



GAVI Supply Chain Strategy People and Practice Evidence Review, March 2014

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ACRONYMS

ARV	Antiretroviral
CCL	Cold Chain Logistics
GAVI	Global Alliance for Vaccines and Immunization
HIV/AIDS	Human immunodeficiency virus/Acquired immunodeficiency syndrome
iSCL	Immunization Supply Chain and Logistics
MoH	Ministry of Health
PSM	Procurement and supply management
SCM	Supply chain management
UNFPA	United Nations Population Fund
UNICEF	United Nations Children's Fund
USAID	US Agency for International Development
WHO	World Health Organization

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EXECUTIVE SUMMARY

Background

A strong vaccine supply chain that improves access to immunization in all GAVI-eligible countries is critical to GAVI's mission to save children's lives and protect people's health. However, developments in immunization and GAVI's increasing vaccine investments are placing a strain on the vaccine supply chains built to deliver vaccines.

Recognizing the importance of this work, the GAVI Alliance partners, GAVI Secretariat, WHO, UNICEF, and the Bill & Melinda Gates Foundation are currently designing a supply chain strategy to increase investment in supply chains, coordinate global activities on the issue, and ensure that more children receive the vaccines they need. The purpose of the review is to identify and document evidence to support the hypotheses proposed by the People and Practice Working Group, and the recommended interventions.

Methodology

The study adopted a systematic review of the evidence using three techniques: bibliographic online searches using keywords; use of websites of international organizations that support, fund or monitor issues related to health supply chains; and finally, a grey literature search used to unearth further information by examining and following up sources from different websites.

The review sought to address the following six hypotheses:

- *Many elements of immunization supply chain functions are not performed by logistics professionals;*
- *People who manage the supply chain (transport, storing, handling, etc.) are inadequately trained and do not have ready access to appropriate training;*
- *Ministry of Health (MoH) leadership and staff are not empowered to make critical decisions and investments that positively impact the supply chain;*

- *The supply chain management (SCM) organization is inadequately designed to face the increasing complexity and challenges of the supply chain;*
- *There is a lack of proper incentives and performance management to enable people who manage the supply chain; and*
- *Poor supply chain practices result in weak information systems, poor cold chain and vaccine management, and ultimately stock-outs and wastage.*

The findings of the study were compiled in a table of evidence to help inform the People and Practice Working Group as well as donors and others interested in the development of health supply chains.

Summary of the main findings

The following are the main findings of the review relating to each hypothesis:

1. **Professionalization:** There is a general consensus that immunization supply chain functions are frequently performed by untrained health workers for the function, such as pharmacists, clinicians and drivers in developing countries;
2. **Training:** Lack of training was indeed a central issue for those managing the supply chain, and the available training was often too rigid, distributed in a geographically uneven way and did not prepare individuals to connect and coordinate with the key institutions;
3. **Empowerment:** Poor availability of accurate national data and a misunderstanding of the importance of SCM in relation to global health arose as key impediments to MoH empowerment;
4. **SCM Organization:** The SCM organization has not responded adequately to meet new demands. There is inadequate capacity in the supply chain necessary to deal with the dual issues of demographic and epidemiological change, and future influx of new vaccines;

5. **Incentives and performance management:** For SCM staff performance to be managed well requires SCM to be professionalized, accountability and transparency to be increased, and both financial and non-financial factors to be considered.

6. **Poor supply chain practices:** Poor monitoring systems and poor knowledge of both drugs and the supply chain are causal factors of drug wastage and stock-outs. In some cases, it is estimated that up to 50% of vaccine doses are wasted by not being administered (Sabot et al. 2011).

A clear direction arises from this study, which combines HRH practices and SCM capabilities. The issues discussed in each hypothesis are in reality interconnected in a complex web which HRH theory goes some way to explain. While human resources issues in immunization supply chains need to be considered in conjunction with other critical supply chain areas including: system design, data management, cold chain equipment, transport and distribution.

The recently published 'Human Resources for Supply chain Management Assessment Guide and tool' and 'Capacity Plus Technical Brief 12' articulate the HR aspects of these complex relationships and bring a systematic approach to the human resource issues in immunization and health supply chains more broadly (USAID | DELIVER Project and People that Deliver. 2013b, CapacityPlus 2013).

The literature in this area is limited and more research is needed, beyond what was possible in the time-frame for this study, to help inform future investment and decision making. Specifically it would seem appropriate to scrutinize in greater detail how SCM is or could be professionalized in the developing world. Secondly, an assumption in the literature is that increased accountability follows recognition – however more evidence is required to support this. It appears particularly urgent to action a systematic approach to tackle these issues in order to increase the effectiveness of health supply chains.

1 INTRODUCTION

An effective public health supply chain requires motivated and skilled people with competencies in various essential supply chain functions. Staff must be empowered to make decisions that positively impact health supplies and supply chains. In many countries, a lack of trained staff and poor supply chain practices are frequent causes of poor performance, resulting in weak information systems, poor vaccine management, and ultimately stock-outs and wastage.¹

1.1 Background

Critical to GAVI's mission to save children's lives and protect people's health by increasing access to immunization in poor countries is a strong vaccine supply chain in all GAVI-eligible countries. However, developments in immunization and GAVI's increasing vaccine investments are placing a strain on the vaccine supply chains built to deliver vaccines in developing countries.

Recognizing the importance of this work, the GAVI Alliance partners GAVI Secretariat, WHO, UNICEF, and the Bill & Melinda Gates Foundation are currently designing a supply chain strategy that will seek to increase investments in supply chains, coordinate global activities on the topic, and ensure that more children receive the vaccines they need.

The People and Practices Priority Working Group (comprising members from various health agencies and donors), has been established to aid in the development of the GAVI Alliance Supply Chain Strategy, through focusing on people and practices. The complete strategy will inform the GAVI Secretariat and partners on allocation of time and resources.

This paper reviews the evidence for six hypotheses that the People and Practice Working Group has proposed. The hypotheses are:

- *Many elements of immunization supply chain functions are not performed by logistics professionals;*

¹ <http://deliver.jsi.com/dhome/whatwedo/capbuilding/cbhrscm>

- *People who manage the supply chain (transport, storing, handling, etc.) are inadequately trained and do not have ready access to appropriate training;*
- *Ministry of Health (MoH) leadership and staff are not empowered to make critical decisions and investments that positively impact the supply chain;*
- *The supply chain management (SCM) organization is inadequately designed to face the increasing complexity and challenges of the supply chain.*
- *There is a lack of proper incentives and performance management to enable people who manage the supply chain.*
- *Poor supply chain practices result in weak information systems, poor cold chain and vaccine management, and ultimately stock-outs and wastage.*

1.2 Purpose

The purpose of the review was to identify and document evidence to support the hypotheses proposed by the People and Practice Working Group, and the recommended interventions.

1.3 Organization of the paper

This review comprises five chapters, including the Introduction (Chapter 1). The following chapters are listed below to guide the reader through the paper.

- Chapter 2: Introduction of underlying concepts and definitions.
- Chapter 3: Methodology - it describes the process used for finding the literature and explains the approach used for data extraction.
- Chapter 4: Hypotheses analysis – it consists of a descriptive analysis of the evidence for each of the hypotheses under investigation.
- Chapter 5: Conclusion – it highlights the limitations of the study and considers areas for further research.

Where possible, tables have been kept within the body of the text in order to assist the reader. However, tables exceeding one page in length, or those which readers may refer to at their own discretion, have been included as appendices.

The findings of this review provide insights into human resources (HR) issues affecting vaccine supply chains. International health agencies – such as the World Health Organization, donors, and national governments of developing countries are provided with grounded remarks to better understand the integral role of HR for increasing effectiveness in health care supply chains.

2 CONCEPTS AND DEFINITION

There are various understandings of SCM and its relationship with other business functions. In particular, SCM has been closely identified with purchasing and logistics, and some use the terms interchangeably. For this study, the author has adopted the GAVI Alliance definition of SCM and other terms which have been adapted from the mainstream literature to the vaccine and immunization context (Christopher, 2005), as follows:

- Supply chain: is a system of organizations, people, activities, information, and resources involved in moving a product (vaccines and other immunization supplies) from suppliers (manufacturers) to customer (children or target populations);
- Cold chain: is a temperature-controlled supply chain that maintains the product (vaccine) within a given temperature range throughout – between 2 and 8 °C;
- Supply chain network: refers to the description of the flow of products and information from the point of origin (manufacturers) to the point of use (vaccinations).
- Logistics: refers to the process of getting the product (vaccines and others) through the supply chain from the point of origin (manufacturers) to the point of use (vaccinations). Logistics is broken down into the operational components of supply chain management: quantification, procurement, storage, transport, inventory management, information system, etc. These operational components can be referred to as logistics activities, which focus more on specific tasks within a particular health system program, such as immunization.
- Supply chain management: refers to the active management of the supply chain and encompasses the planning and management for logistics. In other words, supply chain management includes the logistics activities, plus the coordination and collaboration of stakeholders involved in the supply chain, such as the MoH, the national immunization program,

manufacturers, third-party logistics companies, and multilateral agencies such as UNICEF Supply Division, etc. Supply chain management further includes and tries to address supply and demand dynamics at the international level.

Many of these terms are used interchangeably in the immunization community despite the obvious differences in their scope and range of activities, and permutations can also be found, such as the Cold Chain and Logistics (CCL) taskforce of UNICEF; the WHO and UNICEF Immunization Supply Chain and Logistics (iSCL) hub; and the Supplies and Logistics website of UNICEF (<http://www.unicef.org/supply/>).

3 METHODOLOGY

3.1 Introduction

The author was tasked to identify and review evidence that supports the hypotheses described in Chapter 1 and the recommended interventions.

Three techniques were used in conjunction to search for sources of information pertaining to the hypotheses. The primary method was bibliographic searching, using keywords to search online databases (EBSCO, ScienceDirect) for papers relevant to the hypotheses. Secondly, the websites of international organizations – USAID, People that Deliver, Bill & Melinda Gates Foundation among the others, that support, fund or monitor issues related to global health supply chains were scoured for relevant grey literature. Thirdly, a realist approach was taken to unearthing further information by examining and following up sources used by websites discussing issues related to global health supply chains.

Literature that did not directly, or indirectly, offer insight into the hypotheses in question was deemed to be irrelevant and such papers have not been included in this analysis. Literature that was published prior to 2008 or focuses on the developed world was discarded following the initial search.

A working group consisting of supply chain specialists from various organizations provided the author with expert advice and guidance on both the GAVI strategy and sources of literature relevant to the project. A meeting of the working group in Copenhagen on February 10th 2014 provided additional guidance, as described in Appendix 7.

3.2 Data extraction and synthesis

Data were extracted from 47 papers and recorded in Appendices 1-6. The record includes bibliographic information, author, date of publication, geographic location of study, study subject, and a brief note on the key evidence cited.

Insights relating to each particular hypothesis were extracted and captured in a table format. These were analyzed in Chapter 4. Out of the 47 publications analyzed, 26 are cited in chapter 4.

4 EVIDENCE BY HYPOTHESIS

4.1 Introduction

The key evidence findings from the literature are discussed in Chapter 4: Section 4.2 discusses Professionalization; 4.3 discusses Training; Section 4.4 looks at MoH leadership and empowerment; Section 4.5 discusses SCM organization; and Section 4.6 discusses Incentives and performance management. The chapter ends with Section 4.7 discussing supply chain practices.

4.2 Professionalization

This hypothesis sought to examine whether roles in the immunization supply chain are performed by logistics professionals in the developing world. Following exploration of the literature, it appears that not only there are few immunization supply chain defined roles, but there are not enough professionals in developing countries to fill those that exist. It seems this often leads to specific supply chain roles being performed by underqualified individuals on an ad hoc basis. Authors addressing this hypothesis are shown appendix 1.

