Unlocking key drivers and potentials of supply chain integration on influencing the availability of health commodities

Alfred Ain Sallwa[1*]
Henry A. Mollel[2]
Leonada R. Mwagike[3]

[1*]alfredsalwa@gmail.com

[1]College of Business Education, [2,3]Mzumbe University, [1,2,3]Tanzania

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ABSTRACT

Supply chain integration (SCI) is crucial for healthcare facilities in ensuring the availability of health commodities, as it connects actors of the chain to improve efficiency and effectiveness while ensuring a win-win situation. To have an effective SCI, the study identifies strategies to achieve it and improve the availability of health commodities. The study utilized institutional theory and the resource-based view to analyze new SCI impact pathways; future studies can analyze using different theoretical lenses and frameworks. The study focused on the downstream level of health commodities, surveying healthcare workers' perceptions. This cross-sectional study involved 119 public healthcare centers in Tanzania, where healthcare workers were sampled using multi-stage sampling to answer the questionnaire in hand. The key results of the partial least structural equation modelling show that organizational resources are a key driver of integration. Organizational resources exerted a favorable influence on SCI ($\beta = 0.834$, $p < 0.001$), but professional norms had a negative effect. Conversely, professional norms showed a significant negative relationship with integration ($\beta = -0.532$, $p < 0.001$), as supply chain integration was found to be a major driver of the availability of health commodities ($\beta = 0.984$, $p = 0.002$). Mediation study indicated that SCI mediated the influence of professional norms and regulatory frameworks on commodity availability, with regulation enhancing and professional norms obstructing access. The impact of industrial practices and organizational resources was negligible when mediated by Supply Chain Integration (SCI). The findings provide a roadmap for healthcare facilities, policymakers, and regulators to proactively address commodity supply tensions and improve public healthcare facilities' resources and capabilities, enabling them to initiate an effective SCI to improve the availability of health commodities. By reframing the solution to health commodity availability, the study suggests new opportunities arising from SCI implementation and new responsibilities for different healthcare stakeholders. This research offers (1) a comparative analysis of different antecedents of SCI, and (2) a clear understanding of SCI and how it affects the availability of health commodities. The study recommends a shift in improving the resource capacity of the healthcare centers to allow them to fully integrate as a means of improving the availability of health commodities, while keeping the regulatory frameworks at minimum.

Keywords: Availability, AYSRH, Healthcare Commodity, Impact Pathways, Key Drivers, Supply Chain Integration

I. INTRODUCTION

Health systems across sub-Saharan Africa continue to struggle to ensure reliable access to essential reproductive health commodities for adolescents and young people (Mwamasangula & Gibore, 2024). Adolescent and Youth Sexual Reproductive Health (AYSRH) is vital for socio-economic development (Mwandali et al., 2020). Recognizing its importance, governments worldwide prioritize AYSRH to reduce maternal and child mortality (Mwandali et al., 2020), prevent sexually transmitted infections (STIs) (Mtaita et al., 2021), and improve youth mental health (Bylund et al., 2020). Globally, AYSRH service delivery varies, with Sub-Saharan Africa lagging in key indicators such as teenage pregnancy rates, STIs, and contraceptive availability (Mesiäislehto et al., 2021). In Africa, barriers to the provision of AYSRH services include limited availability of AYSRH commodities, inadequate health infrastructure, supply chain disruptions, limited youth-friendly services, and socio-cultural constraints (Mrisho et al., 2022; Mtaita et al., 2021). These challenges are compounded by poor health system coordination, fragmentation among supply chain actors, limited availability of essential supplies such as contraceptives, and delayed service delivery, particularly in rural and underserved areas (Mesiäislehto et al., 2021).

Most empirical literature suggests that developed countries may have made significant advancements in AYSRH services (Mrisho et al., 2022; Hunter et al., 2023). A recurring factor in these studies is that these nations benefit from integrating SC members, which ensures coordinated medical supply distribution, thereby reducing disparities in demand planning and forecasting for adolescents and youth needs (Bylund et al., 2020; Mtaita et al., 2021). However, these studies have not established the relationship between supply chain integration (SCI) and its effects on AYSRH commodity availability, leaving a significant research gap. Empirical evidence highlights SCI's potential to improve the

availability of essential commodities in the manufacturing sector by streamlining logistics and distribution and strengthening collaboration and communication among supply chain partners (Yuen et al., 2019; Tiwari et al., 2024).

