Institutional Work to Routinize the Use of a Digital AMR Monitoring System

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Abstract. Antimicrobial resistance is described as a "slow-moving Tsunami" and a top global health threat, particularly affecting low and middle-income countries. A key strategic tool to engage with this challenge is effective monitoring to improve knowledge and awareness and support evidence-based interventions. However, LMICs have an inadequate capacity, resources, infrastructure, and culture to implement digital interventions. To engage with this challenge within the context of a public hospital in India, a global AMR hotspot, empirical work is carried out in studying the design and implementation of an AMR monitoring system and in understanding the process of antibiotics use and associated challenges in their digitization. A practice-based perspective informs understanding of these empirical problems, and how practices evolve into institutional work. This paper contributes to understanding the challenges and approaches to implementing AMR digital monitoring systems.

Keywords: AMR · Information systems · Digital AMR monitoring · Practices · Institutional work · Actors

1 Introduction

This paper seeks to understand the link between information practices and institutional work and how these can be best linked to create enabling structures to strengthen the implementation and use of *digital monitoring systems for Antimicrobial Resistance (AMR) within public hospitals in India.*

Antimicrobial Resistance (AMR) occurs when bacteria, viruses, fungi, and parasites change over time and no longer respond to medicines making infections harder to treat and increasing the risk of disease spread [1]. The World Health Organization (WHO) has described AMR as 'a global crisis' and the perfect example of the complex, multi-sectoral, multi-stakeholder challenges increasingly facing the world [1]. AMR is endangering the future of societies [2], including the achievement of all Sustainable Development Goals (SDGs) [3]. AMR is a lifestyle disease [4] impacting the world inequitably, with Low- and Middle-Income Countries (LMICs) amongst the worst hit, due to the high prevalence of infectious diseases, overcrowding, poor sanitation, weak

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access to diagnostics, inadequate monitoring, indiscriminate antibiotic use, and weak regulations. India is the world's AMR capital [5] reporting an annual AMR attributed mortality of 700,000, estimated to reach 10 million by 2050 globally [2]. India is the biggest producer [6] and consumer of antibiotics globally, reflected in the more than 100% increase in antibiotic use between 2000 to 2015 [7]. Compounding this problem is the relative lack of effective monitoring systems, and while 163 countries have developed National Action Plans (NAPs) to combat AMR, very few have materialized them in practice. A mere 2.3% of monitoring systems globally are in LMICs [7] contributing to the vicious cycle of poor information and evidence base about the AMR problem which limits focused interventions that magnify its spread and associated social inequities.

A strategic priority of the NAPs is to ***strengthen the knowledge and evidence base through surveillance***. This is easier said than done because it involves systematic information on various complex and inter-connected parameters, such as i) antimicrobial susceptibility testing (AST); ii) monitoring of resistance; iii) monitoring of consumption and use of antibiotics; and iv) specific skills on areas such as medicines management, hospital-acquired infections, and infection prevention and control. All these represent new forms of knowledge and require specific skills, capacities, and infrastructure, currently largely unavailable in the public sector of most LMICs. This paper argues that trying to build these new forms of knowledge and skills, to enable digital AMR monitoring, will need understanding both at a micro-level of what new or redefined information practices should become part of everyday institutional work, and how these institutional work arrangements could contribute towards systematic and continued monitoring of AMR. Given this background of the research and practice-related challenges, this paper addresses this research question: **What is the institutional work required to routinize the use of a digital AMR monitoring application at the facility level?**

The empirical base for analyzing these research questions is a public hospital in India, which has limited resources and capacities to absorb new initiatives like that required for AMR monitoring. The rest of the paper is organized as follows. In the next section, we discuss institutional practices and institutional work, and their relevance in guiding the analysis. In Sect. 3 we describe the research methods followed by the case study in Sect. 4. Section 5 presents the case analysis and discussion. Conclusions are presented in Sect. 6.

2 Information Practices and Institutional Work

Practices represent "*shared routines"* [8] or "*recognized forms of activity*" [9] that guide behavior. All institutions have a set of practices and organizing principles that provide the logic of the actions of actors as they respond to their work demands [10] that reproduce institutions [11]. The practice lens is oriented towards understanding the recursive interaction between people and technologies within a situated context [12], implying that technology is not treated primarily as an artifact but as an integral element of people's routine work and the lived character of the everyday world, which serves as the object of analysis [13]. Orlikowski [14] writes:

> *"while users can and do use technologies as they were designed, they also can and do circumvent inscribed ways of using the technologies - either ignoring certain*

properties of the technology, working around them, or inventing new ones that may go beyond or even contradict designers' expectations and inscriptions."

A practice-based approach to IS research provides a strong tool to understand how change happens after the introduction of technology, often after the fact. Concepts of situated action [15] and tinkering [16] are relevant to understanding the nature of these information practices, how they occur, what breakdowns happen, and how are they dealt with. This helps to understand what kinds of contingencies emerge in the course of everyday work and how actors deal with them. For example, Mosse and Sahay [17] in their study of communication practices of health workers in Mozambique, described how they needed to send reports every month to their superiors. They deal with breakdowns, such as the printer not working, by going to the nearby church to take their printouts. Such practices help to find better and improved ways to mitigate uncertainties and install more stability into dealing with emerging work contingencies [18, 19].