There is a general consensus that immunization supply chain functions are frequently performed in developing countries by untrained workers for the supply chain function, such as pharmacists, clinicians and drivers. Many of the authors here allude to this point (Levine et al., 2008; RBM/WG/2012/REP1 2013; Brossette et al. n.d.), however, few directly address the hypothesis and even fewer draw upon empirical research to strengthen their claims.

Where empirical research is presented, it acts to support this consensus. For example, (People that Deliver 2011b) report that only four of the eight developing countries researched require staff in supply chain roles to have SCM certification. Bill & Melinda Gates Foundation (2012), following interviews with 26 vaccine supply chain experts, note that the lack of supply chain professionalization is considered to be a major problem.

Additionally, it is stated that there are few specific SCM roles (Sabot et al., 2011; Yadav et al., 2011; Dowling 2011), and that it is difficult to fill even these due to the high demand relative to the supply of suitably skilled individuals (USAID 2010; Optimize 2011b).

This can result in high vacancy levels in SCM positions, leading to underqualified staff performing these roles on an ad hoc basis (Wuliji et al. 2011; Brown et al. 2012). These authors also suggest that the lack of professional status for SCM in many developing countries leads to lack of inclusion of a devoted SCM curriculum within the healthcare curricula which obscures the importance of SCM in healthcare delivery (USAID 2010a).

4.3 Training

This hypothesis sought to examine whether those who manage the supply chain in developing countries are sufficiently trained, and whether there is indeed access to adequate training at all. Examination of the literature found that lack of training is indeed a central issue for those managing the supply chain, and that available training is often too rigid, distributed in a geographically uneven way and does not prepare individuals to relate and coordinate with key institutions and their procedures. Authors addressing this hypothesis are shown in Appendix 2.

The majority of authors allude to lack of supply chain training as a central human resource for health (HRH) issue in developing countries (Matowe et al., 2008; Sabot et al. 2011; Yadav et al. 2011;). Papers informed by practice offer the most direct insight.

The dearth of supply chain training programs is considered to be the primary issue by many authors (Dowling 2011; Brown et al. 2013). The Global Survey for Public Health Logisticians found that 57% cited lack of training as a major problem and that only four of the eight developing countries researched offer pre- and in-service SCM training of staff (People that Deliver 2011a; People that Deliver 2011b).

The quality of the few programs that do exist, though, is also considered questionable (Mutie 2011). Materials are often inadequate, class sizes too large, materials are not adapted to local contexts and the skills that are learned are not consolidated formally following each session (Brossette et al. n.d.)

This last point is taken up by many of the authors, who note that supply chain functions must be collectively decided upon, translated into competencies and measured using standard performance indicators (Optimize 2011b; Dzau et al. 2012; Brown et al. 2013). The training that is received is also highly differentiated in terms of quality and geographical evenness (Brown et al. 2013).

It is also noted that health logisticians in developing countries require training in how to deal with the Global Fund procedures (RBM/WG/2012/REP1 2013)

4.4 Ministry of Health leadership and empowerment

This hypothesis sought to examine whether MoH leadership and staff are adequately empowered to make important decisions to the benefit of the supply chain. It is evident that there is a dearth of data on this issue. However, the poor availability of accurate national data and a misunderstanding of the importance of SCM in relation to global health arose as key impediments to MoH empowerment. Authors addressing this hypothesis are shown in Appendix 3.

It is notable that of the papers examined there is very little work on empowerment and leadership, either directly or indirectly. What research there is centers on the themes of data, the lack of dedicated SCM roles and understanding the importance of SCM (Levine et al. 2008; Kaufmann et al. 2011; Schouten et al. 2011; Dzau et al. 2012; People that Deliver 2011b; Optimize 2011b).

It is alluded to that the capacity to make empowered decisions is predicated upon the capacity to forecast demand and monitor in-country status for vaccines with accuracy (Levine et al. 2008; Optimize 2011a). This capacity does not exist efficiently in many developing countries due to unreliable or out-of-date population data, inadequate technology and inconsistent energy supplies,

exacerbated in certain locations by seasonal variation in demand (People that Deliver 2011b).

Having dedicated SCM roles also increases the capacity for empowered decisions to be made. However, in Malawi, for example, the procurement and supply management (PSM) system for anti-retrovirals (ARVs) is controlled by only a few central MoH staff who devote only part of their time to SCM (Schouten et al. 2011).

Although in its SCM country assessments People that Deliver (2011b) writes that seven out of eight countries surveyed have dedicated SCM roles, it also notes that only half said that they believed policymakers understood the relationship between commodity security and human resource strengthening; and that as one moves further down the supply chain, the SCM responsibilities of staff become more confused.

4.5 SCM organization

This hypothesis sought to examine whether the current organization of the supply chain in developing countries is adequate to withstand increasingly complex challenges. The literature suggests that there is inadequate capacity in the supply chain to deal with the dual issues of demographic and epidemiological change, and future influx of new vaccines. Authors addressing this hypothesis are shown in Appendix 4.

Few authors directly or indirectly explore the capacity of SCM in developing countries to react to increasing complexity; however, those that do so articulate concerns clearly. These include inadequate space, transport, knowledge and monitoring systems, as well as changing needs of the population and the emergence of new vaccines.

The inability to accurately forecast demand is a current issue in many developing countries (Sabot et al. 2011). However, it is anticipated that this issue will be deepened by the emergence of new immunization products over the coming decades over-burdening already weak supply chains (Levine et al. 2008).

It is also expected that the epidemiological profile of developing country populations will re-orient toward degenerative diseases, as opposed to cheaper-to-treat infectious diseases (Pasquet et al. 2010). This, along with the anticipated increase of HIV drug resistance (Schouten et al. 2011), will increase costs of healthcare and the pressure on in-country supply chains.

National infrastructure also poses a significant obstacle for developing countries if these changes develop as anticipated. Authors agree that current storage space and transportation capacity, both in terms of vehicles and distribution channels, are inadequate in the face of coming changes, with Kaufmann et al. (2011) calculating that storage capacity in the developing world will need to increase by 500% (Bill & Melinda Gates Foundation 2012; VillageReach 2013).

4.6 Incentives and performance management

This hypothesis sought to examine whether there are suitable existing incentive and performance management strategies in developing countries to enable SCM staff. The literature calls for SCM to be professionalized, accountability and transparency to be increased, and non-financial factors to be considered in order to empower SCM staff. What is meant by the term 'adequate' is also asked. Authors addressing this hypothesis are shown in Appendix 5.

In relation to this hypothesis, the relationship between performance monitoring, accountability and recognition is drawn out by the authors (Optimize 2011b; Levine et al. 2008; Pasquet et al. 2010; Sabot et al. 2011). If performance is not monitored, then the incentive to work to the best of one's ability is partially removed. The authors suggest that SCM should be recognized as a profession with clear functions, so that performance can be monitored so as to improve it.

The need for adequate financial and non-financial requirements to be met in order to encourage staff satisfaction and satisfactory work is stated (Dowling 2011; Seifman & Bailey 2013). It is noted that, although adequate remuneration is a key factor in retaining staff and improving performance, so are non-financial factors such as 'living and working conditions, training, feedback and advancement

opportunities.’ (Brossette et al. n.d., p.8). These authors also make the point that data are not readily available on what can be considered ‘adequate’ in terms of salary, and how this can be judged without understanding the relative importance of financial and non-financial requirements, as well as the functions required of SCM staff.

4.7 Supply chain practices

This hypothesis sought to examine whether it can be said that poor supply chain practices lead to weak information systems, poor cold chain and vaccine management, and ultimately stock-outs and wastage. The literature suggests that this is indeed the case, with poor monitoring systems and poor knowledge of both drugs and the supply chain being causal factors. Authors addressing this hypothesis are shown in Appendix 6.

It is clear from the author’s research regarding supply chain practices that there are a number of constraints on developing country supply chains that leads to high levels of stock wastage and stock-outs. Empirical data is also deployed to illustrate this. It is estimated that up to ‘50% of vaccine doses are wasted by not being administered, and many more doses are exposed to freezing temperatures that can reduce their potency’(Sabot et al. 2011, p.2).

This is attributed to poor monitoring systems, resulting in poor data for demand forecasting, such as outdated census data (Levine et al. 2008; Matowe et al. 2008; Pasquet et al. 2010); poor knowledge of suitable drug temperature ranges (Pasquet et al. 2010); long procurement processes; and, as such, high susceptibility as a result of seasonal changes in need (Schouten et al. 2011), the lack of diverse sources of financing, lack of storage space and the sharing of transport with other health services (GAVI Alliance 2013; Gallien & Yadav 2010).

5 CONCLUSION

This report has revealed, using a snapshot of the existing literature gathered during a limited time period, that there is a paucity of research on human resources for global health supply chains in developing countries. However, there are conclusions that can be drawn with reasonable certainty from the literature examined here due to the consistency with which certain themes arise, as well as the breadth of sources that they emerge in.

In regards to professionalization, multiple authors raise concerns that specific SCM roles are not being performed by professionals; very few papers illustrate this using empirical evidence, though. Where empirical evidence is drawn upon, this consensus appears to be broadly true; there is not only a lack of SCM roles, but not enough qualified individuals to fill even these. The result is that roles that require specific SCM skills are often performed by those unqualified to do so.

The lack of professional supply chain staff is an issue. This report suggests that there is much scope for further study as to the precise scale and nature of the lack of professionalization as a first step remedying it.

The issue of training also receives scant direct attention in the literature reviewed here; however, there are particular themes that are consistently alluded to. These are: that those currently occupying posts with SCM functions appear to generally be inadequately trained; that existing training programs are not adaptable enough to multiple contexts; and that there is a need for training in how to engage with institutions regarding issues such as funding.

There is also a need for training to be based around key competencies that can be continually monitored in order to ensure relevance, manage performance and increase accountability. Generalizing training as an issue across the developing world, though, acts to obscure the variegated needs of SCM practitioners within and between nations. These requirements and desired competencies are avenues for further research.

MoH empowerment is the hypothesis that is least addressed in the literature examined here. In fact, the word empowerment is seldom seen and it seems this is in part due to a lack of SCM roles and awareness of the importance of SCM in developing countries. Therefore, who is it we are looking at to gauge their 'empowerment'? It is suggested in the papers that indirectly address this topic that giving SCM professional status, and putting in place superior data-gathering and monitoring systems would give practitioners a greater degree of confidence when it comes to decision making.

What is more, where these factors intersect to create the image of a fragile supply chain, then the literature on SCM organization suggests that this supply chain is not prepared for the realistic challenges ahead. The factors that are predicted as changing are the epidemiological make-up of the population and the arrival of new vaccines on the market. It is suggested in the literature that national storage and transportation infrastructures are woefully inadequate in the face of these challenges.

Issues of performance management and incentives in the literature touch upon the recurring themes of this report. It is suggested that performance must first be measurable, and for this to be the case competencies must be established.

The picture that comes together from the findings in relation to the hypotheses suggests that supply chain practices in developing countries are likely to be weak, because staff are generally underqualified, poorly trained, un-empowered and poorly managed. The literature points to this being the case, with the importance of SCM generally disregarded. On this topic, there is relatively strong empirical evidence in the literature to support claims that rates of stock-outs and wastage are high.

A clear direction arises from this study, which combines HRH practices and SCM capabilities. The issues discussed in each hypothesis are in reality interconnected in a complex web which HRH theory goes some way to explain. While human resources issues in immunization supply chains need to be

considered in conjunction with other critical supply chain areas including: system design, data management, cold chain equipment, transport and distribution.

