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Institutionalizing Information Systems for Universal Health Coverage in Primary Healthcare and the Need for New Forms of Institutional Work

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Abstract:

Today, many countries around the world focus on ensuring that all people can access health services of sufficient quality without experiencing financial hardship (i.e., universal health coverage). To measure progress towards this goal, countries need to build robust health information systems. Because countries need to root universal health coverage in primary healthcare, they also need to sensitively anchor health information systems that support universal health coverage in existing routine health information systems. However, doing so involves significant challenges, which we study via empirically analyzing an Indian state's effort to implement a universal health coverage health information system in primary healthcare. Using a theoretical lens informed by institutional theory, we seek to answer the question: "What is required to develop institutions that support the use of new technologies and associated work processes that universal health coverage entails?" We identify the contradictions that emerge when new systems clash with existing ones, and we discuss what implications such contradictions have in terms of system design, work processes, and institutions. We contribute to the literature by explaining inherent complexities in universal health coverage health information system design and implementation and providing system design guidelines.

Keywords: Universal Health Coverage, Health Information Systems, Primary Healthcare, Institutional Work.

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1 Institutionalizing UHC Health Information Systems within Primary Healthcare

According to the World Health Organization (n.d.):

Universal health coverage (UHC) means that all people and communities can use the promotive, preventive, curative, rehabilitative and palliative health services they need, of sufficient quality to be effective, while also ensuring that the use of these services does not expose the user to financial hardship.

This definition entails three related objectives: equity, sufficient quality of service, and protection against financial hardship. Achieving universal health coverage (UHC) represents an urgent global priority, and low- and middle-income countries need to engage in measuring progress towards achieving it. Further, as Chan (2007, p. 5), notes: data forms a key ingredient in measuring this progress:

Without these fundamental health data, we are working in the dark. We may also be shooting in the dark. Without these data, we have no reliable way of knowing whether interventions are working, and whether development aid is producing the desired health outcomes.

In the Global Health 2035 report, the Lancet Commission on Investing in Health put forth an ambitious investment framework for transforming global health through UHC, which included building pathways to provide access to services and financially protecting the poor. While various reports have documented sound technical advice about achieving these goals, such as designing health service packages and financing systems (Bump et al., 2016), guidance on designing and implementing supporting health information systems (HIS) has arguably attracted less focus.

The Institute for Health Metrics and Evaluation has published a composite indicator-based model to measure progress towards the United Nation's Sustainable Development Goals (SDG) and since turned its attention to measure UHC progress (Maurice, 2016). Boerma, Eozenou, Evans, Kieny, and Wagstaff (2014, p. 2) describe the UHC measurement challenge as follows:

The UHC monitoring framework focuses on simultaneous monitoring of coverage of population with essential health services and with financial protection against catastrophic out-of-pocket health payments, stratified by wealth quintile, place of residence and sex.

Today, few countries have a comprehensive UHC monitoring framework, and data for measurement typically comes from infrequent household and facility surveys that use standardized questions or rely on potentially unsound estimates (Boerma, Victoria, & Abouzahr, 2018). The lack of data severely hinders financial measurement. Thus, countries need to invest in strengthening routine facility HIS and regular health examination surveys, which they can achieve only by institutionalizing UHC-HIS in primary healthcare, which, in turn, requires a larger architectural, operational, and institutional integration. As Stigler, Macinko, Pettigrew, Kumar, and van Weel (2016, p. 1811) argue, primary healthcare forms a necessary foundation for UHC:

Health systems development requires more than financing and human resource considerations. Although essential, these components must be integrated into an overall framework for organizing and delivering care.... Primary health care provides such a framework.... [It builds the backbone of an effective health care system].

However, one cannot easily materialize the above design since UHC involve new and different work practices compared to traditional primary healthcare with significant implications on the HIS. Sahay, Sundararaman, and Mukherjee (2014) elaborate on these differences in noting that UHC needs:

- 1) An expanded basket of services (including non-communicable diseases (NCDs)), not just primarily maternal and child health as with traditional HIS.
- 2) Tracking population-based incidence rates of NCDs, assessing the proportions of populations covered by services, and identifying those who do not use the services.
- 3) To ensure continuity of care, whereas traditional HIS provided care more incidentally and episodically.
- 4) To monitor the cost of care.
- 5) To allocate resources based on facility needs, not on uniform allocation models.

Such changes will entail collecting other types of information from different sources as the service coverage expands. As such, health workers will need to organize the way they manage information directly to support continuous and episodic care and to reshape the demand-driven way they provide service to a planning-driven mode.

In this paper, we focus on understanding how countries can ensure that these new practices take root in the health system. It is important to understand change as more than a reconfiguration of work practices that countries can achieve via installing new systems and training staff. On the contrary, we argue that UHC entails more profound institutional changes, which raises the question of what required supporting institutional structures a UHC-HIS needs to exist. For example, the HIS in the primary healthcare settings in most low- and middle-income countries has historically relied on aggregated data (e.g., on counts of “number of children born last month”) and technologies were designed to enable upward reporting rather than strengthen local action. In contrast, UHC requires data about patients and their individual encounters with the health system (e.g., name, date, time, and place they attend hospital). This change in data needs requires a radically different HIS with new institutions and technology support. For example, a new technical solution could use biometrics to enable personal identification, which requires supporting institutions such as personal and unique identification numbers and data-protection regulations. Based on these changes in informational needs, we investigate the following research question (RQ):

RQ: What is required to develop institutions that support the use of new technologies and associated work processes that universal health coverage entails?

This paper proceeds as follows: in Section 2, we elaborate on our theoretical perspective that we use to address this question. In Section 3, we present our research approach and, in Section 4, the empirical study. The study describes an Indian state’s effort to implement a UHC-HIS in the primary healthcare sector. In Section 5, we analyze the challenges of this undertaking as indicating institutional tensions. Based on the analysis, in Section 6, we suggest strategies for systems design and implementation that can help countries successfully institutionalize a UHC-HIS. Finally, in Section 7 we conclude and draw theoretical and practical contributions.

2 A Theoretical Perspective to Understand Changing Institutions

We focus on understanding how new work practices will emerge and take root in primary healthcare. We chose an institutional lens to better focus on the institutionalized and embedded practices around HIS in primary healthcare settings. As a result, we establish a frame to discuss whether one may need to dismantle or deinstitutionalize existing institutions and how one could create (or re-institutionalize) new ones that could support the new practices that UHC and UHC-HIS entail. Through an institutional analysis, we hope to uncover what it takes to successfully implement UHC-HIS.