A practice lens becomes relevant to study a complex societal issue of AMR, which concerns a lifestyle disease and involves multiple actors, artifacts, practices, and structures. Digital AMR monitoring, which is the focus of this paper, represents a novel intervention in the context of a public hospital in India, that requires the development of new practices, which have to also engage with the legacy of existing practices related to manual monitoring. Digital monitoring of AMR to capture, analyze and report data are central to the global response to AMR and is essential for standardized data collection to inform strategies which is unfeasible with the traditional and manual methods of monitoring [4]. Monitoring antimicrobial resistance (AMR) is fundamental to developing strategies and policies to contain the spread of AMR at local, national, and global levels. A digital AMR monitoring system can potentially provide information and evidence to guide clinical decision making; provide information on the effect of antimicrobial resistance and the burden of infectious diseases in the community and guide the stewardship program and infection control strategies.

Institutional work describes "*the purposive action of individuals and organizations aimed at creating, maintaining and disrupting institutions*" [20]. Institutions are 'an organized, established procedure' that reflects a set of 'standardized interaction sequences [21] arising from the interplay between actors and institutional structures influencing institutional change, innovation, and deinstitutionalization processes [22]. There is an ongoing *"duality of work"* representing the interconnected and mutual interconnections between practices and institutions [23], which are both visible and invisible, leading to *creating, maintaining, or disrupting* forms of institutional work [24].

Lawrence and Suddaby [20] identified different types of institutional work that emerge from varying types of practices. *Creating* work describes how new institutions emerge and get established, while *maintaining* is concerned with how institutions are actively produced and reproduced through everyday practices and *disrupting* focuses on the practices that disrupt existing institutions when new interests are not met, contributing to forms of institutional change [25]. The framework of Lawrence and Suddaby [20] is summarized in Table 1:

Institutional work has been extensively used in IS research as a framework to analyze processes of institutionalization, institutional change, and sustainability [26, 27]. For example, Sahay et al. [28] studied the new forms of institutional work required to support

Table 1. Institutional work for creating, maintaining, and disrupting institutions

Forms of Institutional work	Types of Institutional work
Creating	Advocacy; Defining; Vesting; Constructing identities; Changing normative associations; Constructing normative networks; Mimicry; Theorizing; Educating
Maintaining	Enabling work; Policing; Deterrence; Valorizing and demonizing; Mythologizing; Embedding and Routinizing
Disrupting	Disconnecting sanctions; Disassociating moral foundations; Undermining assumptions and beliefs

the introduction of information support for achieving the reform goals of Universal Health Coverage (UHC). They argued that the systems required, such as the focus on integrated individual-level data, represented new forms of institutions such as to enable data sharing, requiring different kinds of institutional work than what existed before [29] examined the relationship between design decisions taken and intended changes in the practices of diabetes care.

In the context of digital AMR monitoring, similar to the study on UHC [28], represents the need to create new forms of institutional work, which however is inter-connected with existing manual processes and the situated context of capacities [30], infrastructures [31], workloads [32] and policy responsiveness [33]. Institutional work helps to understand how information practices need to navigate between the old and new to highlight new or redefined forms of institutional structures. *In this paper, we draw on institutional work as the framework to analyze the information practices of actors around digital AMR monitoring. We study how these practices create, maintain, and disrupt institutions to enable the use of a digital AMR monitoring system.*

3 Research Methods

This was a longitudinal study being conducted since 2019 in the northern state, Himachal Pradesh to understand the practices of different actors around digital AMR monitoring and identify the institutional work done and needed to routinize digital AMR monitoring system in a public hospital. This study was part of a larger initiative under the long-standing ongoing efforts of a national NGO called HISP India in strengthening public health information systems in India.

3.1 Research Site

This study is based in a tertiary hospital setting in Himachal Pradesh in northern India. The state has microbiology testing facilities only in 4 tertiary hospitals, of which we focused on one located in the foothills of the Himalayan Mountain ranges. The hilly geographic terrain makes access to health care services a challenge for its about 7 million citizens [34], 90% of whom are residents in rural areas. With nearly 80% + of

the population reliant on the public health system [35], the introduction of the digital monitoring of the AMR project is reflective of this proactive mindset and policies of the government. The tertiary teaching hospital is using an application to monitor the Antimicrobial Susceptibility Test (AST) results at their microbiology lab developed on an open-source platform. This hospital, typical of most public hospitals, suffers from constraints of weak diagnostics, limited capacity, manpower, and infrastructure at the hospital [32], with information on antibiotics currently invisible in the monitoring system.

3.2 Data Collection

The process of data collection was started in March 2020 to July 2021 after the implementation of the application at the microbiology lab in the hospital in November 2019. The major timelines are shown in Fig. 1

Fig. 1. Project timeline

The data collection process included a study of the practices around digital AMR monitoring at the hospital which currently uses the application to manage AST test results at the microbiology lab. This included understanding the practices of actors in the processes that are related to using the digital monitoring system starting from the arrival of the patient, the physician ordering for the AST, sample collection, sample transfer, testing at the lab, documentation, dissemination, and data use. The data collection methods are summarized in Table 2.