The recently published 'Human Resources for Supply chain Management Assessment Guide and tool' and 'Capacity Plus Technical Brief 12' articulate the HR aspects of these complex relationships and bring a systematic approach to the human resource issues in immunization and health supply chains more broadly (USAID | DELIVER Project and People that Deliver. 2013b, CapacityPlus 2013).

The literature in this area is limited and more research is needed, beyond what was possible in the time-frame for this study, to help inform future investment and decision making. Specifically it would seem appropriate to scrutinize in greater detail how SCM is or could be professionalized in the developing world. Secondly, an assumption in the literature is that increased accountability follows recognition – however more evidence is required to support this. It appears particularly urgent to action a systematic approach to tackle these issues in order to increase the effectiveness of health supply chains.

The breadth and consistency of approach of the literature on global health supply chains is not great. This report, of course, only examines a portion of this literature, and as such there is scope to further probe these hypotheses with time.

It is suggested that there is a need for more comprehensive research along the themes of each of these hypotheses in specific country contexts. This would provide data to act upon, while acknowledging the highly differentiated nature of the challenges facing specific areas. There is also a need to further understand the linkages between the themes raised by these hypotheses in order to ensure that responses are comprehensive and well integrated.

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7 APPENDIX 1: HYPOTHESIS 1

Many elements of immunization supply chain functions are not performed by logistics professionals

Authors	Year	Evidence	
Levine, Pickett, Sekhri, Yadav	2008	Demand Forecasting For Essential Medical Technologies	General
<ul style="list-style-type: none"> “in developing countries themselves demand forecasting has been viewed as one of the many functions required of overburdened technical personnel within ministries of health or particular dedicated units, such as those that manage national immunisation programmes.” (p. 227). On Global Fund procurement grants: “Many of these smaller new buyers have little capacity and experience in demand forecasting, negotiation, procurement and contract management.” Citing Global Fund Working Group, Challenges and Opportunities for the New Executive Director of the Global Fund: Seven Essential Tasks (2006). (p.232). “As with new buyers, new suppliers in developing countries often lack expertise in forecasting demand, negotiation and procurement.” (p.233). 			
Matowe, Waako, Adome, Kibwage, Minzi, Bienvenu	2008	A strategy to improve skills in pharmaceutical supply management in East Africa: the regional technical resource collaboration for pharmaceutical management	East Africa (Kenya, Uganda, Tanzania, Rwanda)
<ul style="list-style-type: none"> “The results of the assessments showed that problems with ART commodities-supply management existed widely in Kenya, Rwanda, Tanzania and Uganda.” “Inadequate skills were cited as the main reason for the identified problems in all four countries. There was thus a need to build skills in HIV/AIDS pharmaceutical supply management in all four countries.” Citing Waako et al. (in press) Capacity for management of pharmaceuticals and related commodities in East Africa; an assessment with specific reference to antiretroviral therapy. 			
Pasquet, Messou, Gabillard, Minga, Depoulosky, Deuffic-Burban, Losina, Freedberg, Danel, Anglaret, Yazdanpanah	2010	Impact of Drug Stock-Outs on Death and Retention to Care among HIV-Infected Patients on Combination Antiretroviral Therapy in Abidjan, Côte d'Ivoire	Côte d'Ivoire
<ul style="list-style-type: none"> “With increased access to cART, drug stock-outs related to insufficient human resources and poor infrastructure have been reported, leading to treatment modifications or discontinuations [5], [6], [7].” “In our study, physicians managed most stock-outs by modifying rather than interrupting therapy. This trend may illustrate physicians' tendency to capitalise on their experience in order to better manage drug stock-outs.” 			
Sabot, Yadav, Zaffran	2011	Maximizing Every Dose and Dollar: The Imperative of Efficiency in Vaccine Delivery	General
<ul style="list-style-type: none"> “Countries can no longer rely on a handful of appropriately trained individuals to distribute vaccines worth tens of millions of dollars. Any improvement to vaccine delivery will require a substantial increase in the number, training, and retention of logistics staff.” (p.3). 			

Yadav, Stapleton, Van Wassenhove	2011	Always Cola, Rarely Essential Medicines: Comparing Medicine and Consumer Product Supply Chains in the Developing World	General
<ul style="list-style-type: none"> • “in the case of medicine supply chains these assets (human or physical) generally have a high level of specificity and are thus in short supply in the market place.” (p.8). • “The relatively low rates of revenue earned from affordable medicines can lead to poor investment in human or physical assets for pharmaceutical distribution.” (p.10). 			
Kaufmann, Miller, Cheyne	2011	Vaccine supply chains need to be better funded and strengthened, or lives will be at risk	General
<ul style="list-style-type: none"> • “In most developing countries health logistics is not considered a profession.... However, as demonstrated in many high-income countries, professionally trained logisticians and supply chain managers are needed to improve supply chain performance.” Citing Silve B. (2010) Addressing the human factor in public-health supply chains. • “the WHO’s training modules for managing the cold chain are aimed exclusively at midlevel managers and therefore, understandably, do not mention more strategic supply-chain issues.” Citing World Health Organization, Department of Immunization, Vaccines, and Biologicals. Training for midlevel managers (MLM): Module 1: Cold chain, vaccines, and safeinjection equipment management 			
Schouten, Jahn, Ben-Smith, Makombe, Harries, Aboagye-Nyame, Chimbwandira	2011	Antiretroviral drug supply challenges in the era of scaling up ART in Malawi.	Malawi.
<ul style="list-style-type: none"> • “The work of keeping the PSM system for ARVs on track is currently in the hands of very few people in the Department of HIV and AIDS in the Malawi Ministry of Health (monitoring and evaluation officer, HIV care and treatment officers) and the National AIDS Commission (director of finance, chief procurement officer), who spend only part of their time on supply management.” 			
RBM-GF	2013	Third joint RBM – Global Fund PSM Workshop “Resolving PSM bottlenecks” Tunis, Tunisia 18-20 September 2012	General
<ul style="list-style-type: none"> • On PSM system challenges: “Underutilization of existing national systems for procurement and distribution, sometimes due to knowledge gaps”; “Lack of training (peripheral level) or misallocation of available skills” (p.6). 			
Brossette, Silve, Grall, Bardy, Pilz, Dicko, Gerbergfo USAID	2013	Workforce Excellence in Health Supply Chain Management: Literature Review	General
<ul style="list-style-type: none"> • “Where dedicated personnel with logistics background or SCM competence are lacking, logistics functions often are performed by clinicians, pharmacists or drivers.” (p.2). Citing Dicko (2010). 			
People that Deliver	2011	Key Points from the “Human Resource Capacity in Public Health Supply Chain Management” Country Assessments	General
<ul style="list-style-type: none"> • Assessment of human resource capacity in public health supply chain management in Ethiopia, Dominican Republic, Indonesia, Liberia, Namibia, Burkina Faso, Senegal and Nicaragua: “While there are often central level units responsible for a variety of supply chain activities, when moving down to lower levels of the system 			

<p>the division of responsibility for logistics activities becomes more complicated and often less clear across programs, regional/district/local municipal geographic borders.” (p.2).</p> <ul style="list-style-type: none"> • “Four of eight countries assessed stated that it is not compulsory to be certified in supply chain management in order to secure a job with supply chain responsibilities” (p.3). • “Four of the eight countries assessed reported having both pre-service training and in-service training programs that include public health supply chain management, and which primarily target pharmacy personnel and nurses.” (p.2) 			
People that Deliver	2011	Highlights from the April-May 2011 People that Deliver “Global Survey” for Public Health Logisticians	General
<ul style="list-style-type: none"> • On online survey of public health logisticians in the developing world: 57% of respondents cited one of their top problems as a lack of training/need for additional training. This feeds into the training hypothesis however it does perhaps go some way to show that certain roles are performed by supply chain professionals in developing countries. 			
Optimize	2011	Vision of future immunization supply and logistics systems: Landscape analysis summary	General
<ul style="list-style-type: none"> • “There are few positions to meet the needs of SCM and logistics and even fewer people to fill the existing positions..... however such a cadre does not currently exist” (p.35). • “As a result, it is difficult to find the right individuals to fill positions in the immunization supply systems at all levels” (p.36). 			
Dowling	2011	Healthcare Supply Chains in Developing Countries SITUATIONAL ANALYSIS	General
<ul style="list-style-type: none"> • “For staff with supply chain responsibilities, issues may be more pronounced due to an overall lack of attention to the importance of supply chain skills, resulting in a lack of capacity in healthcare personnel.” (p.16). 			
PATH, World Health Organization, Health Systems Research Institute	2011	An Assessment of Vaccine Supply Chain and Logistics Systems in Thailand	Thailand
<ul style="list-style-type: none"> • “All surveyed respondents at warehouses and health centers reported that there are staff members responsible for vaccine management activities, although assignments may not be in writing. In the conventional system, the key activities of health center staff include monthly vaccine target planning, vaccine requisitioning, vaccine collection, and inventory control.” (P.12). • “Other vaccine management duties for pharmacists include maintaining vaccine inventories and managing vaccine distribution.” (P.13). 			
Silve	2008	Health logistics is a profession: improving the performance of health in developing countries	General
<ul style="list-style-type: none"> • On the profession of health logistician: “As to the difficulty of creating a new profession when MoHs currently manage more than 40 different specialists, it is submitted that the Health Logistician will deal with numerous functions that are currently either burdening the doctors and nurses themselves, or divided among other personnel, or not addressed at all.” • “To achieve results at a continental level it is necessary to start with existing initiatives and structures..... Almost all of these training programs except applied technology schools are characterized by the absence of a specific treatment of issues related to logistics health. An exception exists in Madagascar, but coverage remains low. Obviously technology schools treat the physical aspects of equipment maintenance of hospitals and laboratories, but unrelated to the whole supply chain.” 			

USAID Deliver Project	2010	Sustainable Training Programs Ensure Access to Health Commodities in Rwanda	Rwanda
<ul style="list-style-type: none"> • “A persistent problem is finding and retaining health workers trained in logistics” (p.1). • “Health commodity supply chains depend on health personnel— primarily nurses and pharmacists—to carry out essential logistics activities.” (p.1). 			
Wuliji, Naimoli, Shirin	2011	Building Procurement and Supply Chain Management Capacity for the Directorate General of Family Planning, Bangladesh	Bangladesh
<ul style="list-style-type: none"> • A telephone survey conducted in July 2010 found that vacancy levels were “as high as 100% for regional warehouse supply officers and 83% for district-level store keepers. These high values are of great significance because individuals in these positions assume responsibility for the functionality and performance of the stores, a role which is currently being filled on an ad-hoc basis by other staff members.” (p. 5). • “the competency profile of each individual varied, on average, approximately 6% are at a low level of competency, 78% at a moderate level, and 16% at a high level.” (p.11). 			
USAID Deliver Project	2010	Do Nurses Need to Know How Long Medical Supplies Will Last?	General
<ul style="list-style-type: none"> • “In many places, formal training for health professionals is clinically oriented; often, everyone assumes that key medications, contraceptives, and other supplies will always be available.” (p.1). • “Stockouts, however, are common in many developing countries, and often professionals are not trained in supply chain basics, such as calculating how long their supplies will last.” (p.1). 			
USAID Deliver Project	2009	Logistics Training, Access to Health Products Improves in Nepal	Nepal
<ul style="list-style-type: none"> • On conditions prior to implementation of project: “They did not have a systematic recordkeeping system, and the fill rate on orders from the hospital wards was problematic. Orders were processed slowly; some products were given in limited quantities or not at all, because the pharmacy was completely stocked out. At the same time, some drugs had to be destroyed because there was low demand for them and they had gone past their shelf life.” (p.1). 			
USAID Deliver Project	2011	Ethiopian Pharmacists Master the Complex Supply System for a Large Teaching Hospital	Ethiopia
<ul style="list-style-type: none"> • On conditions prior to implementation of project: “The MOH relied on donated supplies and they did not have a system for forecasting the quantities they needed.” (p.1). 			
USAID Deliver Project	2011	Success Story The Power of People: Training Course Fosters Logistics Champions in Malawi	<ul style="list-style-type: none"> • Malawi
<p>“the MOH suggested integrating the SCM training into the education curriculum for pharmacists, which would ensure a sustainable source of qualified human resources to support the availability of lifesaving drugs and medical supplies.” (p.1).</p>			
USAID Deliver Project	2009	Uganda National Medical Stores and USAID DELIVER PROJECT Training Improves Product Distribution	Uganda
<p>In Uganda the National Medical Stores (an autonomous government corporation) ensures the distribution of pharmaceutical products. The article alludes that the processes necessary to ensure adequate distribution are not known by many NMS employees.</p>			