We build on existing research on the impact of information technology on institutions (Gawer & Phillips, 2013; Rajão & Hayes, 2009) and argue that we can attend to what users can do and what they actually do with available technology to understand how information technology can contribute to dismantling institutionalized practices. Information technology artefacts potentially afford or constrain different possibilities of users’ actions, which depend on their goals (Majchrzak & Markus, 2013; Markus & Silver, 2008). In traditional HIS in the primary healthcare sector in low- and middle-income countries, the dominant institutional norms concern data reporting from the local to the national levels and serve primarily bureaucratic needs. These norms may conflict with the norms that the UHC-HIS inscribe and that need to focus more on patients (not on bureaucracy) to improve their individual health and wellbeing. Such tensions between the old and new norms can lead to different forms of user resistance (Currie, 2012) and, consequently, to suboptimal data use. Understanding the possibilities of action that the UHC-HIS provides to its users can help one to more insightfully analyze how the systems may contribute to deinstitutionalizing historically embedded work and technical practices.

2.1 Institutions, Institutional Change, and the Role of Technology

Institutions involve assumptions, values, and norms that regulate human behavior (Berger & Luckmann, 1991), which influence how users implement and use information systems (Srivastava & Shainesh, 2015; Srivastava, Teo, & Devaraj, 2016). The way in which we understand institutions has its foundations in conceptualizations of human agency. North (1990, p. 97), for example, describes institutions as:

Humanly devised constraints that structure political, economic and social interaction. They consist of both informal constraints (sanctions, taboos, customs, traditions, and codes of conduct) and formal rules (constitutions, laws and property rights).

Jepperson's (1991, pp. 143-145) describes institutions as the product (intentional or otherwise) of purposive action, as "an organized, established procedure" that reflects a set of "standardized interaction sequences". Researchers have used this lens to understand how existing institutions influence work practices and how they affect whether organizations uptake information technologies or not (Orlikowski, 2000).

Creating new institutions necessarily involves replacing or breaking down existing ones, a process called deinstitutionalization (Oliver, 1992). With a particular focus on cultural and political factors, Nicholson and Sahay (2009) draw on this notion in a policy-based analysis in Costa Rica to analyze how introducing new practices that contradict or cannot coexist with existing policy norms can help to deinstitutionalize the existing practices and build the grounds to reinstitutionalize new ones. Accounts of deinstitutionalization have typically not highlighted the key role that technology plays, something we emphasize in this paper. Different users may see the same technology as providing them with varying possibilities of action to shape their practices and influence change in different ways. For example, community health workers may see an organization's introduction of mobile phones in work practices as allowing them to send their reports through SMS and to give their work more visibility. The state administrators can use the same visibility to strengthen their control and surveillance of the work of the community health workers (Mukherjee, 2017). In this way, conflicts and unintended consequences may emerge from what the different users originally envisaged.

Technology can impact institutionalization processes in other ways as well. The complexity and interconnectedness of sector-wide health information infrastructure in itself generates a resistance to change due to its pre-existing arrangements: "an installed base riddled with social (e.g., legal rights and ownership) and technical (e.g., legacy systems and technical standards) interdependencies" (Sanner, Manda, & Nielsen, 2014, p. 221). Change in existing institutions, social practices, and technology can only come about incrementally.

Various studies of HIS in low- and middle-income countries have adopted an institutional lens to highlight the relation between HIS, users' practices, and institutions and how it may affect information use (Chilundo & Aanestad, 2004; Kimaro & Sahay, 2007; Noir & Walsham, 2007). We build on this stream of work and further contribute to it by incorporating how the technology itself and its material properties can influence the adoption of new institutions at the expense of existing ones. This approach resembles the one that Braa, Hanseth, Heywood, Mohammed, and Shaw (2007) followed in showing how a new "flexible standards" model could break down an existing institution that involved reporting all locally collected data to the national government. Only a new flexible and user friendly technology could enable this new institution: it allowed actors the freedom to include or exclude different data elements for stakeholders at different levels. In this way, the government could resolve competing institutional norms at different administrative levels, and relevant stakeholders could develop a shared understanding about the new ways to operate.

2.2 Strategies for Changing Institutions: Institutional Work

While much research has focused on studying how institutions influence practices, it has insufficiently studied the reverse relation. Researchers have examined the role of actors and practices in affecting institutional change either through focusing on the "institutional entrepreneur" (DiMaggio, 1988; Eisenstadt, 1980) or on deinstitutionalization processes. Lawrence and Suddaby (2006) brought these various research streams together with their notion of institutional work: the work that actors purposefully perform to create, maintain, or disrupt institutions. This practice-oriented lens views institutional work as "intelligent, situated institutional action" that actors who "may or may not achieve... [their] desired ends" and who "interact with existing social and technological structures in unintended and unexpected ways" (p. 219). Lawrence and Suddaby identify nine ways to build institutions: 1) advocacy (the mobilization of support), 2) defining (create identity, rules, boundaries etc.), 3) vesting (allocation of property rights, confer rights), 4) constructing identities, 5) changing normative associations (redefining the moral and cultural foundations for practices), 6) constructing normative networks (inter-organizational sanctioning of practice), 7) mimicry (leverage existing practices, rules, structures), 8) theorizing (naming new concepts and practices), and 9) educating (providing skills and knowledge). Further, they identify six ways to maintain and reproduce institutions: 1) enabling work (create rules that facilitate and support the

institution), 2) policing (ensuring compliance), 3) deterrence (establish barriers to change), 4) valorizing and demonizing (evaluations of moral status), 5) mythologizing (emphasize normative underpinnings), and 6) embedding and routinizing (inscribing into practices). Further still, they identify three ways to disrupt institutions: 1) disconnecting sanctions and rewards (from certain practices, such as through legal changes), 2) disassociating moral foundations (redefining appropriateness), and 3) undermining assumptions and beliefs. While the authors do not claim to exhaustively list all possible types of institutional work, their framework shows that an actor can perform many activities to create, maintain, or change institutions. In Table 1 below, we briefly summarize these three different categories of institutional work.

