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The Role of Technology and Information Sharing in Enhancing Public-Private Partnerships Within Guyana's Healthcare Supply Chain

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Abstract

Public-private partnerships (PPPs) are essential for rectifying inefficiencies in healthcare supply chains, especially in developing nations such as Guyana, where recurrent drug shortages undermine patient care and intensify health inequities. This study examined the role of technology and information sharing in enhancing public-private partnerships within Guyana's healthcare supply chain. A mixed-methods approach was utilized, concentrating on specific healthcare institutions throughout Guyana, including pharmacies, public hospitals, private prescribers, pharmaceutical distributors, Non-Governmental Organizations and manufacturers. The target population comprises of healthcare professionals, including 293 respondents for the quantitative phase, alongside 20 key informants and 20 facility surveys for qualitative insights. A stratified random sample technique was employed, with surveys administered both digitally and in print form to enhance response rates. Quantitative data were gathered via structured questionnaires, and qualitative insights were derived from semi-structured interviews and facility surveys. Results indicated a substantial dependence on hybrid inventory management systems, with many respondents indicating a necessity for improved technological integration. Results revealed that most respondents encountered stock-outs, adversely affecting patient care, and underscore obstacles to efficient information exchange, including insufficient communication and absence of standardized processes. The study concludes that the implementation of an Online Information Sharing Platform can bolster collaboration between the public and private sectors, improve operational efficiency, and ultimately fortify healthcare delivery in Guyana.

Keywords: *Inventory Management, Online Information Sharing Platform, Public-Private Partnerships, Supply Chain, Technology,*

Introduction

Public-private partnerships (PPPs) are crucial instruments for rectifying structural inefficiencies in healthcare supply chains, especially in developing nations such as Guyana. The healthcare system in Guyana faces significant challenges, including recurrent shortages of essential medications, which critically hinder patient care and jeopardize public health. These shortages not only delay needed treatments but also exacerbate health inequities among vulnerable communities, emphasizing the urgent need for innovative approaches to ensure sustained access to medical supplies [17].

In this context, the implementation of an Online Information Sharing Platform (OISP) emerges as a transformative technological intervention capable of significantly strengthening the function of PPPs. By integrating an OISP into the healthcare supply

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chain, stakeholders from both the public and private sectors can access a centralized system for real-time communication and data exchange, thereby improving transparency and collaboration. Such technology empowers healthcare providers with up-to-date inventory data, enables effective tracking of stock levels, and supports swifter, more strategic responses to fluctuating demands [6]. Moreover, leveraging a suite of digital innovations—including telemedicine, health informatics, and artificial intelligence—can further enhance healthcare delivery, streamline resource allocation, and promote patient participation and empowerment [5].

Guyana's conventional supply chain approaches often rely on fragmented information systems and manual processes, which significantly impede the timely sharing of crucial data. Gaps in effective communication between public and private actors exacerbate the challenges of maintaining a steady supply of key medicines. The COVID-19 pandemic, in particular, underscored these weaknesses, highlighting how disparities in healthcare access led to disproportionate adverse outcomes for marginalized populations. While traditional measures (such as public awareness campaigns and improved resource distribution) are valuable, the pandemic demonstrated the necessity for adaptive, collaborative solutions spanning multiple sectors [2, 10].

Examples like the Health Equity Consortium (HEC) in California showcase how PPPs, strengthened by technological innovation, can address health disparities. HEC's approach—building trust with community-based organizations and leveraging real-time data exchange across healthcare professionals and agencies—demonstrates how technology-driven PPPs can enhance care coordination and empower underserved communities, leading to better health outcomes [2]. These real-world interventions illustrate the substantial role that technology-enabled PPPs have in improving communication and reducing inequities at the community and district levels.

Looking ahead, the trajectory of PPPs in healthcare is shifting toward integrated models that emphasize not only illness treatment, but also wellness and prevention. Central to these models is the expanded use of advanced data analytics to optimize care delivery and operational efficiency [11]. This study, therefore, focuses on how specific technological advancements—such as real-time health information systems, robust analytics, and automated inventory management—can strengthen collaboration between Guyana's public and private sectors. The primary goal is to clarify how technology and real-time information sharing can fortify PPPs, improve the consistent availability of medicines, and enhance the resilience of Guyana's healthcare system, especially during times of public health crisis.

By focusing on the OISP's role in promoting efficient information dissemination and operational agility, this study aims to identify actionable strategies for improving access to life-saving medications and building a more robust and equitable health infrastructure in Guyana.