PATH Op.ti.mize Newsletter- Project Optimize	2012	Promising practices in distribution Newsletter http://www.path.org/newsletters/optimize.php	Senegal
<ul style="list-style-type: none"> “From 2009 to 2012, Project Optimize and the Senegalese Ministry of Health partnered to undertake a number of supply chain improvements and demonstration projects, including an informed push system for vaccine delivery known as “moving warehouse.” Prior to this project, vaccine distribution happened from the bottom up with nurses from health posts responsible for traveling to district headquarters to pick up supplies and, in turn, district teams responsible for going to regional warehouses to collect supplies” (p.5). 			
Seifman, Bailey & Hasselberg	2013	Applying the HRH Action Framework to Develop Sustainable Excellence in the Health Supply Chain Workforce http://www.capacityplus.org/applying-hrh-action-framework-to-develop-sustainable-excellence-health-supply-chain-workforce	Rwanda, Liberia Zambia
<ul style="list-style-type: none"> “The supply chain workforce includes a variety of people who are dedicated to fulfilling these functions at national, district, and health facility levels, such as pharmacists, logisticians, supply chain managers, data managers, and warehouse and transport personnel. It also includes key personnel who contribute only a portion of their time to supply chain functions, such as doctors, nurses, and other clinical and administrative staff, all of whom function within a coordinated system to provide appropriate, effective, and affordable medicines and commodities” (p.1). “Some countries are moving toward more effective SCM systems; in Rwanda, the Logistics Management Unit is hiring qualified staff, and Liberia and Zambia have Logistics Management Units in charge of all SCM functions.” (p.3). “Some countries look to supply chain managers, others to health cadres such as pharmacists, to manage the supply chain with support from health workers with other educational or vocational backgrounds.” (p.5) 			
Coralie Mc Cormack, Gabrielle M. Cooper, Nerida Smith Andrew N. Brown,	2012	‘Developing medicines supply competence in Pacific Island Countries: A needs-based approach to Education	Pacific Island
<ul style="list-style-type: none"> Focusing on the human resources for health (HRH) crisis and how it relates to pharmacy, the International Pharmaceutical Federation (FIP) released the 2009 FIP Global Pharmacy Workforce Report” (FIP, 2009; Hawthorne and Anderson, 2009). The report demonstrates the absence of sufficient numbers of pharmacy staff within many of the world’s developing countries. WHO asserts that “many maternal and child health related deaths in the region may be prevented with readily available essential medicines provided by suitably trained health personnel” (WHO-WPRO, 2005) 			
Andrew N. Brown, Ben J. Gilbert, Andreia F. Bruno, Gabrielle M. Cooper	2012	Validated Competency Framework for Delivery of Pharmacy Services in Pacific Island Countries	Pacific Island
<ul style="list-style-type: none"> “Scarcity of health personnel with relevant competence is an impediment to achieving the UN health related Millenium Development Goals in many Pacific-Island Countries (PICs)” .(pg 1) 			
Bill & Melinda Gates Foundation	2012	Vaccine supply chain strategy: Summary of Foundation Approach 2013-2016	

<ul style="list-style-type: none"> 26 vaccine SC experts interviewed from 15 different organizations and Extensive desk research conducted on current challenges facing vaccine SCs using a wide variety of data sources came up with the following as the major challenges; Lack of supply chain professionalization (slide 6) 			
Andrew Brown, Giorgio Commetto Amelia Cumbi Helen de Pinho, Francis Kamwendo, Uta Lehmann, Willy McCourt, Barbara McPake, George Pariyo, David Sanders	2011	Midlevel Workers: a promising resource	Peru
		<ul style="list-style-type: none"> Evidence, although limited and imperfect shows that where Middle level Health Providers are adequately trained, supported and integrated coherently in the health systems, they have the potential to improve the distribution of health workers and enhance equitable access to health services while retaining quality standards comparable to if not exceeding those of services provided by physicians. Significant challenges however exist in terms of the marginalization and more limited management support of MLP in health systems A cost effectiveness study in Burkina Faso revealed that clinical officers were associated with a higher maternal and newborn case fatality rate as compared to the general practitioners and obstetricians pointing to the need for improved training and strengthened supervision. Similarly, a study from Uganda found that performance problems were often linked to inadequate training and or support and supervision as well as lack of guidelines. 	
USAID	2010	Kenya Health System Assessment	Kenya
<ul style="list-style-type: none"> In Kenya, there is unequal distribution of workers by urban/ rural areas, by regions and by level of care. In service training is largely opportunity driven rather than based on the skill-acquisition needs of the sector or individual providers. A recent study of MCH skills nationwide concluded, “ health providers competency at performing basic life saving skills was quite low”(Mutungi et al, 2008) pg55 There is no program for conducting HRM training nor for hiring individuals with those skills. The HRH plan points to the dearth of HRM skills and skilled professionals as a major gap in the HRH situation in Kenya 			

8 APPENDIX 2: HYPOTHESIS 2

People who manage the supply chain (transport, storing, handling, etc.) are inadequately trained and do not have ready access to appropriate training.

Authors	Year	Evidence	
Matowe, Waako, Adome, Kibwage, Minzi, Bienvenu	2008	A strategy to improve skills in pharmaceutical supply management in East Africa: the regional technical resource collaboration for pharmaceutical management	East Africa (Kenya, Uganda, Tanzania, Rwanda)
<ul style="list-style-type: none"> “Following the development of the training materials and the training of a number of their academic staff members in pharmaceutical supply management, Makerere University's Department of Pharmacy has now adapted various components into its pre-service pharmacy curriculum. In addition, the schools of pharmacy in both Tanzania and Uganda have plans to develop Master's of Science programmes in pharmaceutical supply management that draw largely from the initiative. In Rwanda, the Department of Pharmacy at the National University of Rwanda has revised their pre-service curriculum to include components of pharmaceutical supply management.” – This passage alludes to the lack of formal training programmes and collaboration between service providers and academic institutions prior to the inception of RTRC. This article also describes the prevalence and impact of bottlenecks in AIDS, Tuberculosis and Malaria drug supplies in Rwanda, Kenya, Uganda and Tanzania, citing lack of formal training programmes as a key causal factor. 			
Sabot, Yadav, Zaffran	2011	Maximizing Every Dose and Dollar: The Imperative of Efficiency in Vaccine Delivery	General
<ul style="list-style-type: none"> “Countries can no longer rely on a handful of appropriately trained individuals to distribute vaccines worth tens of millions of dollars. Any improvement to vaccine delivery will require a substantial increase in the number, training, and retention of logistics staff.” (p.3). – This statement alludes to the relative paucity of health logistics training capacity in developing countries/retention of those who are adequately trained. 			
Yadav, Stapleton, Van Wassenhove	2011	Always Cola, Rarely Essential Medicines: Comparing Medicine and Consumer Product Supply Chains in the Developing World	General
<ul style="list-style-type: none"> “In the case of medicine supply chains, the human and physical assets required for effective distribution are highly specific. They required investment in staff training and specialised equipment, for instance, refrigeration. However, the relatively low rates of revenue earned from affordable medicines can lead to poor investment in human or physical assets for pharmaceutical distribution.” (p.10) – This passage suggest that revenues equate to the potential for improving training capacity, and as such the low revenues earned from affordable medicines means that potential for building training capacity is low, however this statement does not have any empirical reference here. 			
Kaufmann, Miller, Cheyne	2011	Vaccine supply chains need to be better funded and strengthened, or lives will be at risk	General
<ul style="list-style-type: none"> “Training supply-chain personnel is usually focused narrowly on specific activities, such as storekeeping, maintaining cold-chain records, and providing security for commodities, rather than the higher-order planning, analysis, and performance management skills needed by supply-chain managers. For example, the WHO's 			

training modules for managing the cold chain are aimed exclusively at midlevel managers and therefore, understandably, do not mention more strategic supply-chain issues.” – This passage suggests that existing training is limited and thus inadequate for the situations faced by supply chain managers.			
RBM-GF	2013	Third joint RBM – Global Fund PSM Workshop “Resolving PSM bottlenecks” Tunis, Tunisia 18-20 September 2012	General
<ul style="list-style-type: none"> • On PSM system challenges: “Lack of training (peripheral level) or misallocation of available skills” (p.7). • Not explicitly related to training, however a crucial point on staffing: “High turnover of FPMs, each with different ways of working, and the impact of the GF restructuring lead to calls for more stability and less turnover” (p.7). • On potential solutions: “Training on implementation of agreements and procedures of GF should be organized for PR and SR” (p.7). 			
Brossette, Silve, Grall, Bardy, Pilz, Dicko, Gerbergfo USAID	2013	Workforce Excellence in Health Supply Chain Management: Literature Review	General
<ul style="list-style-type: none"> • “While it is clear that a professional workforce is vital, there is little information available about how to best recruit, train, retain, monitor and supervise these workers in developing countries. In many countries, national human resource (HR) policies are weak and investment in training, deployment and ongoing development is inadequate” (P.1). • “A review of current SCM capacity revealed weaknesses in the skills required to quantify needs for health products; appropriately order, receive and store products; and accurately record inventories.” (p.2). • “Where dedicated personnel with logistics background or SCM competence are lacking, logistics functions often are performed by clinicians, pharmacists or drivers. Doctors and nurses tend to be responsible many non-clinical tasks; too often, they spend significant amounts of time on logistics activities, reducing the time they have to spend with patients. Overall, in decentralized public structures, personnel tend not to have specific logistics qualifications and dedicate a limited amount of time to SCM (Dicko 2010).” (p.2). • “there is not a formal career path for logisticians, so there is not incentive for staff to undertake specific logistics training. Usually, existing facility personnel end up assuming additional responsibilities without developing specialized expertise.” (p.2). • “Too often, materials are not standardized, are not based on adult learning principles and do not follow a competency-based methodology. Generic materials may not be adapted to the local circumstances. Furthermore, some courses lack the hands-on practice and site visits required to solidify new skills and connect learning with performance. Many training activities are not linked to actual job functions, standard operating procedures or job descriptions. Where training does exist, it is often made difficult by the large number of students in courses.” (p.3). • “The training curriculum should take into account two —profiles of supply chain managers: the one that —must possess a wide and general understanding of how a supply chain works in order to guide 4 system functions and improvements effectively and one that —must work in specific technical areas or settings that require in-depth knowledge (RHSC 2009).” (p.3). • “A logistics-related career ladder could encourage retention and promotion. In particular, it would be useful to develop a career ladder for within pharmacy; a new cadre of —pharmaceutical technician could be developed as a third year of training for pharmacist’s assistants that leads to a diploma” (p.9). • “SCM functions need to be defined and translated into a set of competencies (eg. Stock management, quantification,); competencies, in turn, are placed into a framework of performance-based measures” (p.9). 			
Dzau, Grazin, Bartlett, Udayakumar, Kibasi, Henke, Pettigrew	2012	A Neglected Resource: Transforming Healthcare through Human Capital	General

