

Acceptability of Information Technology Systems Developed for Distant Philippine Communities among Local Health Providers

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ABSTRACT

Introduction. The National Telehealth Service Program (NTSP) has developed Information Technology (IT) systems aimed at improving health services primarily in isolated Philippine communities. These included two electronic health records modalities (Community Health Information Tracking System, or CHITS, and Real-time Regular Routine Reporting for Health, or R4Health), a referral system (Telemedicine), and a remote diagnostic device (RxBox).

Objectives. This study was undertaken to describe the utilization and cost patterns as well as the perceptions of the local health personnel regarding the use of the various NTSP systems. The implications of the end-user perceptions on the acceptability and expanded use of the IT interventions were inferred, from which corresponding policy recommendations were made.

Methods. Twelve NTSP sites, including far-flung and economically depressed communities, where the systems were concurrently available over a defined six month period, were selected. The frequency of respective system transactions for these sites was collected from NTSP files. Interviews and focus group discussions were conducted at the communities, involving physicians, nurses, midwives, and other health workers. Associated costs, and perceptions related to the adoption, operation, and sustained use of the IT systems were elucidated.

Results. Telemedicine, though the least costly modality, was the least utilized of the systems. While both R4Health and CHITS facilitated health data management, CHITS provided more locally-relevant information. The RxBox system, due to its clinical diagnostic device component, was widely accepted and also increased health center consultations, especially among pregnant patients. Technical malfunctions, as well as system failures following natural calamities, were recurrent problems.

Conclusions. The RxBox system, with its bundled health records and specialist consultation functions, is highly accepted by health providers and other community stakeholders. The technology can be expected to be similarly well-regarded in other settings. The stand-alone IT modalities that do not directly or significantly benefit the actual implementers are not as sustainable.

Key Words: electronic medical records, information technology, telemedicine

INTRODUCTION

Information Technology (IT) systems are increasingly relied on to enhance the delivery of health services, especially in settings where standard methods of delivery are rendered impractical or inefficient. International experiences in this regard have been reported, ranging from diagnostic services to public health strategies.¹⁻³ The National Telehealth Center (NTHC) of the University of the Philippines (UP) Manila has long been involved in the development of IT solutions particularly for community-related health concerns. The Department of Health (DOH) sought to enhance the delivery

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of public health services to remote and poor municipalities, or so-called Geographically Isolated and Disadvantaged Areas (GIDAs), using IT modalities. The National Telehealth Service Program (NTSP) was thus established in 2003 as a joint effort between the DOH and NTHC to develop and implement appropriate health IT interventions in disadvantaged communities. Among the IT systems which the program has introduced or enhanced were the Community Health Information Tracking System (CHITS), Telemedicine, Real-time Regular Routine Reporting for Health (R4Health), and RxBox. The characteristics and operational status of these systems are summarized below.

CHITS

This electronic medical records system was developed in 2004 specifically for the use of local health centers. It was designed to be compatible with local clinic procedures and information requirements while facilitating data processing for the DOH's vertical programs.⁴ The software could be utilized through several platforms, depending on the connectivity of the data encoding device to the local server. By 2011, CHITS was in use in 111 health centers nationwide, ranging from highly urbanized cities to isolated municipalities in various provinces.⁵ Wider utilization has been hampered by several factors, including the introduction of analogous DOH information systems.

Telemedicine

This was an offshoot of the NTHC's Buddyworks project, which, as early as 2004, allowed doctors in rural communities to remotely confer with specialists at the Philippine General Hospital at UP Manila. It was incorporated in the NTSP in 2011 and expanded the consultation network to regional medical centers. The Telemedicine system was initially meant for Doctors to the Barrios physicians, who were mostly newly licensed doctors contracted by the DOH to serve in distant communities. Access to the system was eventually extended to municipal health officers, generally older physicians who have been working in their respective localities for some time. At its peak in 2011, Telemedicine had 184 enrolled physicians, who were serving in 14 regions, and had received 564 consultations.⁶ Participation waned in many areas, mostly due to the increase in the personal referral networks of physicians. Complaints have also been raised by specialists as they are not paid for answering referrals.