Methodology

This study utilizes a mixed-methods approach, combining quantitative and qualitative techniques to thoroughly examine the influence of technology on public-private partnerships (PPPs) in Guyana's healthcare supply chain. The objective is to ascertain how technological innovations might bolster collaboration between public and private sectors and improve the accessibility of medicine and healthcare responsiveness.

Study Design

A mixed-methods methodology facilitates the acquisition of quantitative data via surveys and the gathering of comprehensive qualitative insights through interviews. This method

promotes a comprehensive comprehension of the existing healthcare supply chain environment in Guyana.

Study Site

The study will focus on selected healthcare facilities across Guyana, specifically targeting:

1. Pharmacies
2. Public Hospitals
3. Private Prescribers
4. Pharmaceutical Distributors
5. NGOs
6. Manufacturer

These sites were chosen to provide diverse perspectives and experiences regarding the challenges and opportunities within the healthcare supply chain.

Population

The target population includes healthcare professionals and stakeholders engaged in supply chain management, such as:

1. Supply Chain Managers (20%)
2. Pharmacists and Pharmacy Technicians (30%)
3. Public Health Officials (25%)
4. Private Sector Partners (25%)

The diverse composition ensures a comprehensive perspective on the challenges and implications of technology integration within the supply chain.

Sample Size

A total of 293 respondents will be targeted for the quantitative phase, representing various sectors within the healthcare system. For qualitative insights, 20 key informants will be selected based on their experience and relevance to the study's objectives. Additionally, 20 facility surveys were also performed.

Sampling Technique

1. **Quantitative Phase**: Table 1 shows how a stratified random sampling method will be utilized to ensure representation from each sector of the healthcare system, accounting for approximately 293 respondents.
2. **Qualitative Phase:** Purposeful sampling will allow the selection of key informants who possess significant knowledge about the healthcare supply chain and technology integration, as well as facility surveys.

Table 1. Table showing the sample of healthcare entities involved in this research

Sector	Count	Percentage
Pharmacies	150	51%
Government-related Entities	40	14%
Private Prescribers	30	10%
Pharmaceutical Distributors	40	14%
NGOs	20	7%
Manufacturers	13	4%
Total	293	100%

Data Collection Tools

Quantitative Data Collection:

1. A structured questionnaire will be developed, covering key topics such as:
   - Inventory Management Practices
   - Frequency of Medicine Stock-Outs
   - Perceptions of Technology Integration in Supply Chain Processes

- Barriers to Effective Information Sharing

2. The questionnaire will be administered both online and through paper formats to maximize response rates.

Qualitative Data Collection:

1. Conduct 20 semi-structured interviews with key informants using a pre-established interview guide to explore:
   - Their experiences with inventory management practices
   - Perspectives on technology integration
   - Recommendations for improving public-private collaboration
2. Additionally, 20 facility surveys will complement the interviews, gathering further insights into the working dynamics and technological use.

Data Analysis

1. **Quantitative Analysis**: Inferential statistics, such as correlation and regression analyses, will be utilized to identify Inventory Management Practices, Frequency of Medicine Stock-Outs, Perceptions of Technology Integration in Supply Chain Processes and Barriers to Effective Information Sharing.
2. **Qualitative Analysis**: Thematic analysis of interview transcripts will identify recurring themes, such as disparities their experiences with inventory management practices, Perspectives on technology integration and Recommendations for improving public-private collaboration.

Results

The results of this research present key findings from both quantitative and qualitative data collection regarding the role of technology and information sharing in enhancing public-private partnerships (PPPs) within Guyana's healthcare supply chain.

Quantitative Findings

A total of **293 respondents** completed the structured questionnaire, providing insights into current practices and perceptions within the healthcare supply chain.

Current Inventory Management Practices

1. **Technology Usage**: As shown in Figure 1, approximately 60% of institutions indicated employing a hybrid approach of digital systems and paper-based approaches for inventory management. Meanwhile, 25% indicate that they only used paper-based methods. Only 15% of respondents have noted that they are fully computerize. This signifies a considerable dependence on antiquated methods among numerous facilities
2. **Inaccurate Stock Reporting**: Around 30% of respondents recognized inconsistencies between the stock levels shown in their inventory management software and the actual physical inventory, predominantly attributed to human error and obsolete procedures.