Taking the United Republic of Tanzania as an example, where efforts to improve the availability of AYSRH commodities through SCI have been implemented through initiatives such as adapting the Integrated Logistics System done by the Ministry of Health in 2009, and the electronic Logistics Management Information System (e-LMIS) and Enterprise Resource Planning (ERP) system introduced in 2014 (Mwamasangula & Gibore, 2024). These systems aim to integrate the supply chain actors for health commodities, including AYSRH products, to reduce inefficiencies, improve service delivery, and ensure the timely availability of essential healthcare services for youth (Mtaita et al., 2021).

Despite these efforts, challenges persist; the current demographic shows that the availability of AYSRH commodities at the public healthcare center is 57% as of the financial years 2022/23 and 2023/24 consecutively (Mwamasangula & Gibore, 2024), which is led by the availability of male condoms, followed by HIV testing kits, oral contraceptive pills, emergency contraceptive pills, antiretroviral therapy, and intrauterine contraceptive devices lastly (Mathias et al., 2024; Mwamasangula & Gibore, 2024). This limited availability of AYSRH commodities hinders health facilities from providing timely AYSRH services, which endangers youth by exposing them to STI infections, unsafe abortions, and early and unwanted pregnancies (Tiwari et al., 2024). A vital factor contributing to the problem of AYSRH commodity availability is the fragmentation within the health supply chain (Mathias et al., 2024). Many health facilities continue to experience poor coordination between procurement units, central medical stores, local government authorities, and service delivery points (Hunter et al., 2023; Ooms et al., 2020). There is limited internal integration across facility departments, and external integration with suppliers, donors, customers, and other facilities is often unreliable (Mathias et al., 2024).

Existing literature lacks empirical evidence for why a country that adopted SCI would still experience a fragmented supply chain and a low availability of AYSRH commodities. The question of SCI remains underutilized as the key drivers of effective SCI remain underexplored, and its role in improving the availability of AYSRH commodities remains uncertain. Drawing on ongoing field research in developing countries, this article positions SCI as the key remedy and a central operational mechanism in improving the availability of AYSRH commodities.

1.1 Research Objective

The study assessed:

(i) The influence of the four identified antecedents on the implementation of SCI, and
(ii) The influence of SCI on the availability of AYSRH commodities.

II. LITERATURE REVIEW

2.1 Theoretical Review

2.1.1 Institutional theory

Institutional theory posits that organizations strive for legitimacy by aligning with institutional pressures, resulting in similarities in practices and structures across industries (Liu et al., 2016). The development of the theory by Saldanha et al. (2015) explains how organizations adopt institutionalized practices and structures not necessarily for efficiency but to gain legitimacy. It further emphasizes that organizations do not operate independently; they are influenced by external institutional pressures: coercive, mimetic, and normative (Saldanha et al., 2015). Coercive pressures stem from legal and regulatory mandates and political directives imposed by authorities (Saldanha et al., 2015). Mimetic pressures arise from industry-wide practices, shared beliefs, and societal expectations that drive organizations to emulate successful models (Liu et al., 2016). Normative pressures, on the other hand, are shaped by professional standards, ethical norms, and established work roles within a given field (Liu et al., 2016). Institutional theory provides insights into why organizations adopt specific strategies in response to institutional pressures.

2.1.2 Resource-Based View Theory

The resource-based view (RBV) theory provides a strategic management framework that explains how organizations achieve competitive advantage by effectively utilizing their internal resources (Barratt & Oke, 2007). The theory identifies an organization's potential resources and capabilities that can improve performance and achieve competitive advantage (Barratt & Oke, 2007). Unlike institutional theory, which focuses on external pressure, RBV theory emphasizes that an organization's success in adopting and implementing new strategies for performance improvement depends on its ability to develop, manage, and leverage unique resources and capabilities (Yuen et al., 2019). Therefore, this study employed RBV theory to introduce one independent variable (organizational resources), which complements the three drivers of external pressures from an institutional theory perspective, thereby enabling a holistic assessment of SCI determinants of the availability of AYSRH commodities.