R4Health

This electronic records system was initiated in 2011 and was meant to facilitate the collection and transmittal of population health data by front line health workers to the DOH and local health authorities. It was intended for far-flung sites where the government's conditional cash transfer program was in place. The latter program provided financial support for poor families, contingent on their complying with defined health care obligations (e.g., immunization of

children). Consequent changes in the utilization of health services, as well as health status parameters, therefore needed to be monitored. Cognizant of the near-universal use of cell phones, R4Health was designed as a mobile phone application. NTSP provided the R4Health-enabled cell phones to the health workers of participating communities. Nine health indicators were monitored, which included Millennium Development Goal measures as well as social program coverage. The system came to be implemented in 213 municipalities by 2012.⁶

RxBox

Also in 2011, the NTSP collaborated with the Department of Computer Sciences and Electronics and Electrical Engineering Institute of UP Diliman, and the Department of Science and Technology. The partnership engendered the upgrading of the NTHC's previous IT platforms as well as the introduction of the RxBox device. The NTSP has deployed the second generation of the device, which electronically measures blood pressure, heart rate, and dissolved oxygen as well as monitors fetal heart rate and uterine contraction among pregnant patients (Figure 1). The latter features were added to help address the still considerable maternal mortality rates in the country, more so as the devices were initially rolled-out to distant and poor municipalities. Tied-in with the provision of the devices were concomitant arrangements for utilizing Telemedicine and CHITS. The latter allowed not only the transmittal of public health data but also the digitally recorded physiologic data for remote interpretation by experts. The RxBox system was distributed to 114 municipalities by 2015.⁷

Further improvements in the mentioned NTSP systems as well as the expansion of their coverage require a more inclusive assessment - especially by way of the expected resource requirements and outcomes from the perspective of the main client base, local governments, and their health care providers. The latter concerns may be considered as being within the purview of Diffusion of Innovation Theory, a framework that has been increasingly utilized for assessing as well as promoting health and related IT interventions.^{8,9} According to the theory, there are four main determinants for the successful introduction of an innovation: communication channels, attributes of the innovation, characteristics of the adopters, and the social system. The further deployment of the NTSP technologies can be expected to hinge on their concurrence with these factors.

A research project was commissioned by the NTHC with the end in view of guiding government or private agencies that may want to adopt the NTSP IT systems. In line with this, the study was undertaken to describe the utilization and cost patterns as well as the perceptions of the local health personnel regarding the use of the various NTSP systems. In particular, the frequency of electronic transactions and the costs for health providers of the IT modalities were assessed. Likewise, the health workers' perceptions, by way of perceived

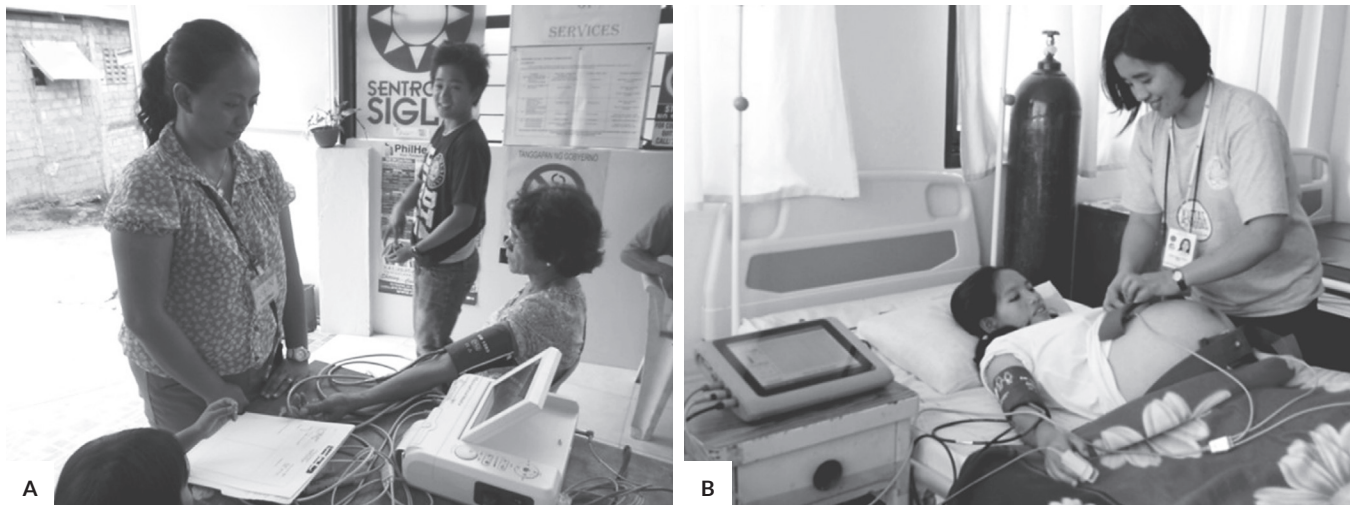


Figure 1. RxBox utilization in community health centers for: (A) routine consultation, (B) obstetric care (pictures provided, and permission for publication obtained from the included persons, by NTSP).

benefits or problems, related to the adoption and operation of the systems were also specifically determined. The implications of the end-user perceptions on the acceptability and expanded use of the IT interventions were inferred, from which corresponding policy recommendations were made.

