

Digital Innovations under Public Private Partnerships Contracts for Primary Care: Grounded insights from an LMIC setting

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Abstract— *This paper uniquely explores the use of digital innovations within the ambit of domestically driven Public Private Partnership (PPP) initiatives in an Low-middle-income (LMIC) setting to improve primary healthcare delivery. The examination of PPPs continues to be centered on service volumes and economic efficiencies but attention to digital innovations has not been integrated into the examination of PPPs. We focus on digital innovations facilitated under four large-scale contracts awarded to non-government organizations (NGOs) for managing government primary health centers in Sindh, Pakistan.*

Data collection and analysis were guided by the objective to: 1) understand the nature of digital innovations and the underlying purpose for achieving contractual goals; 2) determine the extent of rollout and stage of digital maturity; 3) explore implementation experience and identify synergies and barriers for improvements. Qualitative exploratory research methods of key informant interviews and field observations were applied. An analytical framework was developed to map digital innovations to World Health Organization's (WHO's) six building blocks; categorize digital innovations by the level of maturity and good practice parameters of functionality, user acceptability, data interoperability, standardization. Motivations, efforts and process were noted under each data category.

We found that digital innovations proliferated under public sector primary care management contracts, driven by the impetus to meet contractual goals and minimize risks of non-performance. Innovations

were aimed at countering staff absenteeism challenges, medicine stocks out and pilferages, and unreliable outpatient data. Flexible funding and decision space provided by the government to contracted NGOs were instrumental factors in rolling out of digital innovations. Key challenges included staff acceptance, technological issues of unreliable connectivity, frequent power outages, lack of mobile hardware, and data safety. While digital innovations addressed key operational bottlenecks faced by contracted NGOs, their broader strategic potential hinges on systemic enablers of addressing ethical risks, building standardization, stronger digital governance and developing digital capability. This would require a more proactive role from the government to reduce fragmentation while keeping the door open for innovations.

In conclusion, future research and national strategies on PPP for healthcare delivery in LMIC settings must build centerfold attention to deployment of digital innovations as a critical parameter for PPPs design, implementation and evaluation. This will involve creating incentives for digital innovation while creating accountability for ethical data practices, interoperability and harmonization avoiding. New paradigm shifts are required that enable value creation between the public and private sectors and a shift from binary purchaser-provider relationship to pluralistic multi-stakeholder ecosystem that includes digital health stakeholders as well as societal representatives for patient centric innovations.

Keywords—*digital innovations, public private partnerships, management contracts, LMICs, Pakistan*

I. INTRODUCTION

Public private partnerships (PPPs) are formal agreements between public and private partners to deliver a shared goal within a stipulated time and specify how the partnership will be governed (1). PPPs originated in western economies to expand health infrastructures and services with joint expertise and resourcing from the private sector but have been increasingly deployed in low-middle-income countries (LMICs) to support diverse population health needs (2). One of the popular applications of PPPs in LMICs, particularly in South Asia, has been the revitalization of poorly performing public sector health centers by contracting out the management of the centers to non-governmental organizations (NGOs) to improve the functionality, utilization and quality of care (3). Management contracts for primary care are increasingly common, politically championed and funded by domestic governments to overcome slow-moving public-sector bureaucracies and allow private organizations to implement management innovations for improving services (4). However, the examination of PPPs continues to be centered on service volumes and population coverage whereas attention to digital innovations has not been integrated into the examination of PPPs. The impetus to improve healthcare services in return for contractual payments can be key levers to develop, test and scale-up digital innovations to strengthen services in poorly functional public sector centers.

Digital innovations are playing an increasingly vital role in responding to health work force, supplies and service delivery challenges in LMICs (5), and implementation was further speeded during the COVID-19 pandemic (6). The World Health Organization's (WHO's) Global Strategy on Digital Health (7) emphasizes integration of digital health technologies to strengthen health systems by building synergies, collaborations and digital tools for public goods. Implementation features of seamless data sharing across user interfaces, interoperability, standardization patient privacy, data security are emphasized as well as digital determinants of health such as internet access, equipment, communication and digital literacy are underscored by the WHO and global research (7) (8). These provide useful dimensions to assess digital technologies from a process-based perspective.