2.2 Empirical review

Studies have leveraged RBV in SC; for instance, Yuen et al. (2019) applied RBV to examine the critical success factors for SCI within the container shipping industry. The study revealed the pivotal role of relationship management, information management, organizational commitment, strategic alignment, and performance measurement in driving SCI implementation and performance. Similarly, Barratt and Oke (2007) utilized RBV to investigate the antecedents of SC visibility in retail supply chains. The study highlighted the interplay between technological and non-technological factors, such as trust and commitment, similar to Mesiäislehto et al. (2021).

Other studies have used the theory to assess how healthcare facilities can improve the supply and availability of healthcare commodities (Ndayishimiye et al., 2020). Ndayishimiye et al. (2020) conducted a study on the availability, accessibility, and quality of adolescent sexual and reproductive health services in Rwandan health facilities. The study revealed underutilization of some services, like female condoms, is influenced by family, community, and religious beliefs. The study acknowledged the high cost of SRH services among private facilities and the unavailability of the commodities among public facilities, which puts the adolescents in a service utilization dilemma.

Mesiäislehto et al. (2021) assessed the disparities in accessing SRH services at the intersection of disability and female adolescents in Tanzania. Using a qualitative participatory approach to explore access to SRH services among 136 Tanzanian adolescents with disabilities. The study revealed that SRH services in Tanzania do not adequately meet the needs of female adolescents with disabilities.

The study of Mathias et al. (2024) assessed the availability of essential health commodities in Tanzania, focusing on the tracer commodities. The study found low availability of tracer health commodities, especially in rural settings. The study listed delayed shipments, global shortages, and long lead times by MSD being the main causes of low availability of the health commodities. Other causes for low availability were poor quality of logistics data, inadequate use of data for decision-making, and poor inventory management.

2.3 Developed Variables

From the reviewed theories and empirical studies, the study adopted the regulative framework, industrial practices, and professional norms from the institutional theory and organizational resources from the RBV theory as independent variables influencing the SCI, which also influences the availability of AYSRH services. Table 1 below shows the variables and indicators adopted for the study and how they will be measured.

Table 1

Operationalization Matrix

Variable	Code	Construct	Items	Source	Scale
Regulative Frameworks (RF)	RF1	Government regulation emphasizing SCI	5	(Liu et al., 2016; Mesiäislehto et al., 2021; Saldanha et al., 2015)	Ordinal scale using 5 points Likert scale Strong Disagree=1 to Strong Agree=5
	RF2	Health policies compliance			
	RF3	Standardization guidelines			
	RF4	Donor requirements			
	RF5	International guidelines			
Industrial Practices (IP)	IP1	Adoption of industrial best practices	5	(Birhanu et al., 2022; Munakampe et al., 2024; Yuen et al., 2019)	Ordinal scale using 5 points Likert scale Strong Disagree=1 to Strong Agree=5
	IP2	Industrial benchmarking			
	IP3	Industrial standards compliance			
	IP4	Collaborative knowledge sharing			
	IP5	Innovative improvements			
Professional Norms (PN)	PN1	Professional standards	5	(Khanuja & Jain, 2020; Ooms et al., 2020; Tumusiime et al., 2025)	Ordinal scale using 5 points Likert scale Strong Disagree=1 to Strong Agree=5
	PN2	Professional education			
	PN3	Adoption of best practices from professional networks			
	PN4	Regulatory influence of professional norms			
	PN5	Professional development programs			
Organizational Resources (OR)	OR1	Financial resources	7	(Alzoubi et al., 2020; Barratt & Oke, 2007; Mauro et al., 2024)	Ordinal scale using 5 points Likert scale Strong Disagree=1 to Strong Agree=5
	OR2	Human resources			
	OR3	Technological resources			
	OR4	Infrastructure resources to support logistical activities			
	OR5	Innovative capability to adopt new strategies			
	OR6	Top management support			
	OR7	Relational management capability			

