issues.[Accessed 4 October 2020]

Johnson, R. B. and Christenen, L., 2014. Educational research :quantitative, qualitative, and mixed methods approaches, *Educational Researche*r [e-journal] Vol. 33, No. 7 (Oct., 2004), pp. 14-26 . doi: 10.3102/0013189X033007014

Kaur, A., Kanda, A. and Deshmukh, S. G., 2015. A graph theoretic approach for supply chain coordination. *International Journal of Logistics Systems and Management* [e-journal] 2(4), p. 321. doi: 10.1504/ijlsm.2006.010379.

Kembro, J., Näslund, D. and Olhager, J., 2017. Information sharing across multiple supply chaintiers: a Delphi study on antecedents. *International Journal of Production Economics* [e- journal] 193, pp. 77–86. doi: 10.1016/j.ijpe.2017.06.032.

Khera, A. and Mukherjee, R. 2019. Artemisinin resistance: cause for worry?, *Journal of Marine Medical Society*, [e-journal] 21(1), p. 4. doi: 10.4103/jmms.jmms_43_18.

Khuluza, F. and Heide, L., 2017. Availability and affordability of antimalarial and antibiotic medicines in Malawi, *Plos one*, [e-journal] 12(4). doi: 10.1371/journal.pone.0175399.

Kothari, C. R. and Garg, G., 2014. *Research methodology: methods and techniques*,. [e-book]. 2nd ed. New Delhi: New Age International. doi: 10.1017/CBO9781107415324.004.

Kumar, R., Singh, R. K. and Shankar, R., 2013. Study on coordination issues for flexibility in supply chain of SMEs: a case study. *Global Journal of Flexible Systems Management*. doi: 10.1007/s40171-013-0032-y.

Lee, A. S., 1991. Integrating positivist and interpretive approaches to organizational research,*Organization Science*, [online] 2(4), pp. 342–365. Available at :http://www.jstor.org/stable/2635169 [Accessed 4 October 2020]

Lee, Y., Song, S. H. and Cheong, T., 2018. The value of supply chain coordination under moral hazard: a case study of the consumer product supply chain, *Plos one*, [e-journal] 13(3). doi: 10.1371/journal.pone.0194043.

Leedy, P. and Ormrod, J., 2015. *Practical research: Planning and design.* 11th Ed. [e-book]. New York, Pearson Education Limited. doi: 10.1017/CBO9781107415324.004.

Lichtman, M., 2012. *Qualitative research in education. A user's guide*, 3rd Ed. Thousand Oaks: Sage .

Malone, T. W. and Crowston, K., 1994. The interdisciplinary theory of coordination', *ACM Computing Surveys*, [online] 26(1), pp. 87–119. Available at: https://dl.acm.org/doi/10.1145/174666.174668 [Accessed 4 October 2020]

Mehrabi, S., Siyadat, S. and Allameh, S., 2013. Examining the degree of organizational agility from employees' perspective (Agriculture-Jahad Organization of Shahrekord City), *International Journal of Academic Research in Business and Social Sciences*, 3(5), pp. 315–323.

Miles, M. B. and Huberman, A. M., 1994. *Qualitative data analysis: an expanded source book*. California, Thousand Oaks: Sage.

Morris, A.,Ward, A., Moonen, B., Sabot, O., and Cohen, J.M., 2015. Price subsidies increase the use of private sector ACTs: evidence from a systematic review, *Health Policy and Planning*, [e-journal] pp. 397–405. doi: 10.1093/heapol/czu013.

Msimangira, K. A. B. and Tesha, C. P. 2014. Global supply chain practices and problems facing developing countries : a Study in Tanzania. *Operations and Supply Chain Management.* 7(3), pp. 130–138. Available at: journal.oscm-forum.org.[Accessed 20 February 2018].

Myers, M., 2000. Qualitative research and the generalizability question, standing firm with Proteus. *The Qualitative Report,* 4(3). [online] Available at: https://nsuworks.nova.edu/tqr/vol4/iss3/9 [Accessed 4 October 2020].

Myers, M. D., 1997. Qualitative research in information systems: living scholarship to support qualitative research. *MIS Quarterly*, 21(2) pp. 241–242.