Table 1. Different Categories of Institutional Work (Lawrence & Suddaby, 2006)

Creating institutions	Maintaining institutions	Disrupting institutions
<p>Work that focuses on creating new institutions.</p> <p>Forms of institutional work: Advocacy, defining, vesting, constructing identities, changing normative associations, constructing normative networks, mimicry, theorizing, and educating.</p>	<p>Supporting, repairing, or recreating the social mechanisms that ensure actors comply with institutions.</p> <p>Forms of institutional work: Enabling work, policing, deterring, valorizing and demonizing, mythologizing, and embedding and routinizing.</p>	<p>Attacking or undermining the mechanisms that lead members to comply with institutions.</p> <p>Forms of institutional work: Disconnection of sanctions, disassociating moral foundations, and undermining assumptions and beliefs.</p>

Researchers have used this framework to unpack how the design of HIS relates to underlying changes in healthcare models (Thorseng & Grisot, 2017; Vikkelsø, 2010). In the context of UHC, we need to ask which institutions actors need to maintain, disrupt, or create and how (through which strategy) they can do so. At the same time, we critically discuss the role of contradictions that emerge from different and potentially conflicting institutional arrangements (new and old) and the transformational power that lies in them (Seo & Creed, 2002). In summary, we focus on:

- 1) Understanding the institutional nature of the existing and new practices around the UHC-HIS, the institutional work, and the ensuing contradictions and tensions the new practices entail when they clash with the traditionally existing practices and systems.
- 2) Analyzing these institutional contradictions as opportunities for change and deriving insights on how actors can effectively leverage this potential on the ground.
- 3) Deriving insights on the necessary technological material features (design guidelines) that support the institutional work that actors need to undertake to redesign institutions to create an effective UHC-HIS.

3 The Empirical Approach

3.1 Case Study Context

3.1.1 Background on Research Project

We conducted a case study in a state in North India. While UHC represents a national priority in India, different states have shown unequal progress in pursuing the UHC reform agenda, which includes revamping their HIS (Patel et al., 2015; Devadasan, Ghosh, Nandraj, & Sundararaman, 2014). However, the state we examined had initiated at least two alternative models (including the one we report on) for implementing UHC-HIS. We began our case study by focusing on understanding the experience that health facilities across various districts in the state had with the pilot UHC-HIS implementation, which had ran for about nine months and had delivered less than expected results. Specifically, we focused on incorporating the lessons from the first unsuccessful pilot (reported here) into a new attempt to design and anchor a UHC-HIS in this setting. This new project, which adopted a UHC framework, focused on designing, developing, and implementing a patient-centric information system for the healthcare facilities, testing its effectiveness, and allowing the state to evaluate and scale it up if it found the system useful.

The case study forms part of a larger project (called “Building Patient-centric Systems for Primary Healthcare in Resource-constrained Setting”) that we—researchers from a university in Norway and a public health university in India—undertook with various other participants from 2016 to 2018. The other participants included two informatics students (one at each university in Norway and India) who pursued

master's theses on topics relevant to the project (one studied the evolution of requirements for such a patient-centric system, and the other studied the role of standards and how to align system design with national-level standards on nomenclature and formats) and a medical doctor in India who studied the effectiveness of patient-based systems more generally in India and how the new system impacted patients' health. In addition to the two research institutions, a third entity, an Indian NGO, helped to develop the technical systems. The first author of this paper has worked in the public HIS context in India since 2000 and, more specifically, in the state we examined since 2008.

3.1.2 Existing Structures, Systems, and Work Practices in the Research Setting

The pilot site (i.e., the state) comprised one rural and one semi-urban district. In this project, we focused on one primary healthcare facility in each district and the five or six outreach centers (called subcenters) that fell under the primary healthcare facility's jurisdiction. Each subcenter had one or two field nurses (called auxiliary nurse midwives (ANMs)) that provided outreach and clinic-based care (primarily related to maternal and child health) to three to five villages and a catchment population of about 5,000 in total. A primary healthcare facility included a medical doctor who provided outpatient services and limited support staff (e.g., a lab technician), representing the first call for patients to receive medical care.

The healthcare facilities had preexisting HIS in place that staff members used to, for example, report to national-level organizations and track pregnant mothers and children for immunization (we counted nine such reporting systems). The ANMs had the responsibility to provide the data for these HIS. Typically, they recorded data in their field diaries at the point of care and then transferred it to their primary registers (typically, each subcenter had about 20 registers that related to antenatal care, immunization, TB, Malaria, and others) where they entered each patient's name, the date and details of the service encounter. The ANMs typically entered information about individuals in multiple registers and also multiple times in the same register.

On a monthly basis, ANMs extracted the required data from the respective registers and transferred it to various reporting forms and sent these to the primary healthcare facility. In the facility, staff members entered the data into a computer. As such, the new system for our project had to engage with (and hopefully replace) the cumbersome preexisting systems that featured significant data redundancy and manual processing (in the registers) but also introduce new informational requirements associated with UHC-HIS (such as population coverage, non-communicable diseases, referral linkages, etc.). These institutionalized systems of data collection and reporting will influence and be influenced by the new practices UHC-HIS entails.

3.2 Data Collection

We collected data from: 1) a project in which a third-party vendor commissioned by the state implemented a UHC-HIS in a primary health clinic in the state and 2) a project in which we designed and developed a UHC-HIS ourselves in two other primary healthcare clinics in the same state. While we draw on the data from both projects to inform our analysis, the case we present primarily draws from the first one.

3.2.1 Third Party Vendor's UHC-HIS Project

We began collecting data from this project with a state-level review meeting that the state principal secretary of health convened in April, 2016. At the meeting, the vendor demonstrated the system under development and discussed the issues it faced in the presence of various state and district level staff. In this meeting, in addition to seeing the demonstration, the first author held discussions with the principal secretary, the state project coordinator, and the vendor. Not satisfied with the project's progress, the secretary requested the first author (who had worked in the state for many years) to visit the empirical site to assess the issues and give her a report. Subsequently, the first author visited the primary healthcare clinic and then two subcenters under it over two days. At the primary care clinic, the author conducted three interviews: two with the medical officers and one with the pharmacist who maintained the computer system. Additionally, the author sat in the doctor's cabin and observed his interactions with patients and how he used the pilot UHC-HIS to record the transaction details. Following the visit, we wrote an assessment report and presented it to the principal secretary.