Semi-structured, open-ended guides were used to conduct in-depth interviews with physicians, pharmacists, microbiologists, lab technicians, and data entry operators. Questions to understand the workflow at the billing and registration departments, and sample collection unit at the hospital. Discussions were held with staff at the microbiology lab to better understand how information around antibiotics was represented in the AST sample recording, testing processes, data collection, analysis, and use. Discussions were also held with the principal of the hospital to understand the antibiotic policies, guidelines, and the hospital's visions to tackle AMR. Policy documents, both national, state-specific, and hospital-specific were important secondary sources to understand the gap between policy and practice observed, for example, the process of prescription audit as suggested by the state vs how it is done at the hospital. A workshop was held in July 2021 to discuss the implementation process, issues faced by the stakeholders, and to identify the approach to address them.

3.3 Data Analysis

Data analysis was conducted in multiple sequential steps, described below.

Table 2. Data collection methods

Data collection methods	Details
Interviews	Staff at registration and billing counter – 2; Staff at sample collection unit responsible for collection and transfer – 2; Physicians – 7; Pharmacists – 4;10; Microbiologists – 5; Lab technicians- 3; Data entry operator (DEO) at the lab – 1; Principal of Hospital
Observations	Physicians while prescribing; pharmacists while dispensing; DEO while entering data in the application; data management process at microbiology lab; billing and sample collection processes
Discussions	With physicians, microbiologists, staff at the microbiology department, and Principal
Study of policies and documents	National/State-specific policies and guidelines
AMR monitoring application design and development	Engaged in the design, development, and implementation of the AMR monitoring system
Workshop	Microbiologists, hospital management, and microbiologists from the 2 other public hospitals in the state

Step 1: Data collation and organization*:** All data collected including interview notes, observations, and study of documents studied were organized and collated to facilitate analysis. ***Step 2: Transcriptions: All primary data was transcribed and translated from Hindi to English wherever needed, and digitized. ***Step 3: Thematic analysis***: First, responses were grouped by different stakeholders, and practices, were identified around AMR monitoring. ***Step 4: Identification of the institutional work done by actors:*** The day-to-day work of the stakeholders was analyzed to identify the creating, maintaining, and disrupting work done. ***Step 5: Identification of the work needed to routinize digital AMR monitoring:*** Based on the analysis, we identify the work needed to routinize the information practices that support digital AMR monitoring.

4 Case Study

In this section, we describe the information flow in the facility around antimicrobial susceptibility testing (AST). It is a test done at the microbiology lab that provides information about the resistance profile after registration of the patient, consultation, sample collection, etc. The information flows around the AST process are presented in Fig. 2, starting soon after the patient visits either OPD, IPD, or Emergency Departments. Patient registration is the first step at the hospital. Post-registration, the patient consults the physician, or the physician visits the patient in case he/she is admitted at the IPD.

Doctor orders drugs or an AST. This is followed by sample collection, testing at the lab, documentation of results in the register, sharing of results with the patient/attendant.

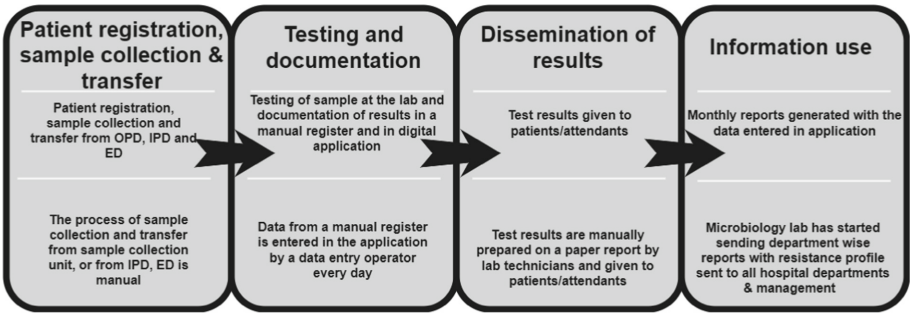


Fig. 2. Information flow around AMR monitoring

The process of data entry by the data entry operator (DEO) takes place with details transferred from the register to the digital application. The data entered in the application is aggregated and the dashboard is updated with the latest resistance figures. Figure 3 shows a section of the data entry application and the dashboard updated automatically based on the data entered daily.

Identifying Information Practices

We identified four key sets of practices to comprise digital AMR monitoring in the hospital: i) patient registration and sample collection at OPD, IPD, and Emergency (EPD); ii) testing of samples at the Microbiology laboratory and the documentation of test results (manual and digital); iii) sharing of test results by the lab to the doctor requesting the test and also to the patients; and, iv) the use of data for providing clinical care to the patients, and for other administrative purposes of reporting. These practices are described below:

4.1 Practice of Sample Collection, Indexing, and Transfer to Microbiology Lab

Upon arrival at the hospital, the patient goes to the registration counter in the main hospital building. The demographic details of the patient and the name of consulting physician are entered into a computerized hospital information system. The patient is given a unique hospital/patient ID that is printed on the Registration form given to the patient. Carrying this slip, the patient then goes to the respective department for consultation with the physician who makes inquiries about the patient's symptoms, orders the sample testing, and maybe prescribes medicines. An AST is generally ordered by the physician only if the patient presents severe symptoms, as described by a physician at the OPD:

> *An AST is generally prescribed to patients who come with severe symptoms/infections. Some of these patients have consulted many physicians earlier so a*