<ul style="list-style-type: none"> • “In low and middle-income countries, the question of how to optimise the utilisation of human capital is just as urgent. In many of these countries, the workforce needed to match the burden of disease simply does not exist. Nor will it materialise if we merely rely on long training processes characterised by increasing sub-specialisation, and restrict care to in-person encounters between a doctor and patient for all types of services.” (p.8). • “To create a more agile workforce, the educational curricula for health professionals should be rethought so that the mix of skills can be rebalanced. The model of cardiac care at Narayana Hrudayalaya Heart hospital is a good example here: it is built around team-based care, which has been reinforced through training that optimises the roles that different professionals play within the team.” (p.24). 			
People that Deliver	2011	Key Points from the “Human Resource Capacity in Public Health Supply Chain Management” Country Assessments	General
<ul style="list-style-type: none"> • “Four of the eight countries assessed reported having both pre-service training and in service training Programs that include public health supply chain management, and which primarily target pharmacy personnel and nurses.” (p.2). 			
People that Deliver	2011	Highlights from the April-May 2011 People that Deliver “Global Survey” for Public Health Logisticians	General
<ul style="list-style-type: none"> • “Responses were categorized into broad groups, with the majority of responses identifying the following as the top problems: lack of training/need for additional training (57% of respondents), lack of human resources and turnover (43%) insufficient supervision (30%), inadequate/poor infrastructure (27%), and poor communication (25%).” (p.1). • “Responses were categorized into broad groups, with the majority of responses identifying the following as the top ideas: training (43% of respondents), improved infrastructure particularly with respect to warehouses (16%), improved communication (14%), improved supervision (14%), and incentives and motivation strategies (10%). In addition, respondents strongly expressed their desire for additional training opportunities for both themselves and their colleagues, thereby creating a supply of adequately trained supply chain professionals” 			
Optimize	2011	Vision of future immunization supply and logistics systems: Landscape analysis summary	General
<ul style="list-style-type: none"> • “There is a lack of in-country skills to plan for, design, implement, and sustain information systems projects.” (p.27). • “In developing-country public health systems, SCM competencies are not subject to a consensus similar to competency frameworks of other health professionals such as pharmacists or nurses. One of the consequences is that SCM does not have an outline of the profession’s key characteristics, notably pre-service training and adequate certifications that are entry points for newcomers and provide recognition and career opportunities. In addition, the individual’s capacity to adapt to new models and technologies is limited. Cross-cutting competency frameworks for SCM have been developed that could benefit integrated logistics as well as other areas, but they have not been implemented in developing countries to date. Finally, training opportunities are scarce and have limited impact on the individuals actually in charge of logistics.” (p.35). 			
Dowling	2011	Healthcare Supply Chains in Developing Countries SITUATIONAL ANALYSIS	General
<ul style="list-style-type: none"> • “Issues of insufficient staff numbers, appropriate training, geographical and professional isolation in rural and remote environments, a lack of supervision/contact with supervisors, inadequate professional and personal facilities, pay and conditions, and workload are all significant issues that affect staff satisfaction, turnover, and the ability of staff to complete their job satisfactorily (Hawthorne and Anderson 2009; WHO 2010).” (p.16). 			
Moses Kioko Mutie	2011	A systematic review of the training of health care workers within essential medicines supply programs in developing countries http://www.canberra.edu.au/researchrepository/items/c9c8595c-fe27-0228-ed23-1efa8cc0d344/1/	general

<ul style="list-style-type: none"> “Deficiencies in Health Care Worker performance in developing countries are due to a variety of causes. These include for instance lack of health resources, low skill, undefined work processes” pg 1. Regardless of the cause of poor Health Care Worker performance, the traditional solution has been to provide training. Incidentally, there is growing evidence that these resource-intensive training programs are not always effective 			
Brown AN, Gilbert B, Bruno AF	2013	Development of an essential medicine supply competency framework	General
<ul style="list-style-type: none"> For primary healthcare, personnel need to be competent in relevant aspects of EMSM in order to use their country supply systems effectively. This material is often missing from their pre-service curriculum while skills in appropriate EMSM are often assumed (Brown 2009b). As a result, many primary healthcare personnel working in the facility level lack the skills they require for the essential part of their day to day work(pg 2) 			
Andrew N. Brown, Ben J Gilbert, Andreaia F. Bruno, Gabrielle M. Cooper	2012	Validated Competency Framework for Delivery of Pharmacy Services in Pacific-Island Countries	Pacific Island
<ul style="list-style-type: none"> “Scarcity of health personnel with relevant competence is an impediment to achieving the UN health related MDGs in many Pacific-Island countries.” Pg 1 			
Anderson, Brock, Bates, Rouse, Marriott, Manasse, Futter, Bhojraj, Brown, Gal	2011	Transforming Health Professional Education http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3073096/	General
<ul style="list-style-type: none"> “Many countries are still faced with the critical shortages of pharmacists, Pharmaceutical Scientists and personnel needed to manage all aspects of medicine use”. pg 2 The critical shortages in educated staff members also affect the availability of pharmacist’s services e.g providing appropriate information to patients and other healthcare professionals and monitoring effects of medication use for patients and communities. Pharmacy Education Taskforce in collaboration with WHO is currently implementing a global survey of pharmacy colleges and schools with an intention to support transformational change toward needs-based educational systems within the profession 			
Andrew Brown, Ben Gilbert	2011	The Vanuatu Medical Supply system-documenting opportunities and challenges to meet the MDGs	Australia
<ul style="list-style-type: none"> “Across Pacific Island Countries, there is less than 1 Pharmacist per 10,000 populations. Some Pacific Island countries have no pharmacist at all hence medical supply system is often operated by pharmacy support staff e.g. assistants, technicians and dispensers with a wide variance in the formal training they receive”. Medical activities are conducted by the healthcare personnel such as nurses or midwives who have little or no formal training in the medical supply role. (pg 2) 			
UNICEF	2010	Evaluation_of_Community_Management_of_Acute_Malnutrition_CMAM_-Nepal_Country_Case_Study http://www.unicef.org/evaluation/files/Nepal	Nepal
<ul style="list-style-type: none"> Staffing GAP Analysis: The table shows that there is inadequacy in the availability of staff within CMAM with the required competencies for the positions defined in the new organizational chart. 			
Mark Kane	2008	Evaluation of the project to support PAV (Expanded Program on Immunization) in Northern Mozambique	Cabo Delgado
<ul style="list-style-type: none"> “Most health centres have few trained staff and no vehicles. Supervision and training of the health staff if often inadequate or absent”. 			

Claire Anderson, Ian Bates, Tina Brock, Andrew Nelson, Brown, Andreia Bruno, Billy Futter, Timothy Pennie and Michael J. Rouse	2012	Needs based Education in the context of globalization	Sub-Saharan Africa
<ul style="list-style-type: none"> Access to medicines in the developing setting is worsened by a lack of pharmacy education to train new pharmacists who could then provide medicines. There is a large disparity in the global distribution of pharmacists with sub-Saharan Africa having some of the poorest density of Pharmacists i.e. 1 in 10000 population) 			
People that Deliver/ Ministry of Health, Mozambique	2012	Who are the people running the supply chain? Human Resources for Logistics Storage and Transportation of commodities from the Central Level	
<ul style="list-style-type: none"> Mozambique-HR for SC storage and Transportation : It is clear that HRM resources involved in the supply chain and distribution of commodities have little to no training in logistics and supply chain management pg 11. The following were identified as challenges facing HR system <ul style="list-style-type: none"> bringing qualified staff to supply chain retention and motivation Insufficient teaching staff Insufficient work placement supervisors Lack of learning materials and clinical instruments in work placements Lack of professionals(logistics area as well as low motivation of the existing workforce 			
GAVI Alliance	2013	Public Consultation Preliminary Analysis (13/08/13)	General
<ul style="list-style-type: none"> Supply chain Landscape Analysis <p>'Some challenges were found to be common and of high importance across countries, including insufficient and non-functioning cold chain equipment, limited supply chain expertise and lack of functioning information systems.' pg 6</p>			
AN Brown, L Ward-Panckhurst, G Cooper	2012	Factors affecting learning and teaching for medicines supply management training in Pacific Island Countries - a realist review	Australia
<ul style="list-style-type: none"> Limited human resources are a major impediment to achieving the UN health-related Millennium Development Goals in a number of Pacific Island Countries (PICs). Lack of education capacity to support competency development in medicine supply management is one of the main issues affecting workforce development in this region, which is characterized by disparate service delivery due to the range of environments in which supply occurs (ie urban, rural and remote),geographical challenges and cultural practices associated with teaching and learning.pg 2 Medicines specific training is often missing from the pre-service curriculum, while skills in appropriate medication supply are often assumed and not overtly articulated. As a result, many health personnel lack the skills they require for this essential part of their day-to-day work. 			

9 APPENDIX 3: HYPOTHESIS 3

Ministry of Health Leadership and staff are not empowered to make critical decisions and investments that positively impact the supply chain

Authors	Year	Evidence	
Levine, Pickett, Sekhri, Yadav	2008	Demand Forecasting For Essential Medical Technologies	General
<ul style="list-style-type: none"> “National governments and international funders rely on demand forecasts for budgeting, while health programs and implementing agencies depend on forecasts to plan their supply chain logistics.” (p.225). – The suggestion here is that without sufficient knowledge and information systems MoH leadership cannot make informed and confident decisions. 			
Kaufmann, Miller, Cheyne	2011	Vaccine supply chains need to be better funded and strengthened, or lives will be at risk	General
<ul style="list-style-type: none"> “Supply-chain planners and managers are rarely consulted or involved in the plans that ultimately produce incoming vaccine shipments.” “those same managers who report plans and budgets to strengthen vaccine storage, distribution, and inventory management often do not coordinate with vaccine procurements and shipments.” “One of the coauthors, working on a current contract with the US Agency for International Development, recently held discussions about commercial capability with Kenyan and Bangladeshi government medical supply-chain managers, who were unaware that this privatesector supply-chain capacity even existed.” 			
Schouten, Jahn, Ben-Smith, Makombe, Harries, Aboagye-Nyame, Chimbwandira	2011	Antiretroviral drug supply challenges in the era of scaling up ART in Malawi.	Malawi
<ul style="list-style-type: none"> The work of keeping the PSM system for ARVs on track is currently in the hands of very few people in the Department of HIV and AIDS in the Malawi Ministry of Health (monitoring and evaluation officer, HIV care and treatment officers) and the National AIDS Commission (director of finance, chief procurement officer), who spend only part of their time on supply management.” 			
Dzau, Grazin, Bartlett, Udayakumar, Kibasi, Henke, Pettigrew	2012	A Neglected Resource: Transforming Healthcare through Human Capital	General
<ul style="list-style-type: none"> On the environment required to encourage successful healthcare innovations: “Success will depend on a mixture of judicious yet powerful policies, genuine stakeholder support and mobilisation, and consensus-building. Given the vast differences among countries, the balance among these approaches must always be a matter for local judgment. Governments will need to work sensitively and collaboratively to engage professional bodies as well as other stakeholders in any process of change” (p.14). 			
People that Deliver	2011	Key Points from the “Human Resource Capacity in Public Health Supply Chain Management” Country Assessments	General

<ul style="list-style-type: none"> • “Seven of the eight countries report having a national/central level position and department dedicated to supply chain management” (p.2). • “While there are often central level units responsible for a variety of supply chain activities, when Moving down to lower levels of the system the division of responsibility for logistics activities becomes more complicated and often less clear across programs, regional/district/local municipal geographic borders.” (p.2). • “Five of the eight countries reported that SCM ranks as a priority or high priority for their Ministries of Health compared to other programs and priorities.” (p.2). • “Four of the eight countries assessed felt that policymakers understand the relationship between Improved commodity security and human resource strengthening for SCM; this finding indicates that while support exists in some countries, advocacy and education is needed in others.” (p.2). 			
Optimize	2011	Developing a Vision for Immunization Supply Systems in 2020: Landscape analysis summaries	General
<ul style="list-style-type: none"> • “Availability of appropriate tools and information for countries to strengthen national decision-making to help ensure that the vaccine products purchased have attributes that meet country needs.” (p.5). 			