METHODS

The study involved quantitative assessments of utilization and costs associated with the different IT systems and qualitative appraisals about the local health workers' perceptions regarding the use of these technologies. Data were obtained from record reviews as well as interviews and focus group discussions (FGDs). The research was undertaken following approval by the Ethics Review Board of UP Manila.

In the more than 200 sites wherein the NTSP systems were in place at the time of the study, not all of the modalities were introduced, or, even if so, were not concurrently deployed. It was necessary to limit the selection of sites where local officials and health personnel had used the systems simultaneously for a considerable yet relatively recent period if only to ensure consistency in their perspectives. Thus, only those sites which had all the systems documented by the NTSP to be in place and reportedly able to operate over at least six months (for the period 1 July 2014 to 31 July 2015) were considered for inclusion. Fifteen sites qualified for inclusion in the study. Three were in conflict areas and were deemed unsafe for the research staff and were excluded. The selected sites were classified according to location, accessibility, and economic status. For the latter parameter, the official DOH roster of GIDA sites was used for reference. The municipality characteristics and utilization data, by way of counts of the corresponding electronic transactions, for the different NTSP systems for the 12 selected sites, was obtained from NTSP records.

The NTSP already had designated staff who served as coordinators for the local government administrators and health providers. The interviews and FGDs were conducted by these staff members, after being trained for these activities by the investigator. Uniform interview and discussion guides were utilized, and responses were documented using prepared forms. The main guide questions are listed in Table 1. The appropriateness of the guides and response forms were previously validated with the concerned NTSP officers and staff, including the local coordinators. Interviews and single session FGDs were undertaken at different days for the included sites from 5 to 30 September 2016, depending on the availability of the health personnel. The latter was requested beforehand to review the corresponding program costs, so they would be familiar with these during the interviews or discussions.

Only the respective municipal health officers were available at two sites, for whom interviews were conducted. FGDs, involving the local physicians, nurses, midwives, and other health workers, were undertaken in the other areas. Interview and FGD transcripts and summary

Table 1. Lead questions for Interviews and FGDs

1. What resources or investments did the LGU/health office/staff have to commit to enable the introduction of (NTSP system)?
2. What factors have facilitated/hindered the adoption of (NTSP system) in your locality?
3. What administrative or operational aspects in your health center/facility have been affected by the introduction of (NTSP system)? How beneficial or adverse have these effects been?
4. How has the use of (NTSP system) been perceived by your facility's client/community in general/ LGU administrators?
5. What issues have come up concerning the continuity of using (NTSP system) in your locality?
6. What changes in health outcomes (both positive and negative) in your locality have been observed following the adoption of (NTSP system)?

reports were collated and content analysis was done by the principal investigator.

RESULTS

Utilization Patterns

The descriptive statistics for the categorized sites are presented in Table 2. GIDA localities had lower mean population levels. Based on NTSP records, the various systems were introduced in the selected areas at different periods – Telemedicine starting in 2011, R4Health in 2012 for all, and RxBox (with Telemedicine and CHITS modalities incorporated) by 2013. The NTSP had automated monitoring logs only for Telemedicine and R4Health and collated the number of consults and days when reports were filed. On average, there were more Telemedicine consults from upland sites. The R4Health system was utilized for only a year across all localities, despite NTSP connectivity still being available thereafter. GIDA sites, which included the sole island municipality, had more reporting days for this system. There was no remote monitoring for RxBox use. However, the devices provided to the sites already had built-in CHITS reporting capabilities. The average number of weekly reports filed are also shown in Table 2. Upland or non-GIDA sites transmitted more CHITS reports. The submission of these reports, however, was not mandatory.