Nagitta, O. P. and Mkansi, M., 2015. Assessment of coordination frameworks application in the distribution of medical drugs in developing countries. In: *Operations and supply chain management*. 9th International Business Conference, Victoria Falls, Zambia, 20th-22nd September 2015 pp. 24–42. Available at https://www.researchgate.net/publication/332371834_OPERATIONS_AND_SUPPLY_CHAIN_MANAGEMENT_OP_NAGITTA_ASSESSMENT_OF_COORDINATION_FRAMEWORKS_APPLICATION_IN_THE_DISTRIBUTION_OF_MEDICAL_DRUGS_IN_DEVELOPING_COUNTRIES. [Accessed 4 October 2020]

Nagitta, O. P. and Mkansi, M., 2019. Exploring the supply chain coordination dimensions for artemisinin-based combination therapies in Uganda, *International Journal of Supply Chain Management*, 8(4), pp. 134–151.

National Planning Authority Uganda. 2015. [pdf]. *Second National Development Plan - Uganda 2015/16 – 2019/20*, National Planning Authority Uganda. doi: 10.1111/j.1475-6773.2006.00624.x.

Nielsen, L., 2013. How to classify countries based on their level of development, *Social Indicators Research*, [e-journal] 114(3), pp. 1087–1107. doi: 10.1007/s11205-012-0191-9.

Ntayi, J. M. Rooks, G., Eyaa, S., and Qian, C., 2010. Perceived project value, opportunistic behavior, interorganizational cooperation, and contractor performance. *Journal of African Business*. [e-journal] doi:10.1080/15228911003608603.

Office of the Auditor General. 2015. Efficiency of operations of regional referral hospitals in Uganda, (March). [pdf] Available at: http://www.oag.go.ug/wp-content/uploads/2016/07/Efficiency-of-Operations-of-Regional-Referral-Hospitals.pdf [Accessed 21 May 2018].

Onwuegbuzie, A. J. and Johnson, R. B., 2006. The validity issue in mixed research. *Research \in the Schools,* 13(1), pp. 48–63. Available at: http://www.robertrenaud.ca/uploads/2/2/9/6/22962838/onwuegbuzie__johnson_2006.pdf. [Accessed 4 October 2020]

Ramanathan, U. and Gunasekaran, A., 2014. Supply chain collaboration: impact of success in long-term partnerships, *International journal of Production Economics*, [e-journal] 147(PART B), pp. 252–259. doi: 10.1016/j.ijpe.2012.06.002.

Salisbury, C. L., 1989. Construct validity of the adapted questionnaire on resources and stress-short form. *American Journal on Mental Retardation*, 94(1), pp. 74–79.

Saltman, R. B. and Duran, A., 2015. Governance, government, and the search for new provider models. *International Journal of Health Policy and Management*, [e-journal] 5(1), pp33–42. doi: 10.15171/ijhpm.2015.198.

Sammut-Bonnici, T., 2015. Strategic drift. In: *Wiley Encyclopedia of management*. [online] pp. 1–4. Available at: https://onlinelibrary.wiley.com/doi/abs/10.1002/9781118785317.weom120213 [Accessed 16 March 2018].

Saunders, M., Lewis, P. and Thornhill, A., 2016. *Research methods for business students*. 7th Ed. Edinburgh Gate, Harlow: Financial Times Prentice Hall,

Shank, G. and Brown, L., 2007. *Exploring educational research literacy*. [e-book]. doi: 10.4324/9780203943786. [Accesed 5 July 2020].

Shou, Y., 2013. Perspectives on supply chain management in the healthcare industry, *Proceedings of the 4th International Conference on Science and Social Research*, [e-journal] pp. 630–633. doi: 10.2991/icssr-13.2013.144. 13,-14th May 2013, MRIT Unversity Vietnam.

Shretta, R., Liu, J., Cotter, C., Cohen, J., Dolenz, C., Makomva,K., Newby,G., Ménard., Phillips, A., Tatarsky, A., Gosling, R and Feachem, R., 2017. Malaria elimination and eradication, in *Disease Control Priorities, Major Infectious Diseases*, [e-journal] 3(6), pp. 315–346. doi: 10.1596/978-1-4648-0524-0_ch12.

Singh, N., Vaish, B. and Singh, S. R., 2014. Analysis of three level supply chain of inventory with deterioration for multi-items. *International Journal of Industrial Engineering Computations*, [e-journal] 5(3), pp. 417–430. doi: 10.5267/j.ijiec.2014.4.001.