3.2.2 Our Own Projects

As we mention above, we began a research project with two universities and various stakeholders in 2016. The state assigned two health clinics to take as study areas both to provide care and to strengthen the HIS.

Since our research project began, we collected data through two primary modes. First, the first author made five trips to the research site to attend workshops and have discussions with health staff at the clinics. During this process, he conducted at least six interviews with the staff of the clinics and many rounds of formal and informal meetings with other researchers from the Indian public health university. Second, we established a research team at the project site that included a medical doctor, a data-entry operator, and some support staff. This team studied the use of existing paper-based and computerized HIS tools, such as tally sheets, forms, and registers.

Importantly, we set up and used a living lab in the clinic site to collect data and enable system design in context. This lab enabled the research team, in collaboration with the clinical health staff, to jointly discuss current systems, work practices, information needs and gaps, and other issues to appropriately design the new UHC-HIS. The research team could also study the registers in use, seek clarifications on why staff collected certain data, and observe everyday interactions between patients and doctors.

To date, the project has hosted at least four workshops to discuss larger research issues and to review project progress. In the first workshop, the two collaborating universities jointly invited various national- and state-level stakeholders who presented varying experiences of similar patient-centric systems in the country. By sharing these experiences, they helped us understand the strengths and weaknesses of existing systems and provided design inputs for the system we had begun to develop. In the second workshop, we directly interacted with health staff to understand design considerations. We studied the different registers and input and output formats, and the health staff described the kind of changes and improvements they wanted in the new system. In the third workshop in Oslo, four researchers from the public health university in India in addition to the Norwegian team and other stakeholders such as the directorate of e-health discussed how Norway implemented patient-centric systems, which helped the research team to identify areas of learning, such as the key role that regulation plays in protecting patients' privacy. In the fourth workshop held in India in 2018, the systems developed through the project were presented and feedback was solicited from various participants for further improvements.

As we state above, two Norwegian master's students in informatics also worked on this project. The first student diligently recorded the evolution of requirements that resulted from emerging discussions the research team had with health staff and the NGO responsible for building the system. Sometimes, particular design choices did not work, and, through discussions, we identified new requirements, which led to changes in the master requirements document. The other student, who worked on standards (especially about nomenclature and formats), produced a wealth of data for his thesis work that became a common shared data resource for analysis. Further, one PhD student from the Indian side worked on the project and studied the impacts of the ICT intervention.

Table 2. Summary of Data Sources

Means of data collection	At project site of third party vendor	At research project site
Interviews	Five interviews: two with medical officers and three with field nurses. All conducted in respective clinics.	Six formal interviews including two with medical officers and four with field nurses and clinic staff.
Meetings	One at the office of state principal secretary health.	Multiple meetings with research team during the course of the workshops held.
Workshops	None.	Four workshops: three in India and one in Norway.
Research activities	Developed assessment report.	Two master's students and one PhD student.
System demos	One at principal secretary health office and one at primary healthcare clinic.	At least three formal system demos attended.
Observations	Carried out in the primary healthcare clinic and subcenter of work practices and how health staff used registers and reports.	We extensively observed HIS-related activities and interactions between health staff and patients.

In addition to these direct data-collection activities, the research project also included designing, developing, and implementing the UHC-HIS and training healthcare staff. In the process of building different versions of the system prototypes and training, feedback was received from the users that became important sources of data for the project. These different activities helped generate insights into the institutional challenges of reforming the old HIS and introducing a new UHC-HIS.

The research team documented the data in the form of interview notes, minutes for meetings, project review reports, and PowerPoint presentations. Additionally, informal messages over phone and email where relevant and often shared and discussed them through face-to-face meetings was compiled. All this data was made available to the research team using Google drive, which became the data repository for the project. Table 2 summarizes the different data collected.

3.3 Data Analysis

To analyze the overall case, we draw on the learning and insights the research team developed as it designed and developed the UHC-HIS and as the research project was conducted. As a first-level analysis, the research team compiled data into various progress reports at different stages of the project and shared it with others. For example, in the third workshop in Norway, participants intensively discussed a report compiled on the “landscape of patient-centric systems in India” based on data collected during the first workshop in India. The research team prepared and discussed a presentation based on this report along with other presentations from the Norwegian participants. The various policy documents (such as privacy regulations) collected were made available in the common data repository.

As a second-level analysis, based on studying different documents and reports, we identified and discussed themes to help link them to the theoretical concepts drawn primarily from institutional theory. We contextualized these identified themes and concepts in the broader historical understanding of the state health system, which led to our developing the case study description.

The research themes identified through the conceptual analysis focused on the challenges that the different healthcare staff we interacted with reported. We grouped these challenges into five categories: 1) increased work burden for health staff, 2) the new UHC-HIS added little value, 3) an increase in UHC-HIS complexity due to the need to both combine individual and aggregate data, 4) extreme technical and institutional contradictions between the old and the new systems, and 5) severe capacity and resource constraints in effectively working with the new systems. We then used these themes as focal points to develop an institutional-inspired analysis to identify the contradictions that UHC-HIS encounter. In Table 3, we provide some examples that show we inductively identified the themes.

Table 3. Inductive Identification of Themes

Theme	Sample evidence to generate this theme
Increased work burden for the health staff.	Health staff said that, with the new system, they now needed to spend nearly 60 percent of their work time on data-management activities—much more than before.
The new UHC-HIS added little value.	We saw that the system did not strengthen their local care practices, such as being able to electronically synchronize data from their tablets to the primary healthcare facility system to build the referral system.
Extreme technical and institutional contradictions between the old and the new systems.	Technical contradiction: in the clinic, we saw a nurse trying to log in unsuccessfully into the internet. The system we designed relied 100 percent on the Internet. Institutional contradiction: the ANMs now had to screen all people over 35 years for conditions of hypertension, diabetes, oral cancer, and others, which represented new tasks as compared to her earlier focus on reproductive and child healthcare.
An increase in UHC-HIS complexity due to the need to combine individual and aggregate data.	We saw that the health workers needed to collect a lot of new information from diverse sources, which heightened the complexity of the HIS.
Severe capacity and resource constraints.	The same ANM who was already overburdened with work now had a significant amount of additional work through the UHC without more resources to help.