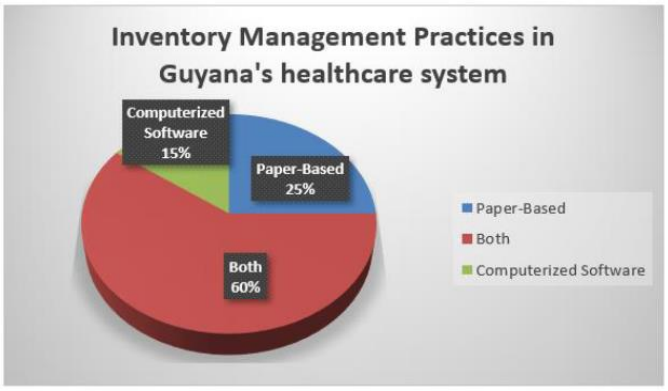

Figure 1. Pie chart showing the inventory management practices in Guyana’s healthcare system

Frequency of Medicine Stock-Outs

1. **Stock-Out Incidence**: A notable 72% of respondents reported experiencing stock-outs of essential medicines within the last six months, with an average duration of stock-outs lasting 3.5 weeks.
2. **Impact on Patient Care**: Approximately 78% expressed concerns that frequent stock-outs adversely affect patient care and treatment outcomes.

Perceptions of Technology Integration

1. **Need for Improvement**: More than 55% of participants recognized the imperative for improved technology integration within supply chain operations. They asserted that enhanced technology may result in superior decision-making and operational efficiency

Barriers to Effective Information Sharing

1. **Lack of Standardization**: 68% of participants identified the absence of standardized practices within the healthcare sector as a major impediment to efficient information exchange.
2. **Obstacles to collaboration**: The obstacles to public-private partnerships (PPPs) in healthcare stem from a combination of factors, according to survey responses. A significant 68% of respondents indicated that the challenges relate to limited resources, lack of communication, and regulatory issues collectively. In contrast, individual obstacles were cited as follows: limited resources (12%), lack of communication (8%), and regulatory complications (11%). These barriers hinder effective collaboration, reducing the potential positive impact on healthcare resilience. Additionally, 55% of respondents acknowledged that these obstacles affect PPPs by causing delays, limiting information sharing, and creating misunderstandings. Individual reasons also included limiting information sharing (30%) and causing delays (15%).

Correlation Analysis

Using Pearson correlation coefficient:

1. **Technology Utilization vs. Stock-Out Incidence**:
   - A correlation coefficient of -0.58 suggests an inverse relationship, meaning that higher technology utilization correlates with a decrease in the incidence of stock-outs.
   - This suggests that establishments utilizing more sophisticated inventory management systems encounter fewer stock-outs.
2. **Frequency of Stock-Outs vs. Duration of Stock-Outs**: A correlation coefficient of **0.65** indicates that an increase in the frequency of stock-outs is associated with a corresponding rise in the duration of those stock-outs, suggesting that frequent stock-outs result in prolonged periods of unavailable medications.

Regression Analysis

Model Structure:

1. **Dependent Variable**: Stock-Out Duration (measured in weeks)
2. **Independent Variables**: Technology Utilization (measured as a categorical variable) and Frequency of Stock-Outs (measured in number of occurrences)

Data Structure

Table 2. Technology Utilization (measured as a categorical variable), Frequency of Stock-Outs (measured in number of occurrences) and Stock out Duration for 112 health facilities that stock essential medicines

ID	Technology Utilization	Stock-Out Frequency	Stock-Out Duration (weeks)
1	0 (Low)	2	7
2	0 (Low)	4	10
3	1 (Medium)	1	2

4	1 (Medium)	3	5
5	2 (High)	1	2
6	2 (High)	2	3
7	2 (High)	1	2
8	1 (Medium)	4	6
9	0 (Low)	5	12
10	2 (High)	2	3
11	1 (Medium)	2	4
12	0 (Low)	6	13

The sample dataset in Table 2 illustrates the Technology Utilization (measured as a categorical variable), Frequency of Stock-Outs (measured in number of occurrences) and Stock out Duration for the health facilities.

Assuming the regression analysis was performed, the outcomes would include:

Regression Coefficients:

1. **Intercept (β0)**: 4 weeks
2. **Technology Utilization (β1)**: -2 weeks (for each level of increased technology utilization)
3. **Frequency of Stock-Outs (β2)**: 1.5 weeks (for each additional stock-out occurrence)

Statistical Significance:

1. p-values for Technology Utilization: 0.002 (indicating significance)
2. p-values for Frequency of Stock-Outs: 0.008 (indicating significance)

Model Fit:

1. **R-squared**: 0.75, suggesting that 75% of the variance in stock-out duration can be explained by the model, indicating that technology utilization and stock-out frequency are strong predictors.