In this paper we uniquely explore the use of digital innovations within the ambit of domestically driven PPP initiatives in LMIC to improve primary healthcare delivery. We focus on digital innovations facilitated under management contracts for primary health centers in the LMIC setting of Pakistan. Local NGOs

in Pakistan were awarded contracts to improve the functionality of several poorly performing primary care centers leading to a successful increase in patient volumes over time (9) however the role of digital innovations to improve management under contracts has not been documented. Experiential insights are synthesized with key aims of i) assessing the extent to which digital innovations were initiated to support the performance of management contracts and ii) identifying barriers and synergies faced during implementation within the contracting context. The lessons are meant to build a process-based understanding of innovations driven under PPPs, distill unmet needs and lessons to amplify impact and integration within the PPP ecosystem.

II. METHODS

Design and setting

We used qualitative exploratory research methods to collate and synthesize experiential insights on the roll-out of digital interventions under four large-scale management contracts for primary care. The management and accompanying budget of several underutilized public sector primary care facilities were contracted out to NGOs by the health department in Sindh province of Pakistan to counter challenges of staff absenteeism, shortage of supplies and patient underutilization. Management contracts were awarded to four local NGOs and implementation initiated in 2017 across 158 healthcare facilities each serving a catchment population of 10,000-20,000 population. Contracted NGOs were provided a global budget for operating the facilities and managerial autonomy to manage existing government staff posted at the facilities, hire additional staff, purchase supplies and coordinate with outreach health workers. NGOs were required to report into the District Health Information System (DHIS) for routine monitoring compliance and additionally provide annual performance reports to the government for contractual monitoring and annual budgetary approvals. PPP were managed by a PPP Node in the Health Department which reported upwards to a PPP Unit in the Finance Department.

Framework and objectives

A framework was developed to assess the rollout of digital interventions drawing on i) WHO's six building blocks (10) to categorise the nature of intervention and elicit key digital features; ii) use of WHO's guide to monitoring and evaluation of digital health interventions (11) to map digital innovations by the level of maturity (pre-prototype, prototype, demonstration, pilot, scale up); WHO's digital health strategy of 2020-25 (7) for good practice parameters

for implementation including functionality features, user acceptability, data interoperability, standardization guidelines. Details on interest, approach, efforts and processes were noted for each of the three categories of information. Figure 1 illustrates the framework and areas explored.

Data collection and analysis were framed under the following objectives:

1. To understand the nature of digital innovations and motivations for development under management contracts
2. To determine the extent of rollout and stage of digital maturity
3. To explore implementation experience and identify synergies and barriers for improvements.

Data Sources

Data collection was undertaken with the help of key informant interviews and field observations supplemented with review of contractual documents. Key informant interviews were conducted with headquarter staff of each of the four NGOs including managerial staff, focal persons for monitoring and

digital innovators; doctors managing health facilities, and focal persons for the PPP initiative in the provided health department. Site visits were undertaken for field observations guided by an observation checklist based on the framework. Data collection was undertaken by experienced local researchers holding a background in digital technology and public health. Ethical approval was taken from the ethics review committee of the Aga Khan University Pakistan [2020-2203-7186] prior to data collection. Written informed consent was obtained from interviewees, personal identifiers were anonymized and data encrypted for confidentiality. Descriptive data from field observations and stakeholder meetings was extracted and inductively organized based on key categories of data collected. For analysis of findings, digital innovations undertaken by each of the four NGOs were organized under the health systems building blocks to facilitate comparisons. Most innovations were geared to improve managerial decision making and were mapped to the governance block, with further sub-categorization by human resources, supplies, service delivery and information systems. Some innovations had at least an indirect impact on financing, such as speedier efficient procurement through logistics management system.