4 The Case: Indian State's Effort to Implement UHC-HIS

From initially reading the relevant literature on UHC and having discussions with researchers and the state's administration, we realized that the requirements of the UHC-HIS fundamentally differ from existing HIS for the primary healthcare sector. Changing from a HIS to UHC-HIS involves a radical shift from an aggregate routine reporting system to what resembles a community-based, electronic medical record that focuses on individuals and tracking them continuously over the care cycle. While the traditional system focused on routinely reporting aggregate maternal and child health data, under UHC, ANMs also had to screen the entire population in their catchment area for eight additional conditions (diabetes, hypertension, anaemia, oral cancer, etc.) and maintain and share this information electronically. In the UHC-HIS pilot, ANMs received a tablet to register this information in and synchronize with the facility's database, which stored the information. With this tablet, the ANMs also had to electronically refer cases to the primary healthcare doctor's system, which further linked with the district hospital. Both hospitals and primary healthcare facilities also had to electronically back-refer patients after a consultation to ANMs for follow-up home-based care.

To actually comprehensively screen an entire population necessarily took time, and, it proved difficult to cover everyone. As such, it would take time to register all potential patients in the new system, which would result in the need to maintain a dual set of work processes in the clinic. In a visit to one of the primary healthcare facilities, we found the staff there had created two categories of patients: "UHC group" and "non-UHC group". The former included those patients that the ANMs had already screened and the rest that the ANMs had not. Only 10 percent of the daily outpatients (of total 60) were in the "UHC group". In terms of the information flow, we saw that a patient who visited the primary healthcare facility would first go to the pharmacist who maintained the computer system and showed their health card, which included an identification number. A UHC-HIS assumes that the primary healthcare facility computer has a patient's record prior to the patient's visit based on the rationale that, after screening all patients in an area, the ANMs electronically register the information in a tablet that constantly synchronizes with the primary healthcare system. However, we found that this information did not exist in all cases, and, as a result, the pharmacist had to reenter the registration details.

Further, the infrastructural constraints that challenged the UHC-HIS's usability in practice impeded the way it should have worked. Once the pharmacist registered a patient's case record, the details appeared on the doctor's screen for an outpatient consultation. But, due to the poor Internet, the doctor required many minutes to log on to the system. Filling the case record in the system while examining the patient could take about 10 minutes, which led a frustrated patient to say: "Doctor, why don't you do your personal work on the computer later and first deal with me?". In the case of electricity failures, the doctor would note case details on paper; however, due to long power outages and the continuous stream of patients, they seldom had time to enter these details into the system afterwards. Over time, this practice contributed to a growing number of unrecorded cases. After a consultation, the doctor could not take a printout due to a lack of printing paper and so noted everything on paper, gave it to the patient, and also entered the same details in a local register. Additionally, the patient showed the slip to the pharmacist who maintained a similar register of outpatient cases for statistical reporting. When asked if work had become simpler, the doctor replied: "No, it has become a torture". Further, in the case that the primary healthcare system did have information about a patient, the system could not automatically synchronize data with the ANMs' tablets. As such, only the particular doctor could access the record via that doctor's desktop computer. To take this data to the tablet, the patient needed to show the outpatient slip to the ANMs, but patients rarely did so, which contributed to a rising number of incomplete and unsynchronized records and undermined the ANM's ability to ensure continuity of care.

While UHC focuses on strengthening continuity of care, we found that the doctor did not use the UHC-HIS to view patients' history. As for why, the doctor reported that he found the search function cumbersome since it required him to search record by record rather than allowing him to view aggregated patient profiles. Further, patients' records did not normally contain historical data related to drugs because the primary healthcare facility doctor had the mandate to prescribe only certain medicines from an approved medicine list. If unavailable or if the doctor wanted to prescribe something not on this list, they would write it on a slip, and not in the computer, to escape possible reprimand for not following the norms of drug distribution. As a result, the doctor had a skewed perception about the system's utility in terms of continuity of care.

The system did also not stimulate or support an intended shift to a population-oriented and preventive-planning practice. For example, the doctor could not see summarized outputs (by graphs and charts) that showed, for example, the total number of hypertensive cases by village. Similarly, the system could not generate referral linkages, so the district hospital would start a new record for every new patient even though they may come through the primary healthcare that already had a record for the patient's medical history. We found that the doctor did not use the readily available functionality in the UHC-HIS to schedule follow-up visits since the doctor believed it was the patients' responsibility to come and not theirs to follow up.

In one subcenter, we met the two ANMs responsible for the UHC-HIS who regarded themselves as competent in using tablets. One ANM's tablet had not functioned for many months and had not been fixed despite her multiple requests for support. As a result, she made entries on paper to later enter into the tablet when fixed. Both ANMs struggled with bad network connections, and, in the two hours that we observed them, could not log in despite multiple attempts. They also reported that they found it difficult to use the tablet outdoors due to sun glare. As a result, they did their outdoor work on paper and later when indoors they entered the data into the tablet, which duplicated their work. After initially screening the patients on eight UHC conditions, the ANMs did not update their base records until a later time due to their high workload. As a result, the records often became outdated.

ANMs reported a significant increase in their workload with the advent of the UHC-HIS, which required them to spend about 60 percent of their time on data-related activities. They entered data in multiple places such as primary registers, the health management information system for aggregate reporting, and the mother and child tracking system for tracking pregnant mothers and children by name, which another system (called RCH +) had recently replaced and included about 100 extra entries. The UHC-HIS was the latest addition to their workload, and they still had to continue to use the earlier systems. They first noted most work on paper and then entered it into the tablet. Overall, doctors and ANMs expressed frustration because they obtain extra value but rather additional work from the UHC-HIS.

5 Analysis

The case study illustrates both challenges that stakeholders typically face when working with institutions and information infrastructures in a primary healthcare context in a low- and middle-income country. These generic challenges include multiple overlapping systems and practices that contribute to double reporting and fragmentation both technically and institutionally. Specific challenges relate to technical infrastructure (e.g., Internet, electricity, technical support) that constrain system use and data-sharing across unevenly and poorly resourced contexts. In this section, we analyze these challenges using the three categories of institutional work (i.e., creating, maintaining, and disrupting) that Lawrence and Suddaby (2006) suggest. Further, we discuss the institutional contradictions that the new requirements of a UHC-HIS cause and how they can be positively leveraged to stimulate change.

