Contraception supply chain challenges: a review of evidence from low- and middle-income countries

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Abstract

Purpose: To identify and assess factors determining the functioning of supply chain systems for modern contraception in low- and middle-income countries (LMICs), and to identify challenges contributing to contraception stockouts that may lead to unmet need.

Materials and methods: Scientific databases and grey literature were searched including Database of Abstracts of Reviews of Effectiveness (DARE), PubMed, MEDLINE, POPLINE, CINAHL, Academic Search Complete, Science Direct, Web of Science, Cochrane Central, Google Scholar, WHO databases and websites of key international organisations.

Results: Studies indicated that supply chain system inefficiencies significantly affect availability of modern FP and contraception commodities in LMICs, especially in rural public facilities where distribution barriers may be acute. Supply chain failures or bottlenecks may be attributed to: weak and poorly institutionalized logistic management information systems (LMIS), poor physical infrastructures in LMICs, lack of trained and dedicated staff for supply chain management, inadequate funding, and rigid government policies on task sharing. However, there is evidence that implementing effective LMISs and involving public and private providers will distribution channels resulted in reduction in medical commodities’ stockout rates.

Conclusions: Supply chain bottlenecks contribute significantly to persistent high stockout rates for modern contraceptives in LMICs. Interventions aimed at enhancing uptake of contraceptives to reduce the problem of unmet need in LMICs should make strong commitments towards strengthening these countries’ health commodities supply chain management systems. Current evidence is limited and additional, and well-designed implementation research on contraception supply chain systems is warranted to gain further understanding and insights on the determinants of supply chain bottlenecks and their impact on stockouts of contraception commodities.
12 countries with the most commonly cited issues being related to supply-chains [10]. Three types of contraception were only offered at rural service delivery points (SDPs) 85% of the time in 16 out of 32 countries surveyed, further demonstrating the continued need to evaluate access and supply chains for FP and contraception programmes.

The projected growth in demand in many LMICs will result in substantially increased contraception use, straining an already-inefficient supply chain system that is unable to keep pace with the growing need. It is crucial for FP and contraception programmes to secure reliable, predictable and long-term funding to match increased demand, but it is equally important to develop and establish reliable end-to-end supply chain systems that focus both on moving products from one place to another, and on satisfying clients’ contraception needs [11]. The principal goal of an efficient supply chain system is ensuring that needed goods and services reliably reach the end user/client. Glaring insufficiencies continue to exist in primary health centers as well with the UNFPA finding in 2015 that of 32 LMICs surveyed, only 19 reported 85% of primary health centers having three or more forms of contraception, a decline from 22 countries 2014 [10]. In addition, the UNFPA has found that lack of trained staff hampers the availability of many LARCs as contraceptive options negatively affecting access to FP and contraception uptake [10]. Efficient supply chains enhance quality of care and support choice of modern contraception methods by reducing stockouts of contraceptives and related medical equipment. Progress is possible exemplified by the successful case example of the Rwandan government’s commitment to strengthening supply chains for modern contraceptives, which resulted in reduced stockout rates for the four major contraceptive methods [12]. Studies reveal that strengthened supply chain systems can enhance contraceptive security, where all clients with a need to use FP can freely choose, obtain, and use good-quality contraceptives. This freedom to choose is only possible with a well-managed and reliably funded supply chain system [11].

Rationale

Supply chain systems play a central role in ensuring end users an accessible and reliable supply of modern contraceptives, reducing stockouts and increasing uptake of modern contraceptives in LMICs. Despite several policy and programme interventions by national governments, donor agencies, and private foundations to increase uptake of modern contraceptives [7], LMICs continue to experience high rates of unmet need, nonuse and discontinuation due to a number of factors, including persistent stockouts [1,6,9,11]. However, there is current uncertainty concerning the determinants of supply chain bottlenecks on persistent contraception stockouts in LMICs. A comprehensive summary of studies on contraceptives supply chains is clearly warranted to identify system inefficiencies and potential interventions to minimize stockouts and to establish a functioning supply chain management system. The main purpose of this systematic review is to assess determinants of functional contraceptive supply chain systems in LMICs. We also wished to identify best practices for improving efficiency in modern contraception supply chain systems in LMICs in order to ensure reliable supply, and in eliminating stockouts.