System Costs

The cost figures obtained were estimates provided by the local health officials, as primary accounting data was often inaccessible even to them. Only the direct costs which

were assumed by the local health providers were considered, and these were subdivided into start-up and recurrent items (Table 3). Start-up costs included transportation expenses incurred when the local health staff attended the initial training sessions for the respective NTSP systems. Likewise, local government funds were used to procure computer equipment for CHITS and, for some municipalities, to renovate health centers to accommodate the RxBox devices. While the upfront expenses were uniformly shouldered by all the respective local governments, the recurrent expenses, specifically for internet or mobile access, often had to be paid for by individual health workers. Phone line and electricity bills comprised the most substantial recurrent expense items. The operational expenses for RxBox subsumed the costs related to the use of its integrated components (e.g., single network access and electricity charges even with concurrent CHITS use).

Perceived Advantages

The supposed benefits, which were not monetized, were categorized into system outputs and outcomes (Table 4). Telemedicine was appreciated by physicians, who were able to obtain updates as well as readily seek second opinions for problematic cases. Likewise, it also reportedly averted unnecessary patient transfers or travel to other facilities. These were felt to ultimately redound to better patient care and outcomes. Both R4Health and CHITS facilitated records management, enabled better monitoring of individual and community health status, and guided medical and public health interventions. The RxBox device was purportedly appreciated by most of the stakeholders - administrators,

Table 2. Summary statistics for the selected NTSP sites

Site Classification	Number of Sites	Population (mean)	No. of Telemedicine consults (mean)	No. of days with R4Health reporting (mean)	No. of weeks of RxBox/CHITS reporting (mean)
By Location	Upland	5	13,827	11.4	27.0
	Island	1	6,281	2.0	38.0
	Neither	6	14,058	2.3	24.5
By GIDA Status	GIDA	5	10,019	6.2	31.6
	Non-GIDA	7	15,667	6.0	23.1

Table 3. Estimated direct costs of NTSP systems, local health provider perspective

Payer	Expense Items	Estimated Cost
Local Government	Start-up	
	• Training (separate sessions for all systems)	P6,000 to P10,000 per individual for transportation to orientation sites
	• Computers (CHITS only)	P60,000 to P100,000 for purchase of computers and peripherals
	• Facility Renovation (RxBox only)	P5,000 to P10,000 for health center renovation
	Recurrent	
	• Mobile or Internet Access (all systems)	P6,000 to P12,000 per unit per year
Local Government	• Telephone (CHITS only)	P24,000 per line per year
	• Electricity (CHITS and RxBox)	P12,000 per year
	• Supplies (CHITS and RxBox)	P5,000 per year
	Health Worker	
Recurrent		
• Mobile or Internet Access (all systems)	P6,000 to P12,000 per unit per year	

Table 4. Perceived benefits of NTSP systems, local health provider perspective

NTSP System	Outputs	Outcomes
Telemedicine	<ul style="list-style-type: none"> • access to specialist opinion for problematic cases • access to clinical management updates 	<ul style="list-style-type: none"> • enhanced physician confidence • less unnecessary patient transfers
R4Health	<ul style="list-style-type: none"> • enhanced data collection, collation, and transmittal • more timely decision-making by local health authorities 	<ul style="list-style-type: none"> • program targets better monitored • patient status better monitored
CHITS	<ul style="list-style-type: none"> • better records storage; improved consolidation and submission of reports • improved monitoring of selected conditions 	<ul style="list-style-type: none"> • more timely local health data • better management of services
RxBox	<ul style="list-style-type: none"> • improved screening and management of cases • responsive to public demand (for "high tech" equipment) 	<ul style="list-style-type: none"> • enhanced diagnostic capacities in the locality • increased utilization especially of maternal services • improved patient satisfaction

health workers, and the general public. It was perceived as a “high-tech” diagnostic device and heightened demand for health center consultations, particularly for maternal care. Health workers from GIDA communities recounted that patients felt local public services were dramatically transformed, and that these were considered better than what could be availed from private practitioners and referral hospitals in the area.

Adverse Impressions

Other than the mentioned costs, there were no other substantial introduction or adoption issues brought up by the local health providers. Several operational and sustainability concerns were raised. The physicians’ need for Telemedicine consultations tapered off over time, due to increasing recourse to personal referral networks. Likewise, the system was faulted for allowing only the exchange of limited information. For the electronic reporting systems, the tediousness of encoding and overlaps with existing DOH databases were contentious issues. The need to pay out of their own pockets for the network access for Telemedicine and R4Health was objectionable to many health workers. The RxBox device, despite its generally favorable reception, had some detractors, particularly mothers who were not comfortable with its fetal monitoring apparatus. Technical glitches as well as total incapacitation of the systems following natural calamities or power outages were also concerns that were consistently raised. These were all the more problematic for GIDA sites, both because community health status reports were essential in such circumstances, and the local capacity to address technical difficulties was limited.