5.1 Creating Institutions

Lawrence and Suddaby (2006) categorize institutional work involved in creating institutions into three subsets: 1) advocacy, defining, and vesting represents overt political work where actors define access to material resources based on rules, property rights, and boundaries (e.g., how interest organizations lobby for resources or new legislations); 2) constructing identities, changing normative associations, and constructing normative networks represents work towards reconfiguring belief systems (e.g., developing new professions and creating private-sector approaches in interventions in the public sector); and 3) mimicry, theorizing, and educating represent alterations of abstract categorizations (e.g., associating new practices with existing practices and establishing common concepts).

The UHC model that the state implemented implied that ANMs and doctors had to change their work practices. For ANMs, they needed to acquire new forms of knowledge (e.g., screening for diabetes and oral cancer) when previously they had primarily dealt only with pregnancies and immunizations. Further, they had to refer at-risk patients to the primary healthcare facility doctor for consultations. ANMs typically did not have to refer such patients previously because the patients themselves initiated the referrals. The ANMs also had to receive "back-referrals" (follow up with patients after consultation from the primary healthcare facility at home). The UHC model further placed new expectations on doctors related to continuity of care. The model assumed that the doctor would establish a longitudinal relationship with the patient in a way that involved using both the functionality for reviewing patients' history data and for

scheduling future appointments with them. These work tasks represent novel institutions since the doctors were not used to referring to written history or to scheduling patient visits.

UHC required ANMs and doctors to perform institutional work to reorient their identity related to continuity of care. They needed to learn to see themselves as having the responsibility to follow up with patients over time through reviewing patient care history, scheduling future appointments, and handling referrals. Doctors also needed to perform additional work to help ANMs in providing an expanded basket of services in terms of identity and to educate them so they can establish the new practices.

5.2 Maintaining Institutions

Lawrence and Suddaby (2006) argue that few institutions have the strength to operate without maintenance and to ensure social compliance, which require stakeholders to support, repair, and recreate revised institutions. They categorize institutional work involved in maintaining institutions into two subsets: 1) enabling work, policing, and deterring focus on ensuring adherence to rule systems (e.g., using sanctions and incentives to ensure compliance) and 2) valorizing and demonizing, mythologizing, and embedding and routinizing focus on reproducing existing norms and belief systems (e.g., public displays of normative foundations and embedded routines and practices).

While the UHC model introduced new ways to work, many of the existing work practices prevailed. Due to sun glare and the tablets' limited connectivity, ANMs added the new UHC-related information-gathering activities to the already institutionalized paper-based practices. For some of the primary healthcare doctors, they used computers to enter details of patient encounters in real time for the first time. However, because severe limitations in power supply and Internet connectivity made doing so difficult, the doctors reverted back to a known institutionalized practice: maintaining local, paper-based documentation. Also, other institutional conditions such as the limitations of the approved drug list and absence of printing paper meant that they often did not use the new system and, when they did, they also entered the details on paper. As a result, their workload significantly increased; instead of a paperless system, the reverse occurred: doctors generated more paper, such as through the local register they had to maintain to record out-patient encounters.

In reverting back to their paper-based practices, the ANMs and the doctors reproduced and extended the existing practices and, thus, compensated for the weak infrastructure.

5.3 Disrupting Institutions

Lawrence and Suddaby (2006) also describe actors attacking and undermining institutions. They describe this work as disconnecting sanctions, disassociating moral foundations, and undermining existing assumptions and beliefs (e.g., non-state actors' working to disconnect incentives and sanctions from certain practices).

Introducing UHC requires disruptive work related to the institutionalized practices that the ANMs and doctors followed and to the way in which patients understand their responsibility for own health and care. First, the ANMs largely catered to the population who came to them either in their facility or during their field visits. However, UHC meant they had to proactively screen the entire population in their homes, which took time and required travel support and ubiquitous access to infrastructure. Second, and in addition to the shift to a population-oriented practice, preventive planning and continuity of care form UHC's core, which differs from episodic care where patients themselves have a responsibility to go see healthcare practitioners. In our case, doctors refused to specify repeated visits through the system because they believed that the responsibility to return lied with the patients. Third, the existing and deeply rooted reporting regime enabled upward reporting rather than reporting between care givers to enable local action.

To change the institutionalized practices that we describe, stakeholders could focus on undermining the existing assumptions and beliefs of demand-driven and episodic care, which includes enhancing patients' role in taking care of their own health. The health staff could also change the deep-rooted upward-reporting regime by changing existing incentives and sanctions related to reporting and information use.

5.4 Institutional Contradictions

In the analysis above, we focus on how introducing the UHC model led to different kinds of institutional work and how it would require further institutional work to progress. Motivated by the extreme challenges

that different healthcare workers we interacted with experienced in dealing with the new and old systems, we now elaborate on and analyze these challenges as contradictions emerging from different and potentially conflicting institutional arrangements. In Section 6, we return to these contradictions and discuss how they could also be used as opportunities for institutional work and change. First, the technological infrastructure did not support the new responsibilities that the ANMs and doctors had to contend with. For example, the tablet that ANMs had to use promised mobility but various practical challenges (e.g., charging, sun glare, and the demand for an online connection) undermined its use in practice. Similarly, the absence of printing paper and limited electricity and connectivity undermined doctors' work of maintaining an electronic medical record of the patient. Second, and as a consequence of the infrastructure challenges, the new system became just another system that often overlapped with and duplicated data that already existed on paper. As a result, the ANMs' workload significantly increased without appropriately adding value in terms of supporting their everyday work with more granular information on people, diseases, and costs over time. To realize its potential, however, the core system would need to provide clinical support, enable ANMs to generate aggregate reports, minimize the need for primary registers, and strengthen follow-up care. Because the UHC-HIS became just yet another reporting system and did not adequately consider the linkages between systems, significant contradictions arose between the expected and provided value for its different users. Third, and again related to the infrastructure, because it ignored actual conditions in the design phase, the system (e.g., the ANMs' tablets and the medical records the primary healthcare doctors used) did not become the expected tool. While the UHC-HIS focused on providing connectivity between the ANMs' tablets and the primary healthcare doctors' computers, in practice, the design, infrastructure conditions, and work practices made the different units act in a standalone manner. Fourth, and again related to the inadequacies of the technical system, the ANMs did not meet their new responsibility to follow up on back-referred patients. The institutionalization of these new practices could not happen without concurrent support from the technology, which required two-way information synchronization about patients' care trajectory. Fifth, while the UHC-HIS had a readily available functionality to schedule follow-up visits, doctors did not use it because they believed the patients themselves had the responsibility to come. Patients themselves also lacked any expectation that doctors would follow up with them

6 Discussion

As the case study and its analysis reveal, the new UHC-HIS suffered many difficulties and contradictions. At first sight, we could conclude that these contradictions contributed to the system's overall failure. However, institutional theory notes that these contradictions need not always be negative because they may carry in them the potential for change. In this section, we discuss possible approaches to leverage their potential through "judiciously designing" HIS and institutional work.