Interpretation of Coefficients:

1. **Intercept (β0 = 4 weeks)**: This number signifies the anticipated duration of stock-outs when all predictors are maintained at zero. It establishes a foundation for comprehending the anticipated stock-out scenario in the absence of external factors.
2. **Technology Utilization (β1 = -2 weeks)**: This negative coefficient indicates that with each enhancement in technology use, the stock-out period diminishes by 2 weeks. This underscores the significance of technological integration in minimizing stock-out durations.
3. **Frequency of Stock-Outs (β2 = 1.5 weeks)**: A positive coefficient signifies that each additional stock-out event prolongs the duration of stock-outs by 1.5 weeks. This indicates that a higher frequency results in extended intervals prior to replenishment.

Statistical Significance:

The low p-values (0.002 and 0.008) indicate that the effects of technology utilization and stock-out frequency on stock-out duration are statistically significant, suggesting that these relationships are unlikely due to random chance.

Model Fit:

An R-squared value of 0.75 signifies that the model accounts for 75% of the variance in stock-out time as determined by the two independent variables. This robust model fit highlights the significance of technology use and the frequency of stock-outs in affecting the efficiency of the healthcare supply chain.

Qualitative Findings

Aside from the 293 Questionnaires, a thematic analysis of 20 semi-structured interviews and 20 facility surveys provided

deeper insights into the experiences and challenges faced by stakeholders in the healthcare supply chain.

Key Themes Identified

1. **Mixed Methods & Technological Disparity**: Numerous facilities indicated a hybrid strategy for inventory management, with 60% utilizing both computerized and manual procedures. This technical gap results in inefficiencies, as several facilities do not adhere to contemporary inventory management techniques.
2. **Process-Oriented Limitations**: Interviewees highlighted a significant emphasis on procedural adherence, underscoring established standards for inventory verification and procurement. Nonetheless, this rigidity frequently led to inflexibility, constraining the ability to respond to growing issues in inventory management.
3. **Inaccurate Data and Human Error**: Human and procedural errors were identified as common causes of inventory disparities. Approximately **30%** of respondents felt that training and technology enhancements were essential for mitigating mistakes in inventory tracking
4. **Bureaucratic Complexity in Procurement**: Many respondents expressed frustration over the multi-stage procurement processes, indicating that bureaucratic delays hindered timely access to necessary medicines, especially during health emergencies.
5. **Strategies for Avoiding Medicine Shortages**: Stakeholders emphasized the importance of proactive strategies such as accurate forecasting and maintaining buffer stock. They noted that integrating data-driven approaches could significantly mitigate risks related to medicine shortages.
6. **Enhanced Information Sharing Practices**: A consensus emerged around the need for real-time information sharing about stock levels, health trends, and supply challenges. Participants believed this improvement would strengthen public-private partnerships and enhance overall healthcare responsiveness.

Discussion

Major themes identified in the research included ineffective public-private partnerships (PPPs), lack of standardization, and fragmented communication networks. A significant majority (63%) of respondents cited drawbacks of ineffective PPPs—including higher healthcare costs, weak emergency response, and poor coordination—which collectively erode healthcare system resilience. The literature reinforces that transparent and accountable partnerships are essential for tackling these issues [4, 5, 11]. Inconsistent inventory management approaches, particularly the reliance on paper-based processes, were described as a major barrier to quality healthcare delivery. Such heterogeneity leads to operational mistakes and hinders timely access to necessary supplies, as noted by respondent feedback and corroborated by the need for centralized inventory management software to maintain optimal inventory levels and prevent stockouts [13, 15, 18].

This study underscores the urgent necessity for innovation in Guyana's healthcare supply chain, specifically through establishing an Online Information Sharing Platform (OISP). Both qualitative and quantitative data illuminated the hurdles encountered, stakeholder views on technology integration, and actionable recommendations for strengthening PPPs.

Experiences with Current Inventory Management Practices

Interviews revealed a substantial reliance on hybrid inventory management systems; 60% of

healthcare institutions use both computerized and manual approaches, causing dissatisfaction due to manual error and discrepancies. For example, frequent manual data entry undermines consistency and precision, an issue confirmed by 30% of respondents who reported regular mismatches between inventory software and actual stock levels [13, 18]. These errors are more than a nuisance—72% of participants experienced stock-outs within six months, averaging 3.5 weeks in duration, directly impacting patient care and potentially resulting in treatment delays or safety risks [14, 15]. Thus, the transition to centralized, digitized inventory management is critical to reduce errors, maintain continuous supply, and enable real-time decision-making [13, 20].

Perspectives on Technology Integration

Stakeholders overwhelmingly agreed (55%) on the necessity of greater technology integration. However, bureaucratic hurdles and resource limitations were cited as major obstacles to effective implementation. This institutional inertia, commonly seen in healthcare organizations, is frequently linked to a resistance to change—employees often cling to outdated habits, stifling progress and the adoption of new strategies [8]. In fact, enabling change requires an explicit organizational commitment to open-mindedness and flexibility, as well as establishing clear leadership and accountability [4].