10 APPENDIX 4: HYPOTHESIS 4

The SCM organization is inadequately designed to face the increasing complexity and challenges of the supply chain

Authors	Year	Evidence	
Levine, Pickett, Sekhri, Yadav	2008	Demand Forecasting For Essential Medical Technologies	General
<ul style="list-style-type: none"> • “If actions by the international community do not increase the ability to generate credible forecasts of demand – if, in fact, those actions contribute to a situation of greater uncertainty, with higher stakes – efforts to achieve greater access to life-saving and life-extending medicines will be undermined.” (p.226). • “In developing countries themselves, demand forecasting has been viewed as one of the many functions required of overburdened technical personnel within ministries of health or particular dedicated units, such as those that manage national immunisation programs.” (p.227). • On MoH, private and public sources of finance for health products: “Although expenditures in all three sources have been increasing gradually in most countries, the expansion in the international public sector donor funds is creating a discontinuity in the resources available, particularly in the lowest-income countries.” (p.228). • “The emergence of so many products creates challenges for funders, intermediaries and consumers, who are all accustomed to having only a few commodity-type products with quite well established supply and procurement relationships.” (p.229). • “Although more than four suppliers have been deemed qualified to provide the common first line antiretroviral drugs, problems with prequalification and cumbersome national registration processes have led to a situation in which only one or two suppliers are registered in any given country” (p.233). 			
Matowe, Waako, Adome, Kibwage, Minzi, Bienvenu	2008	A strategy to improve skills in pharmaceutical supply management in East Africa: the regional technical resource collaboration for pharmaceutical management	East Africa (Kenya, Uganda, Tanzania, Rwanda)
<ul style="list-style-type: none"> • Weaknesses include inadequate capacity and skills to quantify needs for medications or to order, receive and store medications appropriately and to record medications inventories accurately” (p.2). 			
Pasquet, Messou, Gabillard, Minga, Depoulosky, Deuffic-Burban, Losina, Freedberg, Danel, Anglaret, Yazdanpanah	2010	Impact of Drug Stock-Outs on Death and Retention to Care among HIV-Infected Patients on Combination Antiretroviral Therapy in Abidjan, Côte d’Ivoire	Côte d’Ivoire
<ul style="list-style-type: none"> • “In many developing economies, the epidemiological profile is changing – evolving from infectious and less expensive diseases, which can be treated through massive national campaigns, to chronic degenerative diseases such as cancer and diabetes, which are more expensive to treat” (Introduction). 			
Sabot, Yadav, Zaffran	2011	Maximizing Every Dose and Dollar: The Imperative of Efficiency in Vaccine Delivery	General
<ul style="list-style-type: none"> • “Many of the new vaccines will be substantially more expensive and bulkier than traditional antigens and will place accumulative strain on delivery systems” (p.1). 			
Yadav, Stapleton, Van Wassenhove	2011	Always Cola, Rarely Essential Medicines: Comparing Medicine and Consumer Product Supply Chains in the Developing World	General
<ul style="list-style-type: none"> • On the likelihood of localising production: “The educational and vocational system in many low income countries may not currently have the ability to supply the engineers, pharmaceutical specialists and other skilled workers that are crucial for running a high quality and efficient pharmaceutical production plant.” (p.7). • “Given the lack of quality monitoring capacity, it is safer to limit the distribution of medicines to a few tightly regulated distribution channels. Narrower distribution channels used for medicines also imply that the means of transport cannot be fully realised.” (p.9). 			

Kaufmann, Miller, Cheyne	2011	Vaccine supply chains need to be better funded and strengthened, or lives will be at risk	General
<ul style="list-style-type: none"> • “the new vaccines will strain already fragile supply chains in many lower- and middle-income countries, jeopardizing the ability to get vaccines to those for whom they can make a difference.” • “Project Optimize has estimated that vaccine storage needs in countries introducing the new vaccines may increase by 500 percent or more in the near future.” • “Supply-chain managers in developing countries and those who work with them from international and nongovernmental organizations routinely report that storage, distribution, and inventory management capabilities in many countries are limited and lacking resources.” • “We have seen that the ability in country to analyze and plan efficient transportation routes, develop and operate transportation schedules and networks, or procure and maintain the right vehicles to meet transport needs is often lacking.” 			
Schouten, Jahn, Ben-Smith, Makombe, Harries, Aboagye-Nyame, Chimbwandira	2011	Antiretroviral drug supply challenges in the era of scaling up ART in Malawi.	Malawi
<ul style="list-style-type: none"> • “An increase and spread of HIV drug resistance will necessitate a change of first-line ARV regimens, and these are without exception more expensive and increase the costs of national ART programmes.” • “However, the number of people shifting to alternative first-line ART regimens (for reasons of drug toxicity) and second-line ART (for reasons of treatment failure) has been more difficult to predict.” • “The long procurement process and increasing quantity of ARVs pose major challenges to prevent stock outs. First, predictions have to be made for one year ahead. While a degree of confidence is applied around some of the estimates for each site, with an obvious tendency to over-order instead of under-order, it may be necessary to increase the in-country stocks of ARVs to cover the eventuality of potential delays in the process.” • “The vast majority of ARVs are procured with funds from the Global Fund and the lack of existing alternative funding sources makes the programme very susceptible to any bottlenecks in grant disbursement.” 			
RBM-GF	2013	Third joint RBM – Global Fund PSM Workshop “Resolving PSM bottlenecks” Tunis, Tunisia 18-20 September 2012	General
<ul style="list-style-type: none"> • “PRs and SRs with weak understanding of GF agreements and operational procedures leading to errors and disbursement delays” (p.7). • On potential solutions: “Need to have regionally accredited labs because there are long delays in obtaining results from external labs.” (p.7). 			
People that Deliver	2011	Key Points from the “Human Resource Capacity in Public Health Supply Chain Management” Country Assessments	General
<ul style="list-style-type: none"> • “Three of the eight countries reported having strategic plans for HR strengthening which includes SCM cadres, and budget line items for the implementation of this plan; however, not all levels of the system were always aware that these plans were in place.” (p.2). • “Across all eight countries no clear career track exists for staff with training and skills in supply chain management.” 			
People that Deliver	2011	Highlights from the April-May 2011 People that Deliver “Global Survey” for Public Health Logisticians	General
<ul style="list-style-type: none"> • “Responses were categorized into broad groups, with the majority of responses identifying the following as the top problems: lack of training/need for additional training (57% of respondents), lack of human resources and turnover (43%) insufficient supervision (30%), inadequate/poor infrastructure (27%), and poor communication (25%).” (p.1). • “Responses were categorized into broad groups, with the majority of responses identifying the following as the top ideas: training (43% of respondents), improved infrastructure particularly with respect to warehouses (16%), improved communication (14%), improved supervision (14%), and incentives and motivation strategies (10%).” 			

Optimize	2011	Vision of future immunization supply and logistics systems: Landscape analysis summary	General
<ul style="list-style-type: none"> • “Increased involvement by national immunization programs in research and feedback to inform vaccine product profiles.” (p. 5). • “Supply systems that maximize effectiveness and agility including: Regional distribution hubs to manage the growing pipeline of vaccines; Innovative last-mile transport solutions for health workers.” (p.11). • “There is a lack of in-country skills to plan for, design, implement, and sustain information systems projects.” (p.27). 			
Bill & Melinda Gates Foundation	2012	Vaccine supply chain strategy: Summary of Foundation Approach 2013-2016	
<ul style="list-style-type: none"> • 26 vaccine SC experts interviewed from 15 different organizations and Extensive desk research conducted on current challenges facing vaccine SCs using a wide variety of data sources came up with the following as the major challenges; <ul style="list-style-type: none"> -Process of Vx procurement doesn't meet country needs -Insufficient storage capacity -Increasing diversity in vaccine characteristics -High cost of equipment -Equipment that doesn't meet countries needs -Guidelines don't reflect true thermo stability -Vaccine packaging and presentation not optimized for countries -Limited capture of data 			
VillageReach	2013	District Logistics capacity study 2013-Examining the capacity of 53 Districts in Mozambique to carry out Health Logistics and Supply Chain Activities	Mozambique
<ul style="list-style-type: none"> • All district managers reported that their districts have insufficient infrastructure for medicine/vaccine logistics. • Only 6% of district pharmacy staff (who are responsible for medicine distribution) and 12% of district PAV staff responsible for vaccine distribution scored 100% on basic logistics concepts oral quiz administered during the survey. • 19% of all closed vehicles in the district are unavailable due to damage and it takes an average 38 days for a broken vehicle to be repaired. • Only 4% of districts have closed vehicles that are always available for medicine/vaccine distributions • No district pharmacies and only 8% of district PA programs report that their districts have a budget for medicine/vaccine distribution • Only 21% of districts have adequate storage space in the medicine/vaccine stores • The challenge in ensuring that the health centers in the country receive their medicines and supplies has been that districts do not have sufficient capacity to manage health logistics which leads to poor performing supply chains and a lack of product availability at the service delivery and community levels of the health system.“ Many districts lack specific capacities, resources and infrastructure to carry out health logistics activities such as adequate transport, sufficient staff, planning and management skills and understanding of logistics concepts.....” due to lack of physical and human resources districts are sometimes unable to complete distributions to the health centres.” 			

11 APPENDIX 5: HYPOTHESIS 5

Lack of proper incentives and performance management to enable people who manage the supply chain

Authors	Year	Evidence	
Levine, Pickett, Sekhri, Yadav	2008	Demand Forecasting For Essential Medical Technologies	General
<ul style="list-style-type: none"> “Relatively little has been done to address the underlying weaknesses in data, methods and institutional incentives that are common to virtually all products and that severely constrain good decision making.” (p.227). 			
Pasquet, Messou, Gabillard, Minga, Depoulosky, Deuffic-Burban, Losina, Freedberg, Danel, Anglaret, Yazdanpanah	2010	Impact of Drug Stock-Outs on Death and Retention to Care among HIV-Infected Patients on Combination Antiretroviral Therapy in Abidjan, Côte d’Ivoire	Côte d’Ivoire
<ul style="list-style-type: none"> On the political nature of the hiring process of health managers: “These people are not evaluated based on their performance and have little incentive to strive for efficient resource management.” (p.13). “If at all possible, positions that demand specific knowledge of medicine supply chain should be filled with people who have an academic background and experience in this area, These people should be evaluated on their performance based on a mix of indicators – from maintaining high service levels and achieving savings targets to managing budgets – and rewarded for their efforts.” (p.13). It is suggested on p.14 that transforming supply chain processes can be complex, and results in one area may not lead to overall improvements in the system. Therefore it is suggested that developing countries should use project management offices to centrally coordinate and keep abreast of overall changes. 			
Sabot, Yadav, Zaffran	2011	Maximizing Every Dose and Dollar: The Imperative of Efficiency in Vaccine Delivery	General
<ul style="list-style-type: none"> “Countries should ensure that all staff in the delivery system are accountable for minimizing waste while maximizing coverage” (p.3). 			
Yadav, Stapleton, Van Wassenhove	2011	Always Cola, Rarely Essential Medicines: Comparing Medicine and Consumer Product Supply Chains in the Developing World	General
<ul style="list-style-type: none"> “Supply chain planners for medicines tend to attribute the lack of planning data to the absence of formal information systems. Instead of using the existing mechanisms for collecting information from the points-of sale/dispensing or incentivising third parties to do it on their behalf.” (p8). “Medicine distribution requires traceability to ensure security in the supply chain. In some cases medicine distribution is limited only to state run distribution systems (central medical stores) which makes it difficult to create appropriate incentive structures. Even when medicine distribution occurs through a private distribution network, the regulatory framework and small size of the market prevents adequate competition.” (p.8). “Although there is some understanding of the incentives of different stakeholders in the medicine supply chain, the nature of contracting used is still mostly simple single part contracts. Also, financial incentives to increase sales (and hence availability) as used by soft drinks companies are not as applicable in the case of medicines as they could lead to irrational drug use.” (p.10). 			
Schouten, Jahn, Ben-Smith, Makombe, Harries, Aboagye-Nyame, Chimbwandira	2011	Antiretroviral drug supply challenges in the era of scaling up ART in Malawi.	Malawi