6.1 Design Guidelines based on Institutional Contradictions and Emerging Opportunities

One can develop design guidelines or principles to transform descriptive case studies into a more normative design theory (Walls, Widmeyer, & El Sawy, 1992; Markus, Majchrzak, & Gasser, 2002). Informatics research in the healthcare domain (e.g., Miller, Cafazzo, & Seto, 2014; Sultan, Kuluski, McIsaac, Cafazzo, & Seto, 2018) and IS research in particular (e.g., Aanestad & Jensen, 2011; Nguyen, Nielsen, & Braa, 2016) have used this design approach. In this paper, we do not develop a complete design theory for UHC-HIS. Our design guidelines are socio-technical and not limited to describing user requirements and system features or to giving guidance in system-development processes. Rather, they give broad guidance on where stakeholders needs to focus their design efforts to support system designers but also other actors involved in the institutional work needed to establish a well-functioning UHC-HIS.

When the existing and new institutions meet, contradictions will inherently arise. First, while UHC requires health workers to put more time into care, it also enhances their data-related work. Second, the work (care and data related) demand a working infrastructure that may not yet exist adequately in practice. And third, UHC puts new and demanding responsibilities on both doctors and patients that historically did not exist. However, these contradictions also create opportunities for change. First, health authorities have an opportunity to revise and rationalize what data gets collected and for whom. Second, healthcare workers have the opportunity to better accept the integrating systems due to the increasing burden of data-related work. Third, doctors and patients have an opportunity to build awareness about their responsibilities with

respect to patient care. Fourth, health authorities have the opportunity to recognize the acute need for a more appropriate infrastructure that can assist healthcare workers in their work.

Implementing UHC-HIS entails new forms of institutional work. This work should necessarily seek to maintain and add value to established work practices and support new ones. One cannot implement UHC-HIS in a void and should design it to leverage what already exists in the primary healthcare system (e.g., institutionalized practices for collecting data). We observed that the institutionalized data-collection practices salvaged the care the ANMs and doctors provided from a complete breakdown in the face of an insufficient system. However, one needs to disrupt and challenge these institutions in that they allow data collection for only upward reporting. In deliberately redesigning institutions, one needs to address the rationale and emphasize the value of information to strengthen care rather than control and to design systems that enable work and support more efficient care practices.

We argue that effectively introducing a UHC-HIS requires four new forms of institutional work that also leverage the potential of the contradictions that arise when existing and new institutions meet. First, the UHC-HIS needs to strengthen ANMs' care practices, such as through training in new knowledge domains (e.g., dealing with non-communicable diseases). Second, it requires work practices and supporting infrastructure that connect patients and information (e.g., referrals between outreach and primary healthcare facilities). Third, to expand ANMs' capacity to reach out to the entire population, they need more travel support and better infrastructure, such as Internet coverage. Fourth, patients must be educated to take an active role and share the responsibility of care with their doctors, which entails the introduction of public facing information systems and efforts to establish public awareness (see also Table 4 below).

UHC requires the delegitimization of some current institutions and the creation of new and redefined ones. For example, it requires aggregate systems for upward reporting and new information for patient-based care. In terms of Oliver's (1992) different organizational responses to institutional change, change will require a compromise between the new and the old. When primary healthcare and UHC-HIS come together, inconsistencies between institutional expectations and internal objectives related to efficiency or autonomy emerge, which require organizations to find compromises in building new and redefining existing institutions. The different stakeholders involved (e.g., health ministry, ministry for home dealing with civil registration and vital statistics, donors, and software developers) need to come together to discuss the various contradictions and opportunities that arise and identify the optimal compromised approach to meet needs of both the primary healthcare and UHC-HIS.

6.2 Judicious Design of HIS

The term judicious design (Mukherjee, Aanestad, & Sahay, 2012) reflects an approach that does not seek to obliterate the past to create something new but to cultivate what exists, the installed base, to achieve the new in an incremental manner. This design approach reflects the principle of "airplanes don't fly, airlines do", which emphasizes the interconnected nature of the technical and social domains and the need to build them as heterogeneous networks (Hanseth & Lyytinen, 2010). Further, a judicious design acknowledges that one cannot design and implement all functionality in one go but needs to build it through small-scale and incremental steps. Therefore, UHC-HIS requires an open architecture to allow system development and use to evolve in a way that can easily support future changes.

Traditional HIS inherently conflict with UHC-HIS because the former does not support localized and integrated care, which covers outreach, clinic-based and referral care to best support continuity of care services. At its core, the system must allow health workers to deliver essential care and also help to reduce the burden they experience in recording, tracking, and reporting data (e.g., digitized primary registers could reduce data redundancies). At the core, UHC-HIS entails a population database, to support clinical patient-centric care, and enable health workers to generate all required facility-based reports. This approach supports the "build once, use multiple times" design principle. Beyond supporting local work, UHC-HIS should also support information sharing across organizational boundaries (e.g., to enable interoperability and data sharing with other systems such as hospital systems and births and deaths registration). Such systems must further allow health workers to generate required referral linkages across levels to strengthen continuity of care services. Building interlinkages with systems requires one to understand integration on a case-by-case approach and to materialize that integration in an incremental manner. Both semantic (i.e., business logic and nomenclature) and syntactic (i.e., technical protocols to exchange data across systems) integration require defined standards based on multi-level and multi-sector coordination and governance across organizations. However, a lack of regulation related to freely flowing information between institutions and authority levels presents a key challenge in developing such

standards. Finally, the UHC-HIS must cater for the challenging work context that ANMs and doctors experience (e.g., fluctuating Internet connections and an unreliable electricity supply). These uneven and often technology-sparse contexts need hybrid solutions that combine information technology and paper, online digital solutions that also offer offline support, uninterrupted power supply solutions, and affordable and functional mobile units (phones and tablets). We summarize these contradictions, opportunities, and design guidelines in Table 4.