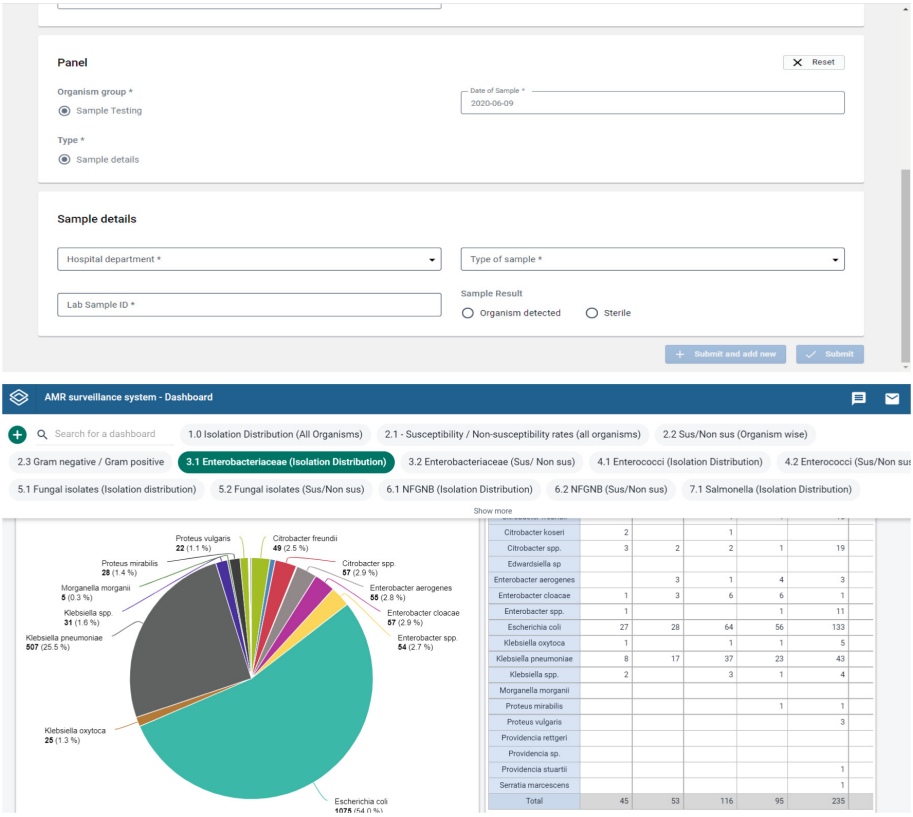


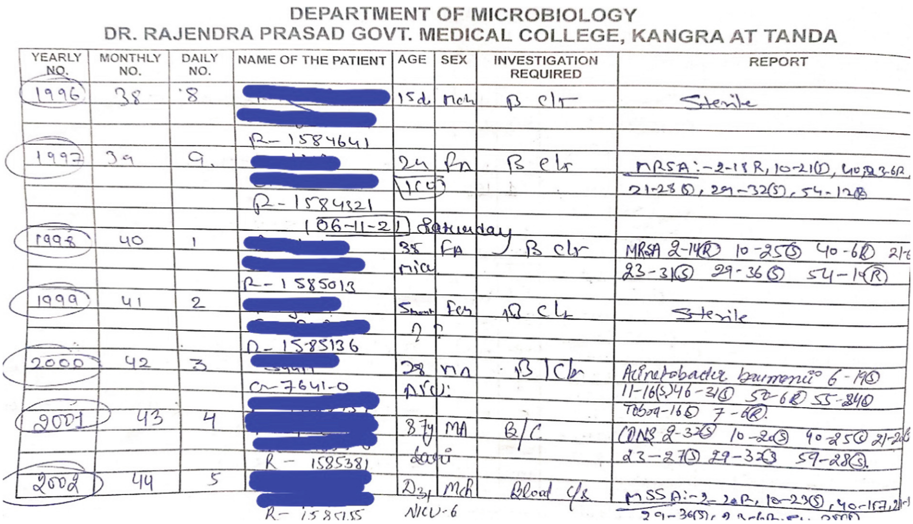
Fig. 3. AMR monitoring system (A snapshot of data entry application and dummy dashboard)

broad-spectrum antibiotic is prescribed, and an AST is ordered. These patients with severe infections are in many cases admitted to the hospital for further treatment.

Some patients come with severe infections, and they need to be admitted to the hospital and an AST is ordered for them. Antibiotics are prescribed to the patient till the time the resistance profile of the patient is received.

The patient comes back to the registration counter to pay for the test after consultation and if an AST is prescribed. He gets an invoice with the test details that he takes to the sample collection unit with him. This process takes place in the wards and the emergency departments for inpatients in the hospital. At the sample collection unit, each sample is given a unique code based on the type of sample and the lab it is to be sent to. For example, a sample sent to the microbiology lab has a code for the lab, the patient's Lab ID, and the sample name. The microbiology as separate registers for different sample types, such as blood and urine. The lab technicians at the Microbiology lab often complain about the quality of data and the sample details received from the sample collection unit from the different departments in the "requisition form" accompanied with all the samples. However, other details like the department where the patient is admitted, his/her

diagnosis, and other related fields are often blank because of which the Microbiology lab has incomplete details of the patient and the sample. The manual register with the data entry fields and an incomplete requisition form can be seen in Fig. 4 and Fig. 5.