DISCUSSION

There has, internationally, been increasing attention to the development, utilization, and assessment of the consequences of various health IT modalities.¹⁰⁻¹² Systematic reviews of health IT studies have generally yielded positive results.¹³⁻¹⁶ A review of health IT applications in developing countries, focusing on areas more related to primary health care, found most of the systems to be useful, though their impact on population health was still not adequately

explored.¹⁷ The importance of making the systems relevant to the actual users was emphasized in other reports.^{18,19}

The present study took the point of view of the NTSP end-users, the local government health providers. The implemented IT systems were developed by academic and technical institutions and were meant primarily to further national health goals. While well-intended, the value of the NTSP systems for the front line users, as with any top-down program, may not be commensurate with those of the developers and even administrators and policymakers. The study attempts to weigh the interests and preferences of the health workers, and, indirectly, local administrators. The approach underscores the importance of assessing the attributes of the introduced technologies, one of the determinants of the Diffusion of Innovation Theory.^{8,9} The extent to which the user perceives any resulting benefits (relative advantage) or directly experience these (observability) especially through prior evaluation (trialability), and deems the innovation to be consistent with the existing social or technical environment (compatibility) or is not overly difficult to use (complexity), pertain to the qualities that bear upon the eventual acceptance and spread of the introduced technologies. The applicability of these attributes on the NTSP systems, as appraised from the study results, is considered in the succeeding sections. As the systems had all been previously implemented, trialability would have been a given in the selected sites. Compatibility is gauged not only in terms of ease of technical integration but also from the administrative perspective. Included in the latter are cost and financing considerations, as these would be of importance for administrators in deciding on the continued operation as well as the expansion of the IT modalities.

The selected localities could not be presumed to constitute a representative sample of the NTSP sites. These, however, had characteristics that made them appropriate for assessing the systems where their use should matter most. Only those sites which had utilized all systems were included to allow internal comparisons by the corresponding local stakeholders. Likewise, time, resources, and even security constraints had a substantial bearing on the extent of site selection and subsequent consultations. Adequate quantitative data would have been valuable in assessing the

magnitude of the utilization of the systems in the NTSP sites. Unfortunately, despite being IT-based, only limited data could be obtained, and mostly from automated real-time monitoring of filed reports or transactions. The frequency of the latter, therefore, was the default measure of system utilization in this study. There were attendant limitations even with the quality of the available data (e.g., not all may have been recorded or referred to valid transactions). Tellingly, usage of the RxBox device was never monitored by NTSP. The systems were acquired at minimal cost for the local providers. They would therefore not have enough reason to collect utilization logs as they may not have any overriding concern in demonstrating the cost-effectiveness of the systems (and also given the dissatisfaction from the front line staff already burdened with data encoding). As for the cost data which were obtained from the local health workers, only estimates of these could be provided during the interviews and discussions. For various reasons, financial management capacities appeared to be limited among public sector health administrators and providers. The interviewees and discussion participants in this study were hard-pressed to provide more accurate amounts, even as only the total or annual values for direct costs were looked into. No responses were given for some known direct costs (such as the transaction expenses for the initial consultations for the setting up of the systems) and indirect costs were not factored in (like the lost service hours while health workers were undergoing training). These limitations should be considered in putting into perspective the results reported in this study.

Telemedicine was the least costly for local physicians. Utilization, as reported during the discussions and as also reflected in the NTSP data, was infrequent, however, and rapidly receded over time as the physicians inevitably initiated their referral arrangements. It is more costly on the receiving end, as physicians who respond to Telemedicine referrals, as previously documented, are not compensated for their participation.⁵ The system was therefore regarded as being difficult to sustain, given the eventual lack of interest among local physicians, and the unaddressed opportunity costs for network specialists.