<ul style="list-style-type: none"> “As a first step, it is important for all stakeholders to agree on what are the key steps and bottlenecks required to move a drug order through to drug distribution in the field, and then to find potential solutions to these barriers. Time-related targets should be set for each step, and then operational research should be conducted every six months to determine if targets were reached and reasons for not reaching targets.” 			
Brossette, Silve, Grall, Bardy, Pilz, Dicko, Gerbergfo USAID	2013	Workforce Excellence in Health Supply Chain Management: Literature Review	General
<ul style="list-style-type: none"> “While an adequate salary is important, there is little data on what constitutes —adequate or how health workers rank the importance of other incentives, such as living and working conditions, training, feedback and advancement opportunities.” (p.8). “Introducing incentive packages (e.g., higher pay, nice housing) could attract pharmacists to underserved regions (Pharmacy Council/Ministry of Health 2009).” (p.8). 			
Dzau, Grazin, Bartlett, Udayakumar, Kibasi, Henke, Pettigrew	2012	A Neglected Resource: Transforming Healthcare through Human Capital	General
<ul style="list-style-type: none"> “For the workforce, the value proposition offered by innovative employers includes not just reimbursement but also the congenial working environment and the enhanced support and development opportunities.” (p.13). “For many health workers, such a working environment is much better than the fragmented, bureaucratic, and frustrating services they worked in previously. Other important factors include: clinical leadership and autonomy, and the empowerment of senior clinicians to take serious roles in the design, improvement and development of services – these factors motivate many within the clinical workforce.” (p.13). “For example, SalaUnoSalud not only focuses on financially incentivising its ophthalmologists, but has also put together a benefits package that includes access to research and publication opportunities, and also attendance at conferences and training events. By such means, the ophthalmologists remain motivated in their professional career development within the organisation.” (p.19). On example of Indian hospital: “the hospital adopted a policy of paying higher wages to a core group of nurses in order to retain them, and at the same time filling other posts through a continuous flow of incoming cohorts from its own nurse-training institution. This approach to limiting recruitment costs through differential salaries continues to be one of the key success factors at Narayana Hrudayalaya” (p.19). 			
People that Deliver	2011	Key Points from the “Human Resource Capacity in Public Health Supply Chain Management” Country Assessments	General
<ul style="list-style-type: none"> “Five of the eight countries report not having any mechanisms in place to encourage retention of staff With supply chain responsibilities.” (p.3). 			
People that Deliver	2011	Highlights from the April-May 2011 People that Deliver “Global Survey” for Public Health Logisticians	General
<ul style="list-style-type: none"> “Responses were categorized into broad groups, with the majority of responses identifying the following as the top ideas: training (43% of respondents), improved infrastructure particularly with respect to warehouses (16%), improved communication (14%), improved supervision (14%), and incentives and motivation strategies (10%).” 			
Optimize	2011	Vision of future immunization supply and logistics systems: Landscape analysis summary	General
<ul style="list-style-type: none"> “Recognition and motivation: Supply chain managers are currently not considered a critical factor of success for health operation and lack recognition and incentives. The need for improved logistics expressed at the district/peripheral level is not a seen as a priority at the central/national levels. There are few champions for this field that often remains marginal in most international meetings. Contrary to other technical areas, there is no clear evidence demonstrating the benefits of recognition and incentives in terms of savings and improved staff performance. Furthermore, initiatives promoting the professionalization of supply chain managers often raise concerns on the part of some health workers, such as pharmacists, district administrative officers, and others. In such a context, the poor performance of SCM systems further reduces staff motivation—not only among supply chain managers but among all health care personnel” (p.35). 			

Dowling	2011	Healthcare Supply Chains in Developing Countries SITUATIONAL ANALYSIS	General
<ul style="list-style-type: none"> “Issues of insufficient staff numbers, appropriate training, geographical and professional isolation in rural and remote environments, a lack of supervision/contact with supervisors, inadequate professional and personal facilities, pay and conditions, and workload are all significant issues that affect staff satisfaction, turnover, and the ability of staff to complete their job satisfactorily (Hawthorne and Anderson 2009; WHO 2010).” (p.16). 			
John Snow, Incorporated	2011	Promising Practices in Supply Chain Management for Community-Based Distribution Programs : Global Survey of CBD Programs http://www.k4health.org/toolkits/cba2i/promising-practices-supply-chain-management-community-based-distribution-programs OR http://sc4ccm.jsi.com/files/2012/10/Promising-Practices-in-Supply-Chain-Management-for-Community-Based-Distribution-Programs-Global-Survey-of-CBD-Programs.pdf	
<p>‘Effective distribution is dependent on reliable transportation, cold chain capacity, timely flow of information for planning, adequate human resources, and sufficient financial resources to support distribution related costs. Every Women Every Child (EWEC) countries currently experience a number of barriers and challenges to improving commodity distribution practices as summarized in the bullets below:</p> <ul style="list-style-type: none"> • Transportation: Availability, reliability and quality of transport infrastructure and services, especially at the last mile as well as maintenance of cold chain during distribution for temperature sensitive and cold chain dependent commodities • Lack of Funding: Limited funds to support distribution costs at the lower administrative levels of the health system • Distance: Distance between health centers and resupply points and between community health workers and health centers. This problem can be exacerbated when systems are set up according to administrative boundaries/reporting lines rather than by distance, topography or population density. • Poor Planning: Ad-hoc distribution strategies and poor distribution planning with limited incentives for timely distribution. • Seasonality: Seasonality, affecting the need for some commodities, and geography, with terrain being a challenge for transportation. • Poor Data Access: Poor data management and/or lack of sufficient stock at higher levels of distribution leading to inadequate stock distributed.(pp 1&2) 			
Andrew Biketi Musuya& Gregory Namusonge	2013	Medical products demand and supply stability as a factor influencing implementation of just in time supply chain management policies: A case study of Ministry of Public Health and Sanitation in Kenya	JKUAT, Kenya
<ul style="list-style-type: none"> Although there are many benefits of SCM reported in the literature, most SCM linked problems originate from either uncertainties or an inability to co-ordinate activities and partners (Turban, McLean, & Wetherbe, 2004). The bullwhip effect (demand variability) is one of the most common problems in supply chains discussed in the literature (Fransoo & Wouters, 2000; Basu and Wright, 2008). Pg 550 “It was concluded that the stability of demand and supply, meant effective implementation of the JIT policy in the ministry.” Pg 1 			
Richard Seifman & Rebecca Bailey	2013	Applying the HRH Action Framework to Develop Sustainable Excellence in the Health Supply Chain Workforce	General
<ul style="list-style-type: none"> “To reduce turnover of supply chain workers, leaders need to provide clear career paths with financial and nonfinancial incentives and career development opportunities based on performance, as well as adequate workplace environments and working conditions”. 			

Bill & Melinda Gates	2012	Vaccine supply chain strategy: Summary of Foundation Approach 2013-2016	General
<ul style="list-style-type: none">• 26 vaccine SC experts interviewed from 15 different organizations and Extensive desk research conducted on current challenges facing vaccine SCs using a wide variety of data sources came up with the following as the major challenges;<ul style="list-style-type: none">-Low awareness of need for redesign-Little focus on HR improvement-Poor incentives to improve performance			

12 APPENDIX 6: HYPOTHESIS 6

Poor supply chain practices result in weak information systems, poor cold chain and vaccine management, and ultimately stock outs and wastage.

Authors	Year	Evidence	
Levine, Pickett, Sekhri, Yadav	2008	Demand Forecasting For Essential Medical Technologies	General
<ul style="list-style-type: none"> • “Many of the shortcomings in funding and functioning of health systems impede accurate forecasting of demand – and without the ability to forecast demand with reasonable certainty and some assurance of a viable market, manufacturers cannot scale production capacity, make commitments to suppliers of raw materials or justify a business case for investing in costly clinical trials and other activities to develop future products.” (p.225) • “Relatively little has been done to address the underlying weaknesses in data, methods and institutional incentives that are common to virtually all products and that severely constrain good decision making.” (p.227). • On the Global Fund’s procurement design: “In practice, however, this approach has significantly burdened in country supply chains by creating a market of small, disaggregated buyers with limited ability and experience to influence product quality, price, packaging, shelf life, availability or delivery times.” (p.232). 			
Matowe, Waako, Adome, Kibwage, Minzi, Bienvenu	2008	A strategy to improve skills in pharmaceutical supply management in East Africa: the regional technical resource collaboration for pharmaceutical management	East Africa (Kenya, Uganda, Tanzania, Rwanda)
<ul style="list-style-type: none"> • “Inappropriate patterns of drug use behaviour can result in unsafe pharmaceutical use, waste of resources, non-compliance and excessive adverse drug reactions.” (p.2). • “These problems ranged from the inability of the existing systems to adequately scale up programmes to lack of readiness of the workforce to efficiently use and manage large supplies of antiretrovirals, including inadequate capacity to quantify needs and distribute the medications and inappropriate medication-distribution practices.” (p.4). 			
Pasquet, Messou, Gabillard, Minga, Depoulosky, Deuffic-Burban, Losina, Freedberg, Danel, Anglaret, Yazdanpanah	2010	Impact of Drug Stock-Outs on Death and Retention to Care among HIV-Infected Patients on Combination Antiretroviral Therapy in Abidjan, Côte d’Ivoire	Côte d’Ivoire
<ul style="list-style-type: none"> • On creating an essential drug list: “Ideally, a national list of essential drugs should include between 300 and 400 drugs; a district hospital – one that treats large communities and has several specialisations – should have between 150 and 200 drugs on its essential list, a health centre should have 40 to 50, while a dispensary should have 20 to 30 drugs on its list.” (p.5). • Significant improvements in expenditure and efficiency can be made by consolidating the drug procurement process. (p. 8). 			