Methods

Search strategy

We searched the Database of Abstracts of Reviews of Effectiveness (DARE) to establish whether there are related reviews done on our intended study topic and we found none. Although we did not limit our study search to any particular time period, we did not find any studies older than 1970s. We searched the following electronic databases for published studies and unpublished gray literature: PubMed, MEDLINE, POPLINE, CINAHL, Academic Search Complete, Science Direct, Web of Science, Cochrane Central, Google Scholar and WHO databases (AIM, LILACS, IMSEAR, IMEMR and WPRIM). In addition, we extended our search to include specialized journals in FP and contraception, and websites of key organisations working in the field of reproductive health and related areas, including reports and other unpublished material from U.S. Agency for International Development (USAID), United Nations Population Fund (UNFPA), Management Science for Health (MSH), FHI360; Population Service International (PSI), John Snow Inc. (JSI) and Marie Stopes International (MSI). We primarily used selected index terms and free text terms related to supply, transportation, storage, and distribution of FP and contraceptives in LMICs, but also searched by hand to check for additional potentially eligible studies.

Inclusion criteria

Due to a paucity of randomized controlled trials and other intervention studies, we included unpublished well-written literature with clear descriptions (for example, reports published by organisations such as USAID, JSI, PSI, MSI and FHI360) of research on interventions to enhance supply, transportation, storage, and distribution of modern FP and contraception methods to end users in LMICs. With no restrictions on language, interventions included in this review addressed supply bottlenecks at all levels, including national, local governments, health facilities and at individual (both skilled and unskilled health providers). Supply chain management concerns the steps involved in moving a product from the supplier to the customer [3]. We defined the contraceptive methods supply chain for this study to mean all stakeholders involved in the process of moving contraceptives from national level to end users. Supply chain bottlenecks are all barriers or limitations arising while contraception methods are moved from manufacturers to the local level in LMICs, along with barriers to making contraception available to end users when and where needed.

Outcome measures of interest

The studies we included in this review examined the effects of intervention programmes on one or more of the following primary indicators: (a) stockout rates, (b) number of new users reached, (c) flow of contraception methods from national stores to clients/end users, (d) availability of contraception methods at local facility levels, and (e) information flow both up and down the supply chain. The following secondary indicators have been reviewed: (a) potential for scaling up the intervention, and (b) utilisation of community providers to distribute contraception.

The two authors independently assessed identified studies’ titles and abstracts to evaluate their eligibility.
Determination of eligibility for inclusion was based on topic, scope and population of study. Full text papers that were identified as potentially relevant by one or both of the review authors were retrieved and saved in EndNote. Then, the two reviewers independently assessed the retrieved studies to determine if they met our inclusion criteria. Any disagreements that came up at this stage between the review authors were discussed and resolved. Studies included in this review were obtained from a literature search process in two phases, conducted between June 2015 and April 2016. In phase I, we used keyword search strategy on different online databases and gray literature sources, our initial search yielding 2664 published and unpublished references. After screening only 112 studies were retained for full article review in phase II (see Figure 1).

During this phase, we read all articles in their entirety and made a joint decision to either exclude or include the article in the final review. After full text examination ultimately only 10 were found eligible and were included in the final assessment.

**Results**

**Characteristics of the reviewed studies**

Ten studies met our inclusion criteria [13–22] and were conducted in Africa (Ghana, Ethiopia, Malawi, Morocco, Rwanda, Senegal, Uganda and Zambia). Ethiopia was the most represented country with three studies, Malawi and Uganda each had two studies each, while Ghana, Morocco, Rwanda, Senegal and Zambia had one study each.

**Review of the interventions**

Five studies [10] in Ethiopia, Malawi and Rwanda; in Morocco [14]; in Senegal [16]; in Malawi [20]; and in Zambia [22] focused on strengthening supply chain systems at different levels (national, regional, district and local). Interventions in the other five studies Uganda [13]; Ghana [17]; Ethiopia [18,19]; Uganda [21] were used to assess whether including CHWs as part of an extended supply chain system increased distribution of medical commodities to hard-to-reach rural clients, particularly injectable contraceptives (Depot medroxyprogesterone acetate [DMPA]).

These studies shared the common goal to address challenges to distributing preferred contraception methods for LMIC clients. Some of the studies examined supply chain bottlenecks for a broad range of medical commodities [15,20,22]. The participants in the reviewed studies ranged from community-based providers and their clients to key informants, such as district health officials, local health center officials, and LMIS experts.

**Bottlenecks in contraception supply chain management system in LMICs**

The reviewed studies pointed to several supply chain barriers contributing to high stockout rates for modern FP and contraception methods in LMICs [14,16,22], especially at local level facilities in rural and peripheral areas where hard-to-reach clients reside. Some of the key themes that emerged from the review are summarized as below.