Table 4. Institutional Contradictions, Emerging Opportunities, and Design Guidelines

Contradictions	Opportunities	Design guidelines
Lack of rationalization and increasing work burden on health workers in terms of services to provide and data work.	To revise and rationalize who collects what data.	Train ANMs Establish the required travel support Establish the required Internet infrastructure
Care and data work assumes non-existing infrastructure.	Leverage the increasing visibility of infrastructure weaknesses.	Develop the supporting infrastructure necessary for information and patients to flow between outreach and primary healthcare centers.
Differing views on whether the responsibility of care lies with the doctor or the patient.	To build awareness about doctors' and patients' responsibilities.	Develop public awareness about individuals' responsibilities for their own health and care. Develop awareness among doctors' about their role and among the public about their responsibilities to ensure continuity of care
System design must simultaneously support new and existing evolving systems and work practices.	Combine information technology and paper, support information sharing across organizational boundaries, and reduce the work burden of healthcare workers.	Develop systems with an open architecture, with the ability to share data across institutional borders, using hybrid solutions that combine information technology and paper, and using online solutions that also offer offline support.

7 Conclusions and Contributions

Where previous research on information infrastructures primarily has focused on the challenges of achieving integration processes based on top-down approaches, we focus on practice-based approaches and on how initiatives can be developed from the bottom up. This approach to achieving UHC also differs from global initiatives such as the Health Data Collaborative¹ and the Open Health Information Exchange², whose integration strategies begin at the top and not at the community level even though healthcare organizations at the community level need strengthened care practices. Where the literature commonly discusses integration as a technical issue, we also focus on the challenge of integrating new and old work practices (since one can never start on a clean slate) and the institutional work that supports such integration. In this process of standardizing work practices in uneven and often technology-sparse contexts, we show that the unique and new UHC phenomenon will remain tangled with the past. Institutional work in this setting involves bridging the new and old and releasing the potential of new practices in rationalizing the old.

In this paper, we specifically address the research question: "What is required to develop institutions that support the use of new technologies and associated work processes that universal health coverage entails?". We identify and discuss central contradictions and three key challenges that arise with UHC: increased work burden for health workers, a lack of working infrastructure, and uncertainties regarding the responsibility of the patients' wellbeing. Leveraging these contradictions, we further identify new forms of work to establish the required institutions to support new UHC-HIS-related technologies and practices. The contradictions we analyze in this paper help to explain the inherent complexities in UHC-HIS design and implementation, and the design principles should offer guidance to actors involved in developing and

¹ <https://www.healthdatacollaborative.org/>

² <https://ohie.org/>

implementing UHC-HIS in a similar context. We also contribute to existing work on institutional theory by using the concept of institutional work to discuss how the material properties of technology can influence how actors adopt new institutions at the expense of existing ones (e.g., a UHC-HIS that features an open architecture can enable interoperability and data sharing among systems). As institutional work, these features have the potential to change existing reporting practices and reduce data redundancy across systems. Further, research on the creation of new institutions has focused on the role of actors in establishing institutions and primarily on institutional entrepreneurs and under which conditions entrepreneurship thrives (Lawrence & Suddaby, 2006). In this paper, we extend such research by providing detailed accounts of the work that actors do when they create, maintain, and disrupt institutions.

Our analysis suggests that one needs to anchor UHC-HIS in the routine facility HIS that exists in the primary healthcare sector to prevent it from becoming “yet another reporting system”. If one can do so, the UHC-HIS can also provide an opportunity for change by helping to rationalize existing facility HIS and revitalizing it with the new focus that UHC provides. Such a unified system can arguably meet both the demands for routine facility and new UHC reporting. We can see an example in which a country effectively integrated UHC into its primary healthcare sector in Thailand. Based on expanding the existing primary healthcare, the country incrementally built its HIS on its existing platforms (e.g., the well-working civil-registration and vital statistics systems) to ensure the HIS covered and provided services to all citizens (Tangcharoensathien, Limwattananon, Patcharanarumol, & Thammatacharee, 2016). The community forms the backbone of a UHC (Schneider & Lehmann, 2016), and a UHC-HIS needs a design that focuses on community-based electronic medical records, which fundamentally differs from a typical electronic medical record (which one typically sees in large private hospitals). This difference arises because UHC encounters do not take place in a hospital but in a geographically spread community. The community electronic medical record needs to capture individual-based data on services needed and received associated costs incurred while simultaneously generating population profiles of health service coverage and financial protection, the two vital pillars of UHC, with the necessary stratifications.

HIS that appropriately and relevantly integrate the old with the new can support health workers' practices and reduce their burden in terms of the time they spend on entering and reporting data and add value to their ability to take local action. Strong and flexible linkages between the UHC-HIS and other systems can enable a more comprehensive UHC. Further, different functions will provide value to different actors (e.g., ANMs, medical doctors, pharmacists and administrators).

Achieving UHC and measuring its progress represent global priorities. Currently, measurement models typically rely on survey data and not on routine UHC monitoring frameworks. While UHC must build on existing primary healthcare, the current debate inadequately discusses its implications for UHC-HIS. UHC-HIS must feature a strong architectural framework to support these evolving informational needs. The capacity of ANMs and doctors must be significantly strengthened and systems rationalized to counter health workers' increasing workloads. The UHC-HIS must support work practices at different levels and link to other relevant systems on a case-by-case basis, such as for civil registration and vital statistics and hospital systems. In this paper, we discuss how this alignment work inherently relates to existing socio-technical structures and requires institutional work that contributes to changing existing norms and practices even as it introduces new ones.

This research has several limitations. First, it builds on empirical insights from a project that designed and implemented a UHC-HIS pilot in India. While one can likely find the challenges and contradictions that we discuss here across the healthcare system in India, other contexts may differ. Scaling the system to the state level would probably introduce further contradictions and require new kinds of institutional work. To release the full potential UHC-HIS, one must implement it at the state or national level, and further research should follow such initiatives. Second, empirical research needs to scrutinize the validity of the principles that we suggest here by examining how health workers and organizations use the design principles in the same or other contexts. Future research could also develop a proper information systems design theory for UHC-HIS, which pertains to the different contexts in India, to developing countries, and to developed countries. Doing so would require more research to underpin each principle with theory and to develop them further to offer more specific guidance to practitioners (Walls et al., 1992).

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