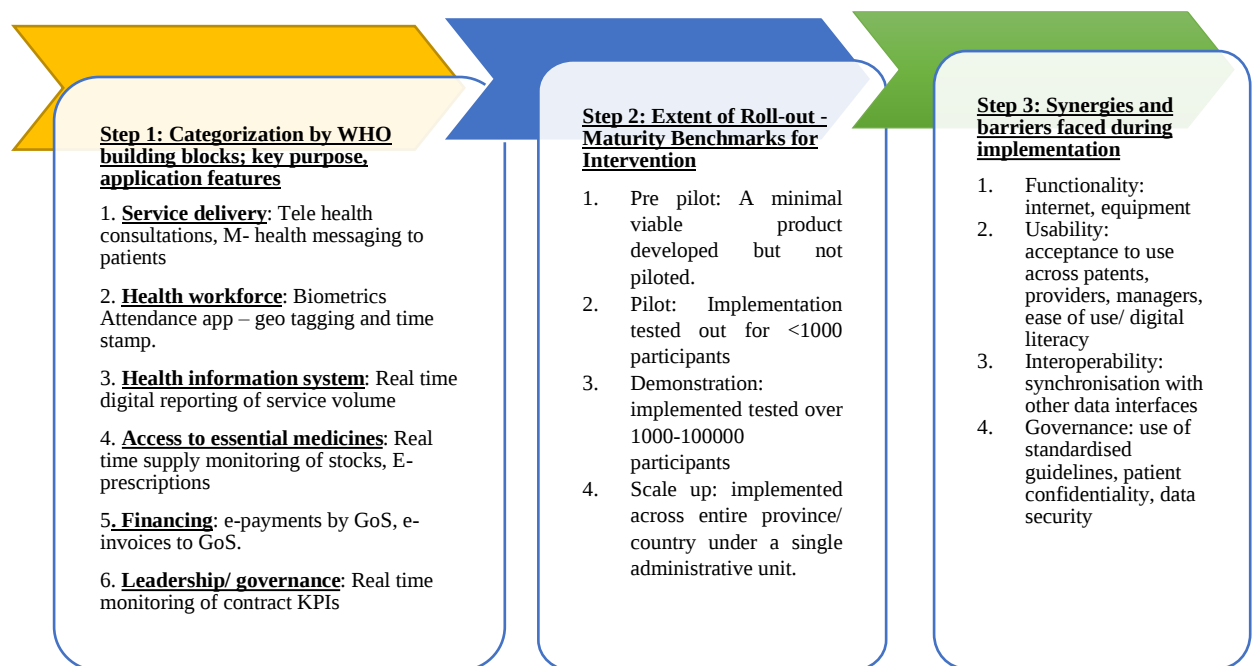


Figure 1: Framework for examining the initiation and implementation of digital innovations under PPP

III. RESULTS

Extent of roll-out

Digital innovations were seen to proliferate under management contracts and were implemented by all four contracted NGOs. The reliance on digital innovations varied across the four NGO partners with one NGO having created several applications to assist with different healthcare management functions, another NGOs applying only one basic digital innovation whereas the others were drawing on more than one application to support contractual management of health facilities. Variations in extent of reliance on digital innovations were seen to be linked to digital capacity and management culture of the NGOs, however, all had similar contractual goals of improving service readiness parameters and patient utilization. Provision of single line budgetary transfers by the Health Department to NGOs was generally perceived to be instrumental in allowing financial flexibility and the decision space for creating innovations that could support agile delivery.

Key features

The most popular application was a basic biometric application for staff attendance used by contracted NGOs and had been largely extended to all health facilities. All NGOs had devised biometric applications with largely similar features comprising fingerprint detection, time stamping and geo-tagging, whereas some had also introduced facial recognition and WhatsApp messaging of attendance as additional features for attendance monitoring. Monthly analysis and triage of biometric attendance was carried out by the contracted NGOs. Digital software for medicine and supplies management was also popularly applied across 112 of 158 facilities.