<ul style="list-style-type: none"> • “To have the right drugs in stock, health care facilities must accurately predict the medicines they will need and diligently manage the supplies they have. In Mexico for example a recent study revealed that more than 50 percent of the undersupply of medicines can be attributed to problems on demand planning and inventory management.” (p.10). • “Given their typically limited investment and operational budgets, public health systems can often benefit by using application service providers, or ASPs. ASPs can acquire, implement, maintain and provide systems on a pay-per-use basis.” (p.13). 			
Sabot, Yadav, Zaffran	2011	Maximizing Every Dose and Dollar: The Imperative of Efficiency in Vaccine Delivery	General
<ul style="list-style-type: none"> • “In some countries, as many as 50% of vaccine doses are wasted by not being administered, and many more doses are exposed to freezing temperatures that can reduce their potency” (p.2). • “In many countries, however, wastage and freezing far exceed the necessary levels.” (p.2). • “Many countries can cut out entire layers of the delivery chain, better utilize innovative cold chain technologies, and/or contract the expertise of the private companies that successfully deliver heat sensitive products to the most remote areas” (p.3). • “Some vaccines can survive at controlled temperatures above the traditional range for substantial periods. Manufacturers, regulators, and countries should exploit this stability to more efficiently reach remote area” (p.3). • “Countries and their partners should pursue a vision in which a national manager or a remote nurse can view vaccine usage and coverage of children at the click of a button.” (p.3). 			
Yadav, Stapleton, Van Wassenhove	2011	Always Cola, Rarely Essential Medicines: Comparing Medicine and Consumer Product Supply Chains in the Developing World	General
<ul style="list-style-type: none"> • “Obtaining an accurate estimate of the size of the market for specific medicines is extremely challenging due to the lack of knowledge on the size, income levels or location of the population (Levine et al, 2008)....Thus, expensive one off monitoring and evaluation exercises are usually used.” (p.7). 			
Kaufmann, Miller, Cheyne	2011	Vaccine supply chains need to be better funded and strengthened, or lives will be at risk	General
<ul style="list-style-type: none"> • “UNICEF’s entire vaccine planning process, including negotiations with vaccine producers and supply-chain logistics, is based on forecasts of future vaccine need. Thus, accurate predictions are vital.” • “Because census data are typically only brought up to date every ten years, even in the best-organized developing countries, the combination of inaccurate estimates means that incorrect vaccine forecasts are replicated year after year.” • “These difficulties suggest to us the need to develop more efficient solutions, such as improved solar refrigerators and long-life cold boxes.” 			
Schouten, Jahn, Ben-Smith, Makombe, Harries, Aboagye-Nyame, Chimbwandira	2011	Antiretroviral drug supply challenges in the era of scaling up ART in Malawi.	Malawi
<ul style="list-style-type: none"> • “A WHO survey in 2009 revealed that 36 (38%) out of 94 reporting countries had documented at least one stock out of antiretroviral (ARV) drugs in health facilities” • “The long procurement process and increasing quantity of ARVs pose major challenges to prevent stock outs. First, predictions have to be made for one year ahead. While a degree of confidence is applied around some of the estimates for each site, with an obvious tendency to over-order instead of under-order, it may be necessary to increase the in-country stocks of ARVs to cover the eventuality of potential delays in the process.” • “the current parallel supply management system operates without a central warehouse and a national buffer stock, which diminishes the in-country capacity to prevent stock-outs of ARVs.” 			

RBM-GF	2013	Third joint RBM – Global Fund PSM Workshop “Resolving PSM bottlenecks” Tunis, Tunisia 18-20 September 2012	General
<ul style="list-style-type: none"> • “Countries are constrained by weak Logistic Management Information System (LMIS), weak forecasting and quantification, poor coordination among partners and with the MoH, and manufacturer delays” (p.7). • On potential solutions: “Set up a functional and sustainable LMIS that enables to capture all disease and consumption data. Need long term investments in LMIS for sustainability” (p.7). • On potential solutions: “Monitor and evaluate PSM system performance and take corrective action accordingly” (p.7). 			
Optimize	2011	Vision of future immunization supply and logistics systems: Landscape analysis summary	General
<ul style="list-style-type: none"> • “Increased involvement by national immunization programs in research and feedback to inform vaccine product profiles.” (p.5). • “Further investigation in ways to continually improve supply systems, with ongoing monitoring, learning, and innovation: Technological and management solutions for temperature monitoring as part of required quality control processes during in-country transport of vaccines; Innovative funding mechanisms to ensure that recurrent expenses for vaccine transportation are covered.” (p.11). • “A number of innovative software tools utilize newly digitized global location information to optimize logistics transport legs. However, up to now, these tools have been used primarily in the private sector and multinational companies. There are likely to be costs in developing-country immunization logistics that could be removed by optimizing delivery routes while at the same time reducing the environmental impact of these programs. More work is needed to utilize available, innovative geographic information system tools to increase the efficiency of developing-country logistics systems.” (p.17). • “A holistic approach to reducing waste in logistics systems can start with making sure that the right quantity and quality of product is accepted into the system in the first place. Excess waste can result from over-ordering, moving product to locations where it cannot be stored or used properly, and accepting product with inadequate remaining shelf life. Work on product optimization through raising capacity for accurate quantification, product redistribution, and proper acceptance procedures can strengthen logistics systems and ultimately reduce the amount of waste for disposal.” (p.17). • “To facilitate the movement to reduce and optimize packaging of vaccines and supplies, it would be helpful to ensure there is a feedback loop about cold chain conditions all the way back to manufacturers. Generating better information about product conditions during shipping and upon arrival and sharing this information with manufacturers could result in improved packaging by reducing manufacturers’ tendency to over pack.” (p.18). • “A challenge lies in demonstrating an innovative, low-cost, low maintenance solution that would meet the basic logistics information needs for at least two health commodities (one of which should be vaccines) at the intermediate and lowest levels of a supply chain for a low-income country. Basic information needs include: The ability to register receipts, issues, and physical on-hand stock. The ability to reorder based on historical consumption data. The ability to keep track of stock at all nodes in the system (and have upward, downward, and lateral visibility of stock).” (p.26). 			
Dowling	2011	Healthcare Supply Chains in Developing Countries SITUATIONAL ANALYSIS	General
<ul style="list-style-type: none"> • “Many in-country supply chains do not routinely monitor and report on their performance. In and of itself, this is a significant indicator of suboptimal performance. If monitoring does occur, it is often based on periodic survey data for a limited set of indicators.” (p.13). 			
Josephine Katabaazi Nakyanzi, Freddy Eric Kitutu, Hussein Oria and Pakoyo Fahiru Kamba		Expiry of medicines in supply outlets in Uganda	Uganda

<ul style="list-style-type: none"> • The expiry of medicines highlights a problem with the supply chain which includes medicine selection, quantification, procurement, storage, distribution and use. Poor management of a change in treatment policy was implicated in the expiry of huge stocks of Chloroquin, Sulfadoxine, Pyrimethamine and Isoniazid. • Main contributing factors in the supply chain included neglect of stock monitoring, lack of knowledge of basic expiry prevention tools, non-participation of clinicians in medicine quantification in hospitals, profit and incentive-based quantification, third party procurement by vertical programmes and overstocking • A possible explanation for expiry of anticancer drugs is slow turnover because they treat rare diseases and are expensive • Poor coordination appears to be responsible for some expiry incidents for example expiry date due to treatment policy change and duplicate procurement can be prevented by sound coordination between key stakeholders 			
GAVI Alliance		Public consultation Preliminary Analysis	General
<ul style="list-style-type: none"> • Consolidated view of the most cited challenges along the supply chain include: <ul style="list-style-type: none"> ○ Data discrepancy between country data and global data ○ Multiple formal and informal signals of demand received by manufacturers with limited opportunity to reconcile ○ Supply chain considerations not sufficiently taken into account in product specifications and standards ○ Lack of total cost perspective on portfolio and SC decision • The incountry challenges identified include; <ul style="list-style-type: none"> ○ Poor equipment repair and maintenance ○ Insufficient vehicles and other transportation resources ○ Multiple levels of supply chain holding inventories cause inefficiencies ○ Lack of well documented supply chain processes and often not well implemented ○ Adhoc delivery schedule leading to unreliable distribution ○ Suboptimal cold chain equipment selection ○ Limited transparency on the frequency, size and location of demand • The following were identified as interface challenges; <ul style="list-style-type: none"> ○ Poor quality of short term forecasts ○ Delay of fund transfer from countries for cofunding of vaccines ○ Vaccine intro decisions and scheduling are not robust enough and change frequently ○ Countries do not always receive products according to their preferred specifications changes ○ Last minute sharing of procurement plan and changes with manufacturers ○ Frequent short term updates and demand forecast communicated to manufacturers ○ Long lead times and delays in getting shipment clearance 			
Jérémie Gallien and Prashant Yadav	2010	Inventory Control for the Public Distribution of Essential Drugs in Zambia: Analysis of Existing System and Alternative Proposal	Zambia
<ul style="list-style-type: none"> • “the distribution of essential medicines in Zambia is challenging because of seasonal demand and supply lead-times, supply shortages and drug shelf life and storage capacity constraints.” • The demand for a number of essential drugs in Zambia exhibits strong seasonality patterns, which complicates forecasting and makes it harder to 			

achieve a high utilization of production and distribution resources

- personal interviews and communications suggest that the availability of essential drugs at the national warehouse seems to be occasionally
- Problematic. The potential causes for this situation that were reported to us include the unpredictability and length of replenishment lead-times from vendors, financing issues and inaccurate demand forecasting, but we have not investigated these issues further given our focus on distribution (as opposed to procurement.
- the delivery lead times from the district offices to the health centers were reported by many to be both long and unpredictable, for the following reasons: (i) District offices do not have access to sufficient transportation capacity and have a very limited budget to pay for private transportation. While some district offices have access to 4WD vehicles, these vehicles are shared across many other health programs (including immunizations and patient visits for example), so that the transportation capacity remaining for drug delivery appears both insufficient and unpredictable.
- It was reported to us as part of personal communications that some health centers periodically run out of storage space, which seems problematic for at least two reasons: (i) this may increase the necessary or desirable frequency of shipments to these health centers, further adding to the load on transportation resources which are already stretched; and (ii) this may limit the ability to load some health centers with inventory in anticipation of their being cut off due to flooding, thus resulting in poor service levels to patients during the rainy season.
- Final challenge is that many of the essential drugs in Zambia have a limited validity period and must be discarded if unused on their expiry date. Some of the drug inventory may thus be wasted if it is not properly managed, which effectively creates a constraint on the cycle time of inventory through the distribution system

Peris Wanjiru Wahome	2013	Factors influencing inventory management in public sector: A case study of the Othaya district hospital.	Kenya
<ul style="list-style-type: none"> • Nevertheless, several challenges are facing inventory management process hence resulting to some extent achievement of intended inventory management in public sector objective by the government. • Such challenges include lack of transparent tender awarding and pre-qualification of supplier not made public. Delays was sought to be another challenge which was caused by the processes of initiating a request for supplies to the supplier, Non availability of some pharmaceuticals from the Kenyan market or in the global market, legislation issues also come in to play as these products had to be authorized to be used in Kenyan market hence delays while awaiting approval and other logistical issues. Lack of e-procurement which could have been fast and reduce the delays. 			

13 APPENDIX 7: WORKING GROUP INSTRUCTIONS

A meeting of the People and Practice Working Group in Copenhagen on February 10th 2014 provided additional guidance on the review:

- The review context should go beyond Burkina Faso and Mozambique to include, MoHs; One English speaking country.- Kenya; Michelle Arnet's work in the Western Cape and South Africa; One Asian country- Bangladesh; Nigeria; DRC – a large country with a lot of interest, partnership with GSK. It was pointed out that current evidence existed from:
 - EVM scores
 - USAID Deliver country/regional reports
 - People that Deliver presentations
 - Anecdotal evidence
 - EPI reviews (coordinated by the MoH)- UNICEF CO, but we need permission from countries
- Other evidence bases to be included:
 - Optimize, JSI/McKinsey, and Gates landscape analyses, Imperial benchmark (done by GAVI- contact Daniel Thornton), World Bank reports
 - CHAI (Chris Collins), Immunization Basics, World Bank, AMP, UN Commission Best Practices
 - The last mile: evidence is very different at the last mile than primary stores
 - AMP has a lot of grey documentation that are not yet published
 - Village Reach (Wendy) has some assessments and evaluations on the last mile in Mozambique.
 - USAID: informed push methodologies , has studies around task-shifting Intrahealth in Senegal
 - ICCM: integrated community case management studies (UNICEF)
- It was agreed to limit the evidence to that within the last five years.
- Organizations to be asked for country level reports.

- There is no plan for a country visit with the given time frame.
- The time allowed for the review was agreed to be 22 days. The author is to share 1 or 2 pieces of global and country specific evidence by 21st February. Full analysis due on 24th March.