The electronic reporting systems, CHITS, and R4Health, directly favored health administrators. While of assistance to front line health workers in terms of streamlining patient data collection and storage, these required additional hours and resources for the encoding processes. R4Health was much less expensive than CHITS for local providers and had been utilized more frequently in a GIDA site. However, as the information generated was more important for national authorities, and given the added cost as well as considerable inconvenience for the involved staff, R4Health became an untenable system for local use. The utilization of the R4Health system was therefore short-lived in the study sites. Unlike earlier cohorts, local providers in the selected sites received the CHITS application together with the RxBox device. The arrangement substantially increased the start-

up expense for the integrated system. These were acceptable investment costs for the local providers, however, given the felt utility of the diagnostic machine with which the CHITS and Telemedicine components were bundled.

The RxBox device, on its own, was highly appreciated by most of the local stakeholders. Being commonly perceived as a state-of-the-art equipment, it had popular appeal and was a source of pride within the communities. The introduction of the device had altered health-seeking behavior as its presence encouraged more health center consultations. That it was well-patronized also endeared its adoption with local politicians. As Telemedicine and CHITS were integrated applications, the complete RxBox system brought with it a complementary suite of functions of benefit to the full range of health IT stakeholders. Though not without detractors, and its long-term operational sustainability remains undetermined, its early and easy acceptance by most providers and patients indicates that it is responsive to latent demands.

The incidences, or apparent distribution among the respective stakeholders, of the benefits of the NTSP modalities, are diagrammatically shown in Figure 2. These essentially capture the relative advantages as well as system compatibilities of the technologies, in terms of their relative importance to patients, physicians or other local health providers, and either local or national administrators. The diagrams not only indicate which of the stakeholders would likely promote or ensure the dissemination of the corresponding IT systems but also allude to the more appropriate financing routes for these modalities.

The benefits of Telemedicine diminished over time, as physicians' interest in and access to the system waned. Relying on referring physicians to pay for the required network access, particularly if the modality would be distinct from the RxBox system, would further discourage its utilization. If it is to be independently sustained, the network costs will have to be borne by local governments, while the maintenance of a ready pool of receiving specialists will preferably have to be financed by the DOH. Particularly as individuals or even communities may not place enough value on the information gathered by CHITS and R4Health, yet be important for public health administrators, these systems may be considered as public goods. It stands to reason then that public sector financing is necessary. If local health officials will rely on CHITS data to enable more timely and appropriate community health interventions, the system may be considered cost-effective and worthy of local government subsidies. As data generated from R4Health is of utility for DOH, then the latter should provide more financing support for the system's operations. The characteristics embodied by the RxBox system broaden the options for sustainability and expansion. That the system has a direct service component, which was also in keeping with an apparent demand for high-tech care, lends itself to user charges. The RxBox use was most appreciated in the GIDA sites. It may be anticipated, however, that user charges may