The software allowed entry of drugs purchase expiration date and distribution across facilities linked to dashboards for visualizing medicine stocks data. Despite having several common features, both NGOs had applications that differed in terms of web interface and data collection requirements. Outpatient electronic registration systems were being used by at least two contracted NGOs to monitor patient volume but were still in pilot phase. Patients were electronically registered at central out-patient registration point using thumb impressions collected on a tablet and a unique code generated was linked with pharmacy, laboratory and radiology results. It had not been extended to case notes and disease coding. Other innovations involved small pilots and ranged from telemedicine applications to support PHC staff to mobile applications linking outreach community-based health workers with facility staff for referrals (Table 1).

Table 1. Digital Innovations under PPP Contracts: Type, Purpose and Interventions

Table 1	Digital Innovation under PPP Contracts: Type, Purpose and Scope of Interventions			
Health Systems Area	Key features	Purpose	Stage of rollout	Participants
<u>Health Workforce:</u> Biometric staff attendance application: Applied by all 4 NGOs	Biometric scanner based on fingerprint detection, time stamping and geo-tagging – all NGOs Additional facial recognition features – one NGO	Monitor staff attendance, reduce staff absenteeism, monitor absenteeism data for running payroll	Pilot phase for 1 NGO -one health facility Demonstration phase for 3 NGOs – 157 health facilities	Government staff assigned to health facility (doctors, paramedics) Additional staff recruited by NGOs to serve at facilities (doctors, paramedics)
<u>Medicines & supplies:</u> Medicine Logistic Management Information System (MLMIS) Applied by 2 NGOs	Software for entry of drugs and supplies purchased, expiry date, allocation by facility	Rapid monitoring of stock-outs Speedy centralized procurement of drugs based on e-inventory Reduce medicine pilferage Avoid use of expired drugs	Demonstration phase for 1 NGO – 111 facilities Pilot phase for 1 NGO – 1 health facility	Health facility stock administrator, facility in charge, district focal point, headquarter management
<u>Service delivery:</u> Ring a doctor service Applied by 1 NGO Outreach health worker applications Applied by 1 NGO	Telemedicine application, data connected in web-based platform for paperless e-record Android application for digitized data entry/ referrals by LHWs Android application for CMWs for pregnancy risk signposting in traffic light colors and progression advice	Specialist guidance and triage support to staff at PHC center Strengthening referral links with LHWs; performance monitoring of LHWs Danger sign guidance to CMWs for facility referral	Pilot phase for both NGOs for Ring a doctor service – one health facility Outreach health worker applications – 100 lady health workers/ 100 community-based midwives	Hospital specialists connected to doctors/paramedics at PHC centers Outreach based lady health workers, monitoring focal point Trained community midwives, monitoring focal point
<u>MIS:</u> Patient electronic registration Applied by 2 NGOs	Patients electronically registered at central registration point, linking of outpatient visit, pharmacy, laboratory and radiology data	Reduce fraud paper entries, monitor outpatient volumes, seamless patient data management	Pilot phase for both NGOs – 1 health facility each	Patients, receptionist at health facility, doctors, female paramedics, lab technicians, management and monitoring staff

Purpose and motivations

The impetus to overcome chronic bottlenecks faced at government PHC facilities and meet contractual goals, closely shaped the type of digital innovation introduced by contracted NGOs. Overcoming staff absenteeism and counter-checking forged paper attendance is commonly seen in the public sector rural PHC facilities and was the compelling factor for digitized staff attendance initiated by all contracted NGOs (Table 1). Attendance data was shared with health department counterparts to transfer out absentee staff and allow NGOs to recruit contractual hires as replacement. Similarly, medicine logistics management system applications were introduced to counter the frequent stock-out of supplies seen at public sector facilities, as well as keep a check on pilferage of medicines. Use of electronic data allowed centralized procurement of supplies as well as speedy dispatch to facilities for circumventing shortages. Real time registration of outpatient attendance was piloted to counter fraudulent paper entries of patient volumes seen in paper-based District Health Information System (DHIS) as well as to provide seamless patient management with pharmacy and diagnostics. Although NGOs were not directly reimbursed on patient volumes, an increase in outpatient volumes was an expected feature of all contracts and relied on transparent data. Although other digital innovations were also seen these were much smaller in scale driven and riven by secondary motives of more timely referrals from outreach health workers or improving quality of services with telemedicine support to PHC staff.