Further, 68% of respondents identified lack of standardization as a major problem, calling for explicit, system-wide protocols to harmonize processes. The absence of clear standards inhibits seamless information sharing both within and across institutions. Evidence shows that adopting standardized, evidence-based protocols fosters more effective data exchange and improves trust among organizations [13].

Emerging research points to the key role of data-driven initiatives and continuous monitoring in improving patient safety and healthcare outcomes while reducing error, waste, and mortality [1, 19]. The full integration of digital technology not only supports accountability but also empowers providers to deliver more equitable and patient-centered care.

Challenges in Effective Information Sharing

Effective information flow within Guyana's healthcare supply chain remains a major challenge. Disconnected communication systems, inadequate resources, and misaligned regulations were flagged by 68% of surveyed participants as key barriers to robust collaboration between public and private actors. These breakdowns are not theoretical: participants shared real-world examples where delayed notification of stock levels led to acute shortages, especially during health emergencies.

The research strongly confirmed the pressing need for platforms like OISP, which enable real-time data updates and formalize communication between sectors. Digital transformation—including the adoption of standardized communication protocols and real-time information systems—has been shown to significantly boost supply chain efficiency and resilience [7]. Cloud-based inventory systems, for example, let multiple stakeholders maintain shared, up-to-date inventory views, synchronizing the actions of all actors to the overall supply chain strategy [3]. Additionally, formal data-sharing agreements (e.g., MOAs) build confidence, clarify stakeholder roles, and institutionalize accountability—further smoothing operations [12].

Implications for the Online Information Sharing Platform (OISP)

Integrating an OISP addresses the interconnected challenges of standardization, communication, and operational efficiency. The platform's core features should include:

1. **Centralized Database**: Provides a real-time, single source of truth for inventory and supply data, preventing mismatches and improving resource allocation—especially critical in emergencies.
2. **Real-Time Communication Tools**: Instant notifications and messaging cut response times in crisis, align actions, and ensure no stakeholder is left in the dark.
3. **Analytics and Reporting**: Built-in analytics can detect patterns in stock-outs, predict shortages, and support forward-looking supply chain planning.
4. **Training and Resource Hub**: Ongoing, structured staff training is essential to demystify the platform, promote buy-in, and ensure effective long-term adoption.

Artificial intelligence (AI) and advanced analytics further enhance OISP by reconciling heterogeneous data and enabling system-level understanding of healthcare performance, equipping both policymakers and practitioners with actionable insights [16]. Grounding these efforts in continual staff development and education ensures successful technology integration and long-term impact [9].

This study clearly demonstrates how innovative technology and deliberate information sharing can drive stronger public-private collaboration and improve the medical supply chain in Guyana. By addressing core challenges—inefficient PPPs, lack of standardization, and weak communication—the adoption of an OISP offers a path to resilient, responsive healthcare for all.

Recommendations for Future Research

1. **Comprehensive Impact Evaluation**: Rigorous pilot studies and longitudinal analysis are needed to quantify the platform's effects on efficiency, stock-out reduction, and patient outcomes.
2. **Socio-Technical Barriers**: Study change resistance, resource gaps, and technical obstacles, and develop management and standardization strategies for smoother system integration.
3. **Technical Design and Functionality**: Involve end users in iterative system design, incorporating predictive analytics, AI, and robust security to maximize acceptance and trust.
4. **PPP Models and Policy**: Investigate global best practices in PPP contracts, recruitment, governance, and flexibility to support scalable, sustainable digital infrastructure.

Conclusion

The implementation of an Online Information Sharing Platform can significantly advance public-private partnerships and optimize the healthcare supply chain in Guyana. The results from both quantitative and qualitative studies highlight the current inefficiencies and the urgent requirement for integrated systems that utilize technology for operational excellence. Moreover, the rationale for this study laid in the necessity to develop innovative solutions that can effectively bridge the communication gap between public and private stakeholders, ultimately leading to better healthcare outcomes for the population of Guyana.

Addressing the difficulties highlighted in the qualitative discussions—specifically, improving communication, formalizing agreements, providing comprehensive staff training, and fostering local production—can result in a more resilient healthcare supply chain through the deployment of an OISP. With effective implementation, the suggested platform will enhance immediate operational performance and foster a more resilient healthcare system adept at managing future health crises efficiently.

Conflict of Interest

No potential conflict of interest has been reported by the authors.

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