Supply Chain Integration (SCI)	SCI1	Internal integration	5	(Dunor & Urassa, 2017; Hunter et al., 2023; Mwandali et al., 2020)	Ordinal scale using 5 points Likert scale Strong Disagree=1 to Strong Agree=5
	SCI2	Supplier integration			
	SCI3	Customer integration			
	SCI4	Technological integration			
	SCI5	Logistics integration			
Availability of AYSRH commodities (AVC)	AVC1	Perceived stock availability	5	(Mesiäislehto et al., 2021; Mrisho et al., 2022; Mtaita et al., 2021)	Ordinal scale using 5 points Likert scale Strong Disagree=1 to Strong Agree=5
	AVC2	Consistency of supply			
	AVC3	Stock adequacy			
	AVC4	Variety of items			
	AVC5	Stockout experience			

III. METHODOLOGY

3.1 Study Design and Scope

This study adopted a cross-sectional design, focused on the downstream level of AYSRH service delivery by examining public healthcare centers, gathering the experiences and perceptions of healthcare workers involved in youth sexual and reproductive health service delivery in the United Republic of Tanzania, selecting four regions with a high rate of unmet AYSRH services among youth aged 15-35 years (Mwamasangula & Gibore, 2024). These areas reflect adolescents' and youth's limited access to SRH services, driven by the low availability of AYSRH commodities (Mathias et al., 2024).

3.2 Unit of Analysis

The unit of analysis for the survey was the public healthcare centers in the selected regions, involving pharmacists who serve adolescents and youth at healthcare centers, the medical officers in charge of the healthcare centers, and the procurement and supplies officers who link suppliers to the healthcare centers.

3.3 Population and Sampling

During the study time, Tanzania had 1036 registered public healthcare centers listed on the Health Facility Register portal, which compelled us to use multi-stage sampling. The sampling process started by focusing on regions with high unmet AYSRH needs, highlighting 284 healthcare centers. The second stage was trimming the regions to end with those regions with the highest unmet AYSRH needs (above 29%), done due to time and financial constraints. Lastly, as an inclusion criterion, the study included only public healthcare centers that provide AYSRH services alongside other services, resulting in 119 healthcare centers that resulted to 357 respondents.

3.4 Data Collection and Analysis

The study employed primary data that reliably reflects the current phenomena and enables real-time analysis. The data collection exploited a structured questionnaire and assessed the variables outlined using a five-point Likert scale response format. This study employed a multiple regression analysis for assessing the antecedents of SCI, and a linear regression for assessing the effect of SCI on the availability of AYSRH commodities.

3.5 Validity and Reliability

Validity of the study was ensured through face and content validity by adapting constructs used in previous empirical studies and involving different stakeholders before data collection for testing and improving the data collection instrument. On the other hand, reliability was ensured by testing the Cronbach's alpha test on the constructs to see if they meet the threshold of 0.7 and above. The test revealed good scores, as all the variables scored above 0.7, as seen in Table 2.

Table 2

Cronbach's Alpha Reliability Test

Variable	Variable indicators	No. of items	Cronbach's alpha
Regulative framework	RF1, RF2, RF3, RF4, RF5	5	0.812
Industrial practice	IP1, IP2, IP3, IP4, IP5	5	0.823
Professional norms	PN1, PN2, PN3, PN4, PN5	5	0.795
Organizational resources	OR1, OR2, OR3, OR4, OR5, OR6, OR7	7	0.857
Supply chain integration	SCI, SCI2, SCI3, SCI4, SCI5	5	0.854
AYSRH commodities availability	AVC1, AVC2, AVC3, AVC4, AVC5	5	0.881

3.5 Ethical Approval and Consideration

Ethical approval for this study and its procedures was obtained from the National Institute for Medical Research (NIMR), with reference number NIMR/HQ/R.8a/Vol.IX/5169 on 05 December 2025. The authors obtained participants' consent to begin the survey by having them sign consent forms. No participant was under the age of 18, as all were employees of the healthcare centers.