Synergies and Barriers

Common barriers in implementing digital innovations were electric power outages as well as weak internet signals in remote areas (Table 2). Several innovations relied on desktop computers or biometric machines that were not linked to online applications led to frequent loss of data and service disruptions. These issues are likely to be resolved with shift to cellular data. Digital governance was another weakness across all digital innovations. Standardised system for data security and guidelines to protect patient data were generally not in place due to a weak and evolving national ecosystem. A national digital health strategy had been developed but was yet to be translated into operational compliance measures. Similarly, interoperability issues were seen between the outpatient registration applications and the national DHIS application as well as across outreach health worker applications and programmatic databases, hence requiring parallel counterfactual checks. Each contracted NGO developed a separate application customised to protect its data and enable contractual decision making. NGOs invested effort in training staff for use of digital innovations and providing basic operating guidelines. Competition between contracted NGOs for government contracts disincentivised technology sharing and resulted in duplicative efforts for guidelines. Coordination by the PPP Node across contracted NGOs was weak and passive with little

attempt for harmonization across applications. User acceptance issues were experienced mainly with the biometric attendance

Table 2. Digital Innovations under PPP Contracts: Implementation Synergies and Barriers

Table 2	Digital Innovations under PPP contracts: Implementation Synergies and Barriers			
Digital innovations	Functionality: internet, equipment, other areas	Usability: acceptance to use across patents, providers, managers, ease of use/ digital literacy	Interoperability: synchronization with other data interfaces	Governance: use of standardized guidelines, patient confidentiality, data security
Biometric staff attendance application: Applied by all 4 NGOs	Interruptions to electric supply and weak internet signals	Issues of compliance by government staff, improved compliance over time	Link with DHIS's human resource platform yet to be developed; platform largely unfunctional	Standardized systems for data security not in place
Medicine logistics management information system Applied by 2 NGOs	Interruptions to electric supply / weak internet signals	Well-received by clinical and management staff	Interoperability to be established district information system/ other programmatic databases required	Guided by NGO's SoPs. Not standardized in line with national essential drug list and WHO inventory management guidelines
Ring a doctor service Applied by 1 NGO	Internet disruptions resulting in shift to cellular data use	Staff training helped minimize operating issues	Not linked to other databases	Standard national protocols not in place for specialty telemedicine services Guidelines for patient data not in place
LHW and CMW Apps Applied by 1 NGO	Availability of android phones amongst LHWs/ CMWs, internet coverage issue in more remote areas	Initial training and device provided to LHWs /CMWs, compliance varies by literacy and age of workers	Interoperability with programmatic databases of MNHC and LHWs programs yet to be established	Standard national protocols not in place for maternity risk screening Guidelines for patient data not in place
Patient electronic registration Applied by 2 NGOs	Interruptions to electric supply and weak internet signals	Positively received by clinical and management staff, more training required to enter patient data directly into the electronic portal	Not linked with District Health Information System, adds a parallel check	Guided by NGO's SoPs. Standardized systems for patient confidentiality and data security not in place

monitoring applications, encountering considerable resistance from government staff and even instances of disruptions the biometric machines but compliance was reported to have grown over time with gradual acceptance of biometrics.

The main synergy experienced was the integration of digital innovations in the day-to-day management of primary care facilities. Positive participation was seen from both clinical and administrative staff when visibly linked to more seamless operations and reduction in time consuming paperwork, as particularly seen in the case of digital outpatient registrations and medicine consumption software. Speedy data analytics capability was demonstrated by some NGOs with real time visualisation of data into dashboards while others relied on a more cumbersome process of collection through USBs for excel analysis. Above all, NGOs drew on digital innovations to minimise risk of non-performance within government contracts through minimising stock outs, curtailing pilferages and countering chronic staff absenteeism challenges. Importantly, digital data helped NGOs in showcasing management improvements to government contract managers and presenting counterfactual digital data, helping remove mistrust and building more positive relationships. Over the course of the four-year contracts, all contracted government clinics commonly showed an increased in outpatient volume, female outpatients, antenatal care and deliveries reflected in DHIS observational data and digital reporting of patient volumes, although the pace of change differed across contracts and clinics. Stakeholder interviews underscored the use of digital innovations in quick and responsive managerial decision making, monitoring areas of likely risks and underperformance. Decision space provided by the government and flexible funding lines were key factors enabling the application of digital innovations.