DEPARTMENT OF MICROBIOLOGY
DR. RAJENDRA PRASAD GOVT. MEDICAL COLLEGE, KANGRA AT TANDA

YEARLY NO.	MONTHLY NO.	DAILY NO.	NAME OF THE PATIENT	AGE	SEX	INVESTIGATION REQUIRED	REPORT
1996	38	8	[redacted] R-1584641	15d	Mch	B clr	Sterile
1997	39	9	[redacted] R-1584321	24 ICU	Fm	B clr	MRSA:-2-18R, 10-21(S), 40-23-6R, 21-28(S), 29-32(S), 54-12(R)
			(06-11-21) Saturday				
1998	40	1	[redacted] R-1585013	35 mic	FA	B clr	MRSA 2-14(R) 10-25(S) 40-6(R) 21-... 23-31(S) 29-36(S) 54-14(R)
1999	41	2	[redacted] R-1585136	Short ?	Fen ?	B cL	Sterile
2000	42	3	[redacted] CR-7641-0	28 ARU	MA	B Clr	Acinetobacter baumannii 6-14(R) 11-16(S) 46-31(S) 52-6(R) 55-24(R) Tob 29-16(S) 7-6(R)
2001	43	4	[redacted] R-1585381	87y	MA	B/C	CONS 2-32(S) 10-26(S) 40-25(S) 21-26 23-27(S) 29-32(S) 59-28(S)
2002	44	5	[redacted] R-1585155	D3 NICU-6	Mch	Blood c/s	MSSA:-2-26R, 10-23(S), 40-15... 29-36(S) ...

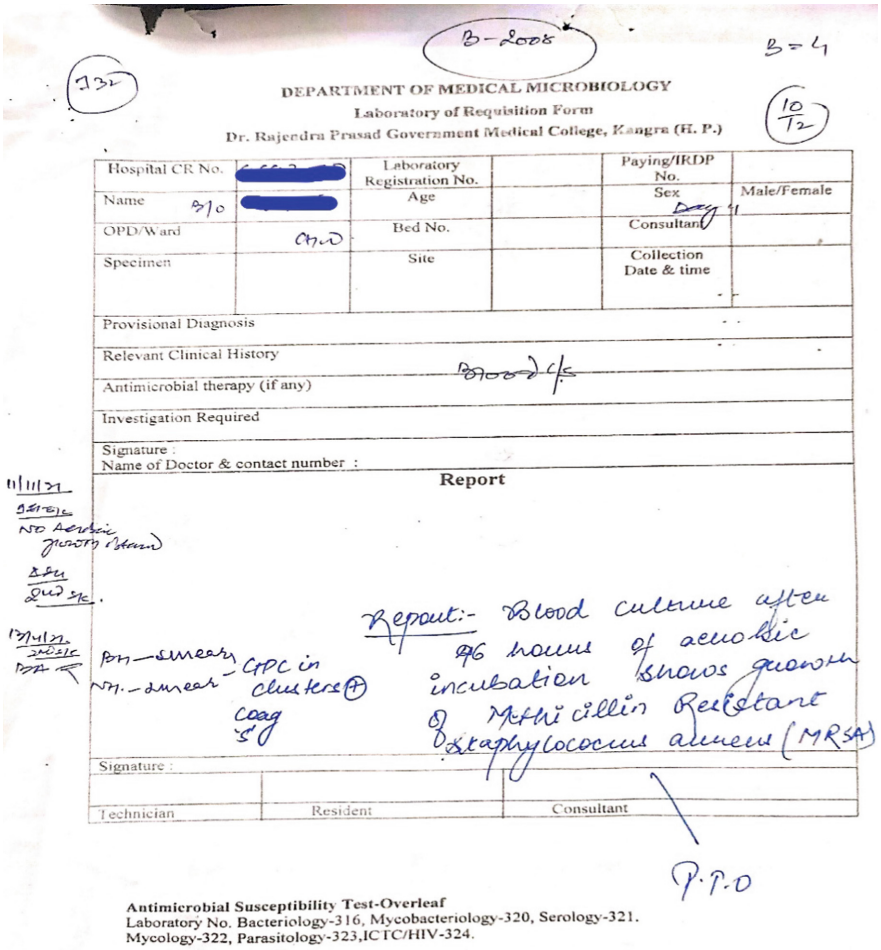
Fig. 4. Register for data entry at microbiology lab (incomplete information maintained and sometimes illegible)

An analysis of monthly data revealed that even the patient's identifiers like patient's CR number and age are missing from 2% records and crucial details to see department wise resistance pattern like the name of hospital department and location are missing from around 35% records. To promote data quality, a full-time resource is hired who checks the manual as well as digital data quality and reports to the in-charge microbiologist. A data quality report with details of missing fields in a month is shown in Table 3:

4.2 The Practice of AST Testing and Documentation of Results

The testing of the samples starts after they are received at the lab and the details are noted in the register by Lab technicians. The testing starts the same day the samples are received, and the process was explained by one of the lab assistants:

> *Once we receive samples at the lab, a standardized technique is followed for AST testing. The samples are put on a culture medium on Agar. These agar plates are then inoculated overnight. During the night, the organisms grow on the agar place inoculated with test organism and filter paper disc with a specific concentration of antibiotics. The growth is then checked for resistance patterns on the next day. There are specific incubation time ranges for the bacterial colonies as specified by the Clinical and Laboratory Standards Institute (CLSI) which is followed to identify the susceptibility and resistance.*



DEPARTMENT OF MEDICAL MICROBIOLOGY
Laboratory of Requisition Form
Dr. Rajendra Prasad Government Medical College, Kangra (H. P.)