**Weak and lack of institutionalized LMISs and inadequate information about inventory, financing, and product flows to guide procurement**

The studies identified distribution system inefficiencies and lack of institutionalized LMISs as critical barriers to effective contraception supply chain management systems in LMICs.
Several studies \cite{14,15,16,22}. Morocco’s highly complex ‘pull-based’ supply chain system involved excessive steps and relied on the accuracy of 900 minimally-trained midwives at service delivery points to make contraception forecasts \cite{14}. The system required facilities to pick up supplies from the warehouse at their own expense, and many facilities kept poor inventory records. In Senegal, Daff et al. \cite{16} posited that the system inefficiencies contributed to lack of accurate and timely data, the key pre-requisites to a well-functioning supply chain system.

Vledder et al. \cite{22} found that Zambia’s three-tier public sector system (where the central warehouse supplies to the district warehouses which in turn send supplies to the health facilities) for delivering essential drugs was characterized by inefficiencies at the health facility level, resulting in frequent stockouts. Pre-intervention assessments showed that more major supply chain bottlenecks existed at the secondary distribution level from district to health facilities than with primary distribution – from national storehouses in Lusaka to the district level. According to Vledder et al. \cite{22}, Zambia’s distribution system lacked accurate data about demand for contraception due to poor inventory management, especially at the secondary level, making sound supply decisions below the district level difficult.

Various interventions revealed the challenge of poor information systems as a major bottleneck to effective and efficient supply of FP and contraception commodities in LMICs \cite{14–16,20,22}. Lack of well-functioning communication systems in Zambia, especially between district central stores and local health facilities, forced health facility to frequently accompany their requisitions in person to the district, and pick up stock \cite{22}. The pre-intervention studies done by Daff et al. \cite{16} in Senegal indicated that poor record keeping at facility level provided little visibility into contraceptive method preference and consumption. Lack of accurate and timely data limited the supply chain’s ability to meet client demands. In the study covering three countries (Ethiopia, Malawi and Rwanda), Chandani et al. \cite{15} noted that communication was a common barrier, undermining efficiency and effectiveness of the supply chain of modern FP and contraception commodities in these countries. Specifically, Chandani et al. found that poor communication between different levels of the supply chain in Ethiopia and Malawi made obtaining information to inform supply chain decision difficult, and contributes to the frequent stockouts of contraception commodities at local facilities.

**Inadequate infrastructure, including insufficient road networks and lack of appropriate storage facilities**

Several studies \cite{15,16,22} identified lack of reliable and poorly maintained physical infrastructures such as road networks and warehouses, to be a major bottleneck hindering effective and efficient supply of modern FP and contraception commodities in LMICs. Vledder et al. \cite{22} found that Zambia’s poor road network system, made secondary level distribution of contraception supplies from the district to health facilities challenging. Vledder et al. \cite{22} noted that Zambia’s health clinics are geographically dispersed with some located in villages with impassable roads due to bad terrain, making certain health facilities completely inaccessible during the rainy season. Some facilities are only accessible with off-road vehicles, with or without rain \cite{22}.

Similarly, Daff et al. \cite{16} identified transportation as a critical bottleneck to supply chain of FP and contraception commodities in Senegal. Facilities are responsible for picking up and transporting supplies from warehouses at their own expense \cite{16}. Zambia had insufficient vehicles at the district level to complete all necessary tasks for the district central stores. The vehicles that did exist broke down regularly because of poor roads and high usage. Chandani et al. \cite{15} noted that rural locations are characterized by difficult geographies, making transit to contraception resupply points burdensome. In some rural locations, public transport is also either unavailable or costly, so local providers rely on non-motorized forms of transport such as bicycles, donkeys, camels, boats, and even walking.

Chandani et al. \cite{15} noted lack of appropriate storage facilities for contraceptive methods is a critical supply chain barrier in rural areas where local community health workers are the providers of choice. A majority of community health workers store medical commodities in boxes together with paperwork in limited storage places in their own houses, potentially compromising drug quality and security. Shieshia et al. \cite{20} indicated that in Malawi the challenge of poor health infrastructure, including weak supply chain systems, was a critical barrier to supplying contraception products, leading to frequent stockouts at the community level.