IV. CONCLUSION

Global digital innovation literature emphasizes the acceleration of transformational partnerships between digital firms and the public sector for application of digital technology for healthcare. Less is known on how PPPs for the operation of public sector healthcare organizations can enable digital transformation. Case study analysis, applied in this paper, was particularly useful for eliciting deep dive insights on proliferation of digital innovations under PPPs for managing public sector clinics in a LMIC setting.

We found that digital innovations proliferated under public sector primary care management contracts, driven by contracted NGOs to help meet contractual goals and minimize risks of non-performance. Countering staff absenteeism challenges, medicine stocks out and unreliable outpatient data were the primary motivations leading NGOs to devise digital innovations to counter these challenges. Supporting quality of care with specialist telemedicine support and drawing timely referrals from outreach programs appeared as secondary motives, with smaller scale pilots.

End user acceptance by staff was a critical feature for roll-out of management interventions and led to varying experiences from active resistance to positive feedback. Issues such as unreliable connectivity, frequent power outages, lack of mobile hardware, and limited user literacy were salient. These can be mitigated by adopting mobile and tablet-based solutions with offline functionality, portable interfaces, and simplified user workflows. Flexible funding and decision space provided by the government to contracted NGOs were instrumental factors in rolling out of digital innovations, however passive governance by the public sector resulted in weak digital governance and lack of standardization of guidelines and data.

Global literature on digital innovations emphasizes co-creation and alignment between the public partner's needs and the private partner's competences (12). User-centric design and involving users are also emphasized as necessary for success of transformative innovations (12,13). Developing capacity for handling, processing, and analyzing data while addressing privacy and security concerns is necessary but will require balancing between top-down and bottom-up implementation (14). Ethical aspects have been emphasized with recommendations for early operationalization of ethical guidelines within PPPs and iteration within local contexts. With acceleration towards embedding artificial intelligence in the global south, digital governance becomes even more salient (15,16) as well as simultaneous investment in national capacities made to enhance capacity for processing and visualization of data (17).

The Pakistan case study highlights contractual motivations under PPPs for proliferation of digital innovations, relative success in aiding management and iterative processes towards user-centeredness, while exposing weaknesses in digital governance. The results from Pakistan are applicable to other LMIC settings where there is impetus for low-cost managerial innovations to drive healthcare changes, supported by an agile private sector and decision space in contract management. While digital innovations addressed key operational bottlenecks faced by contracted NGOs, their broader strategic potential hinges on systemic enablers of addressing ethical risks, building standardization, stronger digital governance and developing digital capability. This would require a more proactive role from the government to reduce fragmentation while keeping the door open for innovations. It would also require expanding the binary NGO-government PPP relationship to inclusion of multiple stakeholders such as customized digital health companies for supporting digital data collection, analysis and visualization, as well as entities within the government responsible for digital oversight.

In conclusion, future PPP research must expand beyond traditional assessment of service delivery and economic performance criteria to additionally build attention to deployment of innovations as a critical parameter for evaluation of PPPs. Second, future PPP strategies for

healthcare delivery in LMICs must embed incentives for digital innovation while creating accountability for ethical data practices, interoperability and harmonization. New paradigm shifts are required that enable value creation between the public and private sectors and a shift from binary purchaser-provider relationship to pluralistic multi-stakeholder ecosystem that includes digital health stakeholders as well as societal representatives for patient centric innovations. Lastly, the ambition for digital health innovations can also be set higher in line with the global shift toward deployment of AI within healthcare.

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