Hospital CR No.		Laboratory Registration No.		Paying/IRDP No.	
Name		Age		Sex	Male/Female
OPD/Ward		Bed No.		Consultant	
Specimen		Site		Collection Date & time	

Provisional Diagnosis
Relevant Clinical History
Antimicrobial therapy (if any)
Investigation Required
Signature :
Name of Doctor & contact number :

Report

Report:- Blood culture after 96 hours of aerobic incubation shows growth of Methicillin Resistant Staphylococcus aureus (MRSA)

Signature :

Technician	Resident	Consultant

P.T.O

Antimicrobial Susceptibility Test-Overleaf
Laboratory No. Bacteriology-316, Mycobacteriology-320, Serology-321.
Mycology-322, Parasitology-323,ICTC/HIV-324.

Fig. 5. Requisition form received at the lab with each sample (Incomplete and sometimes illegible)

Once testing is done, the test results are entered on a test result form with the details of the susceptibility and resistance patterns with specific antibiotics. Lab technicians also enter these test results in the register where they entered patient and sample details on the receipt. Once the documentation of the test results is completed in both the test result sheet and the register, the results are ready to be shared with the patients and/or the indenting physician.

The data entered in the registers by 2 PM is entered in the application by a DEO who comes to the microbiology lab for a couple of hours every day. The microbiology department had a manpower crunch, so a DEO was assigned by the hospital administration to enter all data from the registers to the application after he gets free from the Registration Desk, which is his primary appointment. A desktop with an internet connection has been set up on a table in the microbiology lab next to a table where the registers are kept. The DEO has no experience working in the Microbiology department and is new to the

Table 3. Record of missing fields in a month

	Blood register		Urine register		General register		Overall %
Data fields missing/incorrect	Number	%	Number	%	Number	%	
Hospital department	68	25	105	21	260	52	34
Location	50	18	95	19	258	51	32
Computer registration number	1	0.4	0	0	0	0	0.1
Age	1	0.4	9	1.8	1	0.2	0.9
Wrong computer registration number	10	3.7	14	2.8	0	0	1.9
Total number of records	273		501		502		

terms used, and often needs to take help in understanding them from the lab assistants. The DEO told us:

> *I come to Microbiology Department every day after getting free from the Registration Desk. I pick up registers for one sample type at a time, copy and enter the details written in the application. Earlier, I did not understand the terms used in the register and asked the lab assistant for their help. Now, I need less help after entering data for more than one year.*

Some problems have been experienced with the regularity of the DEO work since no dedicated staff could be hired for the same. The DEO was mandated by the hospital principal to come to the lab once he was free from his work at the registration desk in the afternoon. Since the DEO is unaware of the terminology and codes used, he takes help from the lab assistants, who sometimes are not free to answer the queries leading to delays or even incorrect information being entered. To help the DEO, the lab has prepared a sheet with codes and names of the antibiotics, which has been pasted on the wall next to his desk shown in Fig. 6.

Post data entry, the lab staff generates the test results and required reports. All patient details added to the application are aggregated and automated data analysis is done by the monitoring application, providing details of Isolation numbers, rates, resistance profiles, sample type, and location type of the patients i.e., OPD, IPD, ICU, etc.

4.3 Practice of Sharing Test Results

Test results are ready to be shared on the third day after the sample had been submitted to the lab. The lab assistant documents the test results in the lab register and on the test result form, after which it is approved and signed by the doctors at the Microbiology lab. Test results are shared once the resulting form is approved and signed by the resident doctor. Outpatients or their attendants come to the lab, show the form/receipt received from the