IV. FINDINGS & DISCUSSION

4.1 Model fitness tests

The analysis was divided into 3 phases. The first phase involved multiple regression for assessing the effect of the four identified antecedents on SCI, while the second phase involved linear regression to assess the effect of SCI on the availability of AYSRH commodities. The last phase involved a mediation effect analysis of SCI in this relationship, and the findings are presented together with those of phase two in Table 6. The analysis is preceded by the model summary results, ANOVA test, and the coefficient results in the end.

4.1.1 Model Summary Results

The results of the model summary show the R Square of 0.795, which reveals that the used model, which combines all four independent variables, explains the variance of the SCI implementation in the healthcare sector by 79.5% as presented in Table 3. Therefore, the employed model was a good predictor of the dependent variable.

Table 3

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.795[a]	.687	.684	.997	1.659

a. Predictors: (Constant), RF, IP, PN, OR

b. Dependent Variable: SCI

4.1.2 Analysis of variance (ANOVA) test

The analysis of variance tests was conducted to test the statistical adequacy of the model. The results revealed a goodness of fit of the model in explaining the implementation of SCI amid the AYSRH supply chain actors in Tanzania. The score was less than 0.001 and F-tests was 31.150.

Table 4

ANOVA test

ANOVA[a]						
Model		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
1	Regression	30.946	4	30.946	31.150	<.001[b]
	Residual	324.859	327	.993		
	Total	355.805	328			

a. Dependent Variable: SCI

b. Predictors: (Constant), RF, IP, PN, OR

4.2 Antecedents of SCI

The first part of the study aimed to assess the influence of several antecedents on the implementation of SCI. To achieve the objective, the study involved the analysis of four antecedents of SCI (regulative frameworks, industrial practices, professional norms emerging from the institutional theory, and regulative framework from the RBV theory) as seen in Table 5. Among all these, only organizational resources were found to influence the effectiveness of SCI significantly positively (p-value = 0.000, beta coefficient = 0.8341). Professional norms were negatively significant in this link (p-value = 0.000, beta coefficient = -0.5317), while industrial practices and regulative frameworks were insignificant. The results indicate that improvements in public healthcare resources and capacities can enhance the effectiveness of the SCI in the healthcare sector. These findings align with many other empirical studies, such as Alzoubi et al. (2020) and Yuen et al. (2019), which highlight the impact of organizational resources on improving supply chain integration. Also, the revealed negative influence of professional norms on the effectiveness of the SCI means that the practiced professional norms hinder the integration of SC actors, as each professional is restrained from integrating, which is contrary to the study by Junaid et al. (2023).

Table 5

Coefficient Results

Coefficients[a]						
Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
		B	Std. Error	Beta		
1	(Constant)	.417	.379		12.397	.0000
	RF	.0970	.050	.0900	5.581	.57011
	IP	.1665	.056	.1611	4.543	.1213
	PN	-.5479	-.505	-.5317	15.532	***
	OR	.8697	.795	.8341	7.650	***

a. Dependent Variable: SCI

4.2.1 Effect of SCI on the availability of AYSRH commodities

The study also revealed a strong and significant influence of SCI on the availability of healthcare commodities (beta coefficient = 0.9841, p-value = 0.0021), indicating that an improvement in SCI will lead to a significant increase in the availability of AYSRH commodities in healthcare facilities (see Table 6). The healthcare sector can leverage SCI by improving its effectiveness and placing greater emphasis on all health supply chain members to increase the availability of AYSRH commodities. The findings support those of Yuen et al. (2019) and Mesiäislehto et al. (2021), indicating that an effective SCI is essential for improving the availability of healthcare commodities in developing countries. Despite the contextual difference of the reviewed studies above and this study, they both revealed the importance of SCI in improving organizational performance in different sectors.