**Absence of a stable, well-trained human resource based dedicated to supply chain management**

Many government organisations find it difficult to recruit and retain staff with supply skills \cite{23} and ministries of health often have insufficient human resources dedicated to the medicine supply chain. This is further compounded by high staff turnover. The studies reviewed also pointed to a lack of dedicated logistics staff, from national stores all the way to local facilities in Ethiopia, Malawi, Rwanda and Senegal \cite{15,16,19,20}. According to Shieshia et al. \cite{20}, the shortage of committed, skilled human resources to manage the supply chain system for essential commodities in Malawi left supply chain responsibilities in hands of less-skilled health workers. In Senegal, the distribution system depended on poorly trained and overburdened midwives to manage stocks and making forecasts for contraception \cite{16}. FP programmes depend on the uninterrupted flow of contraceptives through multiple levels of the supply chain. If the system lacks trained, committed professionals to manage it, an erratic supply of contraceptives results along with constant stockouts and loss of programme credibility in eyes of the clients.

In their intervention study to identify proven, simple, affordable solutions that address the unique supply chain challenges faced by community health workers who may not be able or trained to deliver contraceptives (CHWs), Chandani et al. \cite{15} located a major roadblock to LMIC public health supply chains in the shortage in human resource capacity and skill. Prata et al. \cite{19} found that shortage of highly skilled health care providers in rural and peripheral areas of Ethiopia was a strong barrier to expanding the supply of contraceptives. Lebetkin et al. \cite{17} also
noted similar findings in Ghana, arguing that lack of trained health workers greatly impeded distribution of modern FP and contraception methods to clients. Lebetkin et al. [17] emphasized that the shortage of human resources was even greater in rural parts of the country, where there was high demand, but fewer facilities and weaker distribution chains.

Inadequate domestic and international funding for the procurement of commodities

Several of the interventions in this review noted that lack of consistent and adequate financial resources was a leading limitation affecting modern FP and contraceptives supply chains, potentially contributing to high stockout rates in LMICs [14,16,22]. Despite increased commitment to addressing FP and contraception needs, neither donors nor national governments have kept pace with the ever-increasing demand for contraceptives in LMICs. Daff et al. [16] noted that the Senegal’s government offered little support to local facilities. The pull-based system required them to replenish supplies using their own ready cash, however most facilities had limited working capital. Therefore, health facilities with limited financial capacities to get resupplies experienced higher stockouts.

Rigid government policies regarding task sharing can break down the supply chain

According to several study findings, community-based health workers, local drug shop operators and chemical seller shops are an integral part of the contraception supply chain system that helps make modern contraceptives available to clients in LMIC rural areas, where health facilities are either fewer or non-existent and the shortage of trained health staff is acute [13,15,19]. This implicates the supply chain because it is a problem with the organizational structure of the supply chain when there are not appropriate personnel to deliver the product. However, studies indicate that with available evidence, task shifting is safe and has contributed significantly to expanding access to medical commodities including FP and contraception methods in countries such as Madagascar, Malawi, and Uganda. However, this approach is not yet fully embraced in many LMICs. In their intervention to determine if CHWs in a rural region of Ethiopia could provide injectable contraceptives to women with similar levels of safety, effectiveness and acceptability as health extension workers (HEWs), Prata et al. [19] noted that community-based reproductive health agents (CHRHA) were not authorized on safety grounds to administer DPMA. With critical shortages of skilled-health workers, especially in rural areas of LMICs, rigid government policies that fail to embrace the role of community health workers in distributing contraception methods to hard-to-reach clients, are a huge impediment to contraceptive security initiatives.

Discussion

Availability of contraceptive commodities goes beyond simply supporting better health for women and their children. In Ethiopia, the continued governmental commitment to ensure commodity availability has contributed to improved health for women and children, which also may improve family income and education for children [24]. This shows that successful supply-chain management of contraceptives has the ability to affect health, educational, and economic outcomes.

The studies reviewed here indicated a strong association between supply bottlenecks and stockouts for modern FP and contraceptives in LMICs. The major reasons for stockouts include poor planning, forecasting and quantification of contraception by the health workers who do not have adequate training. There are also issues of weak infrastructure and in-country capacity for managing contraceptive supply chain owing to unskilled human resources. The absence of any accountability mechanism for stockouts at national, state, and local levels is also important to note in this context.

The two major supply chain improvement interventions found were improving LMISs and expanding local distribution channels by engaging existing community providers in the private and public sector for a total market approach. Positive primary and secondary outcomes resulted from these two interventions, including zero or reduced stockout rates, reaching increasing numbers of new users, improving availability of contraceptives methods at health facilities, higher contraception prevalence rates in rural communities, and improving availability of timely, accurate data at different levels in the supply chain. These interventions may be considered when considering interventions to improve supply chains for health commodity delivery.