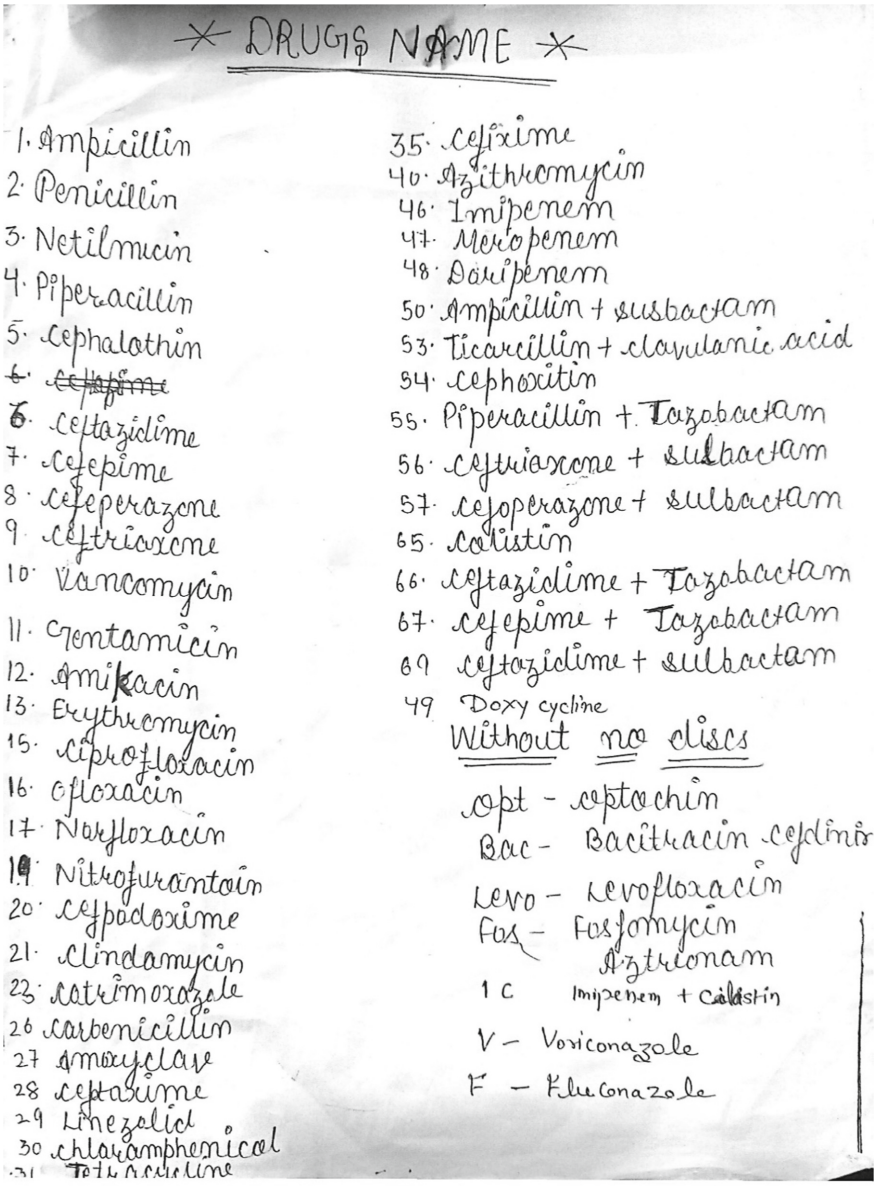


Fig. 6. Antibiotics with codes for DEO (These are written by a lab technician and given to DEO)

registration counter that has the Patient's ID, and get the test results. The attendants of the Inpatients come with the patient's form to collect the test results. These results are added to the patient's file with all the other details. The treating physician has access to the test results via the patient. In the case of Outpatients, the patients visit the physician again with their test results. Based on the AST test results, the physician gives/modifies

the antibiotic or line of treatment. In the case of Inpatients, the test results are added to the patient's file once they are collected by the patient's attendant. Physicians look at the test results when they come for daily rounds and take necessary actions such as modifying the line of treatment, or the antibiotics given earlier. A department-wise monthly aggregated report generated by the data quality analyst at the hospital is sent to each department to promote evidence-based prescription of antibiotics.

4.4 Practice of Information Use

A bi-monthly report with details of the isolation patterns of organism groups and some specific organisms, their resistance profiles based on the sample type received, and the antibiotics are prepared by the Microbiology department. The AMR in charge of the department who is a senior consultant with help of resident doctors and post-graduate students prepares this report. This report was earlier prepared manually based on the patient data entered in registers every day. The AMR monitoring application has helped the department to prepare its reports easily. The case-based data entered in the application is aggregated automatically and presented on the dashboards, prepared based on the reporting requirements of the Microbiology Department. A sample dashboard is given in Fig. 7 below.

Department - Other departments											
Sample - Urine (Attribute)											
Escherichia coli											
S.No	Most Resistant/Sensitive	Antibiotics Name	OPD	ICU	NICU	Ward	CCU	Burn Unit	PICU	Unknown	Total
1	Most Resistant	Cefazolin				20					20
2	Most Resistant	Trimethoprim/Sulfamethoxazole				15					15
3	Most Resistant	Norfloxacin				13					13
1	Most Sensitive	Fosfomycin				27					27
2	Most Sensitive	Nitrofurantoin				25					25
3	Most Sensitive	Trimethoprim/Sulfamethoxazole				14					14

Fig. 7. A sample of data analysis done using the digital AMR monitoring application

The consultant in charge of AMR at the hospital mentioned:

It took a week to prepare the bi-monthly report with the data from registers. The data was aggregated manually by the post-graduate student who helped in making reports and putting them in formats we have the share the report in. With the AMR monitoring application, it takes lesser time to prepare the reports. We need to go and print the individual report and pin them together and share them with the Hospital Management. However, it would be easier to get a summary report from the application that can fit on 2–3 pages and would be easier for the management to comprehend as the current report has around 50 pages. It is difficult to get a full picture of the AMR with several segregated reports.

A monthly report prepared by the Microbiology department is shared with the hospital management and a copy of the report is sent to the state secretariat. This information is currently not actively utilized by the hospital to potentially inform them of the resistance profile of the hospital and prepare an infection control and hospital antibiotics

policy. All departments in the hospital receive an aggregated report about the resistance profiles of the patients in their department. However, because of data quality challenges, the report cannot present an accurate picture right now. The reports are currently not shared with the Infection Control Committee at the hospital or the state authorities who are responsible for designing interventions to mitigate the threat of infections.