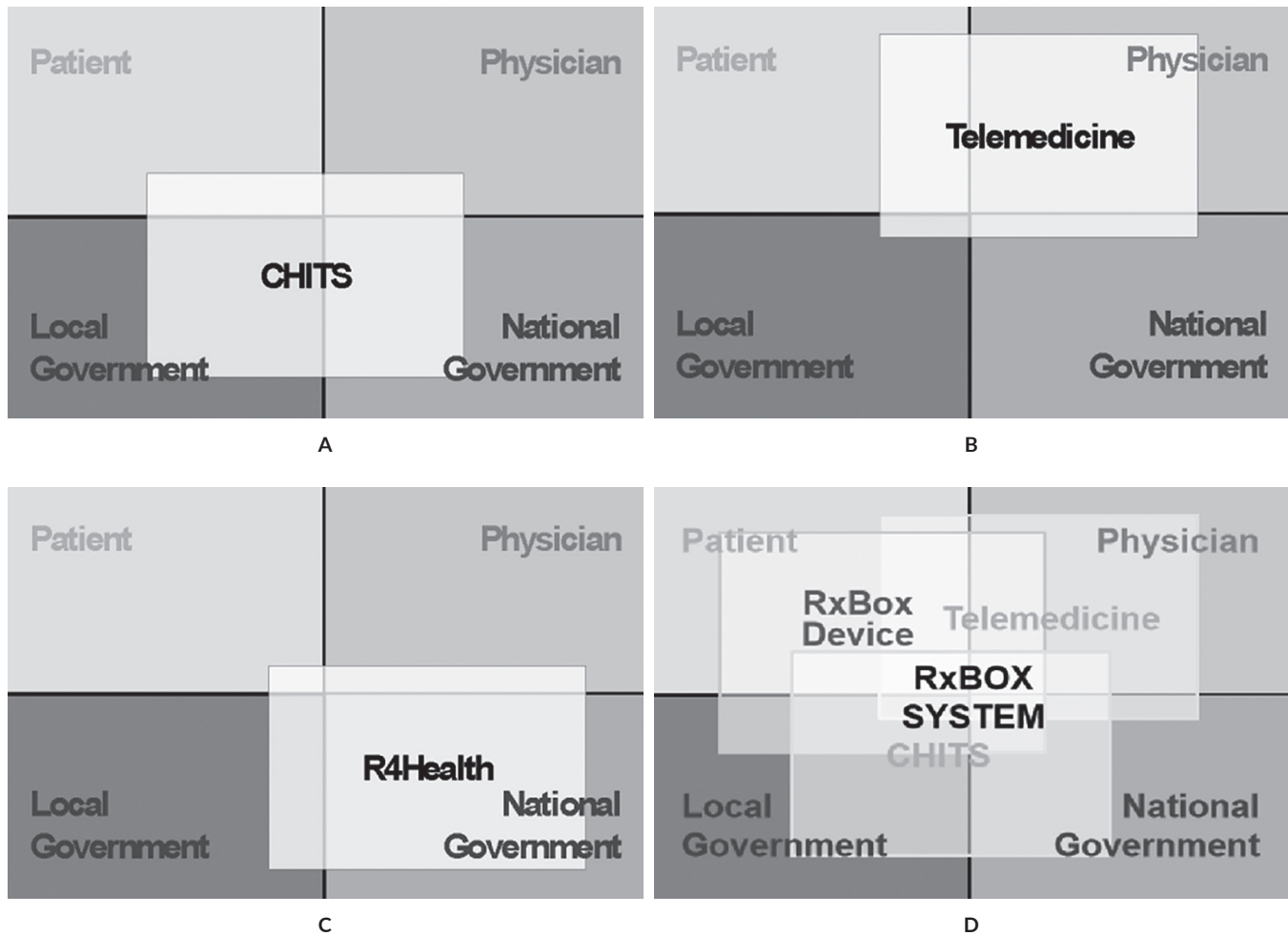


Figure 2. Benefit incidence, represented by overlaid white areas, for specified stakeholders of NTSP modalities: (A) CHITS, (B) Telemedicine, (C) R4Health, (D) RxBox system.

not be enforceable in these less economically well-off areas. In such situations, either tiered pricing or cross-subsidization from higher fees collected from other services may be opted for. Nonetheless, the operations of the attached CHITS and Telemedicine will still need to be publicly financed, preferably from corresponding DOH appropriations.

Adequate financing, while a requirement, is not by itself sufficient to sustain the operations of the NTSP systems. The unreliability of the various NTSP systems during routine operations, and more so following catastrophes, were repeatedly raised by the local health personnel. The need to enhance the related NTSP equipment and software to enable seamless routine operations, and even make these resilient to hydro-meteorological hazards, cannot be under-emphasized. The utility of the systems in conflict areas was not assessed in this study, but their adaptability in such circumstances should be considered. There is also an onus for NTSP to integrate more comprehensive monitoring components if only to better track actual utilization and hence, local relevance of the systems.

Even as the DOH has provided the impetus for the establishment of NTSP and the subsequent development of the reported IT systems, and with due consideration for the financing responsibilities previously averred to, the agency will also have to attend to other equally important areas. Its own population health IT systems will need to be streamlined. Such is needed to address the apparent overlap of the NTSP and other DOH IT systems and the resulting inefficiencies, if not staff frustrations, from data input redundancies. The DOH will also have to prod the concerned national agencies to upgrade the country's telecommunications infrastructure and ensure adequate and consistent connectivity, especially for GIDA localities.

The NTSP modalities, independently, and in the RxBox system, synergistically, have been of benefit to health administrators and providers as well as to patients. Their actual impact on population health has not been assessed in this study. It may be said nonetheless, that in terms of clients' perceptions, the RxBox system, with its direct service utility, was the most responsive to front line demands and

therefore has wide acceptance among local health providers. Bundling the diagnostic device with essentially population health monitoring and specialist referral IT applications will help ensure the continued operations even of the latter. Given adequate technical support and financing, the RxBox system is anticipated to be sustainable and readily expandable to other communities and settings. The same may not apply to stand-alone IT modalities that do not directly or significantly benefit its actual implementers, as has happened with the R4Health system.

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Statement of Authorship

This report was written by the sole author, who assumed full responsibility for its content.

Author Disclosure

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