Singh, R. K., 2011. Developing the framework for coordination in supply chain of SMEs. *Business Process Management Journal*. [e-journal] doi: 10.1108/14637151111149456.

Singh, R. K., 2013. Prioritizing the factors for coordinated supply chain using analytic hierarchy process (AHP), *Measuring Business Excellence*, [e-journal] 17(1), pp. 80–97. doi: 10.1108/13683041311311383.

Singh, R. K., Kumar, R. and Kumar, P., 2016. Strategic issues in pharmaceutical supply chains: a review, *International Journal of Pharmaceutical and Healthcare Marketing*. [e-journal] doi: 10.1108/IJPHM-10-2015-0050.

Soosay, C. A. and Hyland, P., 2015. A decade of supply chain collaboration and directions for future research. *Supply Chain Management*, [e-journal] pp. 613–630. doi: 10.1108/SCM-06-2015-0217.

Spisak C., Morgan L., Eichler R., Rosen J., Serumaga B. and Wang, A., 2016. Results-based financing in Mozambique's central medical store: a review after 1 year. *Global Health Science and Practice*, [online] pp. 165–177. doi: 10.9745/GHSP-D-15-00173.

Stake, R. E. 1995. *The art of case study research: perspectives on practice*, [e-book]. New Delhi: International Educational Publishers and Professional Publishers. Available at: https://books.google.co.ug/books?id=ApGdBx76b9kC&printsec=frontcover&dq [Accessed at 5 July 2020].

Tashakkori, A. and Teddlie, C., 2010. Research questions in mixed methods research. In: *SAGE handbook of mixed methods in social & behavioral research*, [e-journal] p. 912. doi: 10.17051/io.2015.07705. [Accessed 31 July 2019].

Thompson, J. D., 1967. *Organizations in action: social science bases of administration*, *Transaction Publishers*. [online] University of Illinois at Urbana-Champaign's Academy for Entrepreneurial Leadership Historical Research Reference in Entrepreneurship. Available at SSRN: https://ssrn.com/abstract=1496215 [Accessed 4 July 2020].

UBOS., 2016. Uganda 2016., Demographic and health survey: key findings. *Uganda 2016 demographic and health survey* [online]. Available at https://www.ubos.org/wp-content/uploads/publications/07_2018UDHS_2016_FInal.pdf [Accessed 22 August 2019].

USAID | Task Order 1., 2011. The Logistics handbook: A practical guide for the supply chainmanagement of health commodities[online] p. 174. Available at: http://deliver.jsi.com/dlvr_content/resources/allpubs/guidelines/LogiHand.pdf. [Accessed 22 August 2019].

Üsdiken, B., 2014. Centres and peripheries: research styles and publication patterns in "Top" US journals and their European alternatives, 1960-2010. *Journal of Management Studies*. [e-journal] 51(5), pp. 764–789. doi: 10.1111/joms.12082.

Watsierah, C. A. and Ouma, C.. 2014. Access to artemisinin-based combination therapy (ACT) and quinine in malaria holoendemic regions of western Kenya. *Malaria Journal*, [e-journal] 13(1). doi: 10.1186/1475-2875-13-290.

Williams, B.D., Roh, J., Tokar, T., Swink, M., 2013. Leveraging supply chain visibility for responsiveness: the moderating role of internal integration, *Journal of Operations Management*, [e-journal] 31(7–8), pp. 543–554. doi: 10.1016/j.jom.2013.09.003.

World Health Organisation., 2017. *World malaria report 2017* Geneva, World Health Organization.[online] doi: 10.1071/EC12504. [Accessed 22 August 2019].

Yadav, P., 2015. Health product supply chains in developing countries: diagnosis of the root causes of underperformance and an agenda for reform, *Health systems & reform*, [e-journal] 1(2), pp. 142–154. doi: 10.4161/23288604.2014.968005.

Yin, R. K. 2003. *Case study methodology: case study research design and methods*, 3rd Ed. Thousand Oaks CA: Sage.

Yin, R. K., 2013. Identifying your case (s) and establishing the logic of your case study: *Case study research: design and methods*, [e-journal] pp. 25–66. doi: 10.1097/FCH.0b013e31822dda9e. [Accessed 26 January 2018].