Table 6

Direct and indirect effects of SCI

Relationship	**Direct Effect**	**Indirect Effect**	**Confidence level**		**P-value**	**Mediation remarks**
			Lower bound	**Upper bound**		
SCI > AVC	0.9841	-	0.6559	2.08	0.0021	-
RF > SCI > AVC	0.2307	0.3191	0.0363	0.5694	0.0296	Partial
IP > SCI > AVC	-0.0951	0.0689	-0.1334	0.3283	0.5294	-
PN > SCI > AVC	0.0952	-0.4448	-1.05	-0.3347	0.0003	Partial
OR > SCI > AVC	-0.5291	0.3279	0.0132	0.7488	0.0710	-

4.2.2 Mediation effect of SCI

Findings in Table 6 show that professional norms and regulative framework significantly affect the availability of AYSRH commodities, with this effect mediated by SCI. However, that effect is negative for professional norms (coefficient = -0.4448) and positive for the regulative framework (coefficient = 0.3191). This depicts that the implementation of the present professional norms on SCI does not improve the availability of AYSRH commodities but rather worsens it. The findings are consistent with those of Birhanu et al. (2022), who found the same and emphasized information sharing rather than professional conduct as a hindrance to the integration of supply chain members. Also, on the regulative framework side, an improvement in SCI effectiveness can improve the effect of the regulative framework on the availability of AYSRH commodities. The findings align with those of Kalaria et al. (2023) and Ndayishimiye et al. (2020), who insisted that improving healthcare policies and regulations is key to improving the availability of health commodities through SCI. Lastly, the industrial practice and organizational resources were found to be insignificant in influencing the availability of AYSRH commodities when mediated by SCI.

V. CONCLUSION & RECOMMENDATIONS

5.1 Conclusion

The study has assessed antecedents for improving the integration of healthcare commodities supply chain actors, highlighting organizational resources as the most influential factor, followed by regulatory frameworks. This means public health centers need to improve their ability and capabilities first to be able to improve the effectiveness of the integration they form with other supply chain members. Also, the significant negative influence of professional norms has highlighted how the current professional conduct is pulling down the effectiveness of the SCI. The study has also shown how the industrial practices within the health and business sectors are not helping supply chain members to integrate.

The study has linked the supply of commodities with health facilities practices and revealed antecedents that need to improve the status of public healthcare centers, other supply chain members, and improve the supply of health commodities to improve the well-being of youth. The study has revealed the relevance of SCI in improving the

availability of health commodities through the results that show a high positive significance of SCI on the availability of health commodities.

5.2 Recommendations

The study has bolded that, to improve the availability of health commodities, an effective SCI is needed to help members improve performance and deliver value in return. Since organizational resources have a significant influence on SCI, immediate actions are needed to improve the capacities and capabilities of public health centers in terms of human, financial, technological resources, infrastructure, and innovative capability to ensure they integrate well with other members. The central government and other government agencies that administer public health centers should aim at improving the resource capacity of the centers to allow them to fully integrate as a means of improving the availability of health commodities.

The results show the relationship between SCI and the availability of health commodities is exceptionally strong. This confirms the core premise of the study: achieving high availability of health commodities is heavily dependent on how well the supply chain is integrated. The government should create a good environment for the public healthcare centers in terms of resources and a few major regulatory frameworks that will enable them to integrate with other actors to improve the availability of health commodities. Even on the established regulative frameworks, a twist is also required to shift the focus from strengthening the healthcare facilities independently, into integrating these facilities with the business sector, and form stronger integration with distributors and wholesalers to improve the supply chain at large.

Many developing countries invest much in refining regulatory frameworks, leaving the operational part of improving the integration of supply members unattended. The focus on regulative frameworks governing the healthcare sector should be minimal, as they do not affect the SCI effectiveness or the availability of AYSRH commodities directly. But, since the total effect of it was significant, it means any changes to the regulatory frameworks on insisting on integration may improve the availability of AYSRH commodities. Also, there is a need for deliberate efforts to capacitate the health facilities in terms of resources and capabilities for them to manage their integration and excel in ensuring the availability of health commodities is intact.

The current professional norms in the health supply chain may be strictly safeguarding the dominance of each professional; in return, they hinder the effectiveness of SCI in the sector. All relevant professionals, through their bodies, should address this, as the current practiced norms do not help members' integration or improve the availability of health commodities. Lastly, despite the presence of different industrial practices, their influence on SCI and the availability of AYSRH services are still insignificant. The health supply chain practitioners need to adopt new practices that will smooth the integration between members as a measure to improve the availability of commodities.

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