The reviewed studies recognize that effective FP programmes depend on uninterrupted flow of contraceptives through multiple levels of the supply chain, from central warehouses to community-level health facilities and alternative local distributors, such as CHRAs. Addressing the challenge of workforce shortages will ensure availability of qualified staff to man supply chain systems and improve physical infrastructures such reliable road networks. A simple, well-functioning LMIS facilitates smooth flow of information and contraception commodities from central stores to users in local areas.

Recently, national collaborative platforms or VANs (Visibility and Analytics Networks) have been adapted that use supply chain data from multiple sources to improve decision making [10]. There have been increased efforts to create a global VAN that streamlines access to in-country data and reduces parallel data flows, while also capturing data from manufacturers, procurers, freight forwarders, and others in the supply chain. The global VAN facilitates harmonisation and provides a single platform for obtaining the data needed to ensure the supply of products to country programmes [25]. Further adoption of common data standards and innovative ‘trace and tracking’ options for health commodities will facilities global metrics and result in better supply flow [26,27].

Alternative methods of distribution to the pull-based model should be considered, such as the informed push model (IPM) used for distribution of contraceptives as used in Senegal because it has resulted in greater operational efficiencies and has the potential for increased quantities of supplies to drive demand and use in Senegal [16]. Moreover, an approach that leverages the strengths of both the public and private sectors with involvement of local providers, such as CHWs, CRHAs, drug shop operators,
and authorized chemical sellers in contraceptive distribution will increase prevalence rates among rural hard-to-reach clients. The roles of the local providers may be especially useful if they are able to reach new users and provide new methods of contraception, especially in rural areas. Additional local providers may be able to provide otherwise unavailable LARCs, such as injectable contraception, which could be more effective and may lessen the burden on the supply chain compared to methods that require more, regular supply (such as birth control pills).

Finally, increased funding will allow for better maintenance of the supply chain system, conducting needed training for capacity building, and conducting research on new and more simplified LMIS technologies.

Strong commitments by governments towards strengthening supply chains for modern contraception, as evidenced by the governments of Ethiopia, Malawi and Rwanda, can be very beneficial by improving product flow, data flow and the effectiveness of personnel [15]. To be effective and efficient, supply chain interventions must have political commitment from national governments, active involvement of all stakeholders, adequate financial and manpower resources, appropriate quality and quantity of supplies and effective logistics management including forecasting, inventory control, distribution and data. By working on these elements, more women will have the ability to access appropriate modern contraception.

Limitations

We encountered some limitations while carrying out this review. The main limitation is a lack of randomized control trials in the reviewed studies and all studies included focused on the Africa region. The possible reason for this focus can perhaps be the fact that most of the countries in Africa face myriad of challenges in contraception i.e. low contraceptive prevalence and high unmet needs in family planning (FP). In future, it is encouraged to conduct similar research in other regions so that conclusions are context specific to LMIC in all continents. However there are lessons to be learned from these countries as, albeit with some differences, it is likely that similar challenges exists in the supply chains for FP commodities in countries with similar levels of development in Latin America and Asia. In this context, it is important to carefully interpret and apply results to other LMICs settings. Finally, it was not possible to conduct a meta-analysis and compare results across studies due to the level of diversity that was observed across selected studies in terms of the study samples that were used, the measures that were calculated, and the range of methods and approaches that were implemented.

Conclusion

We conclude that supply chain bottlenecks contribute significantly to persistent high stockout rates of modern FP and contraceptives in LMICs. To meet growing demand for contraceptives in LMICs, there is a need to perform quality supply chain systems diagnostics and propose supply chain redesign where needed, review distribution networks, efficiently and strategically locate storage systems, and ensure adequate staffing and training. Results of this study provide evidence that developing national capacity for planning, programming, oversight, monitoring and evaluation is vital for a properly functioning supply chain management system. Ensuring supply chain best practices including establishment of institutionalized LMISs, improvement in physical infrastructures, expanding local level distribution channels and integrating effective partnership at all levels, and addressing shortages of trained workforce improves supply chain systems’ performance and plays a significant role in addressing the challenge of contraception stockouts. National leadership and ownership is considered critical for sustainability, effective documentation and sharing of research findings on effective FP practices among LMICs. Improvements in accessibility, quality, and availability of multiple contraceptive methods will improve FP programmes and contribute in achieving the global targets set in reaching out to additional 120 million women and girls with the contraceptive methods of their choice thus reducing unmet need in FP.

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Disclaimer

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