5 Case analysis and Discussion

5.1 Institutional Work Done

In this section, we discuss information practices within an institutional work framework to understand how these practices lead to *creating*, *maintaining*, and *disrupting* institutions.

In the early phases of this process of implementation of the digital system, the practices of sample collection and testing have not been in focus, but potentially can be with the expanding of the scope of digitization. A summary of the institutional work done by actors that are affected by the introduction of digital AMR monitoring is summarized in Table 4.

Table 4. Institutional work done by the stakeholders

Information practices	Creating	Maintaining	Disrupting
Documentation (Manual and Digital) of test results at the microbiology Lab	**(Defining)** Allocating responsibility to DEO **(Mimicry)** Data entry app interface similar to manual register **(Educating)** the DEO and microbiology team to generate reports	**(Deterring)** Authoritative measures to deal with the resistance of the DEO to come to the lab for data entry **(Routinizing)** Making the process of data entry easier for DEO by providing him a sheet with a list of antibiotics codes	**(Disassociating moral foundations)** Provision of daily reports as a motivation to use the application
Information Use by Microbiology Department/Hospital departments/management	**(Educating)** development of automated reports based on the microbiology team to generate reports in their required formats	**(Routinizing)** The hiring of a new resource to enhance the data quality, active contact through weekly calls **(Policing)** Regular audit and monitoring of the quality **(Valorizing)** Recognition of the work done by the microbiology lab at the workshop	

In the information practice of **sample collection, indexing, and its transfer from OPDs, IPDs, and ED,** there was ***maintaining or enabling work*** taking place of the existing manual work before the digital intervention was initiated. Similar was the case with the practices around the testing practice, which largely remained untouched.

Within the practice of **documentation (manual and digital) of test results at the microbiology lab,** there was ***creating*** work done by ***defining*** roles and allocation of

responsibilities for the DEO at the microbiology lab to initiate data entry work. The technical team was engaged with ***educating*** him regularly to carry out the task of data entry seamlessly, which was designed with ***mimicry*** as a guideline by designing the data entry screens like the manual registers. ***Maintaining*** work was done through authoritative measures of ***deterring*** the DEO from not coming for work every day. ***Routinizing*** of the practice was done through providing job aids such as sticking a sheet with antibiotic codes and names on the wall next to DEO's desk. ***Disrupting*** work included ***disassociating moral foundations*** by replacing the DEO by hiring a new operator directly by the technical team to have greater control over his everyday work. This strengthened the motivation of the microbiologists to use the digital application. The manual work of entering the test results in the registers continued as before in parallel.

While the practice of **sharing test results with patients and physicians** is currently carried out as before, a new potential is being created to do so. This would represent a disruption of existing practices where these results currently don't return to patients, and not always to the physicians. Within the practice of **information used by the microbiology department, hospital departments, and management,** ***creating*** work is being done by the technical team through ***educating*** the microbiology team who have now started to demand new reports. ***Maintaining*** work was done by the technical team keeping regular contact with the microbiology team through WhatsApp and weekly calls that helped in faster resolution of issues encountered. ***Disrupting*** work was through the new data entry operator who initiated a new practice of checking the quality of the digital data by identifying the missing fields in the indent form, such as the name of antibiotics prescribed or the patient diagnosis. **Disassociation of moral boundaries is taking place** is taking place with the data quality gaps being made visible to the microbiologists, something which was invisible earlier. ***Maintaining*** work by ***routinizing*** this practice was done by keeping daily data quality checks on the data entry done by DEO. The microbiology staff was continuously motivated by ***valorizing*** and recognizing the work done with their contribution to the development of the digital application for AMR monitoring, exemplified by the presentation made by the microbiologists in a workshop where they proudly described their achievements to other nearby hospitals, who were also motivated to introduce a similar application in their labs.

5.2 Institutional Work Needed to Routinize Digital AMR Monitoring

Advocacy and ***defining*** of budgets, resources & responsibilities to establish the practice of using the digital AMR monitoring application. As the system expands and more data needs to be entered, the data entry support needs to be necessarily strengthened. Furthermore, the data entry person can play an enhanced role in not only doing data entry but in improving data quality and expanding the circulation of data within the hospital. ***Enabling work, defining*** rules, and regular ***policing*** to legitimize the technology in the norms and belief system of the stakeholders. New systems need to be developed to extend the technology beyond the microbiology lab such as in the sample collection unit etc. by improving the process of sample indexing and transfer and improving coordination between the sample collection and testing functions [36]. ***Disassociating moral foundations*** to institutionalize the use of the digital system and the reports by the physicians

to make treatment plans for patients, the state, and hospital management to make policy decisions to fight AMR.

In summary, we have described institutional work to enable practices of data entry and information use, which are fundamental to the operations of the digital AMR monitoring application. While some of the measures can be seen to support existing work currently touched by the digital intervention, others are needed to enable the expansion of the interventions in terms of other facilities and the functionalities of the applications.

6 Conclusion

The paper has emphasized the important responsibility of IS research to engage with the expanding and urgent challenge of AMR facing the world, particularly in the context of LMICs. A key role of IS research is in guiding the implementation of AMR digital interventions, drawing upon learnings from other implementation studies, but adapting and expanding to the specific context of AMR in public settings in an LMIC context. Key learning which we have drawn upon is the practice-based approach, which we have supplemented with an understanding of how these contribute to the construction of institutional work.

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