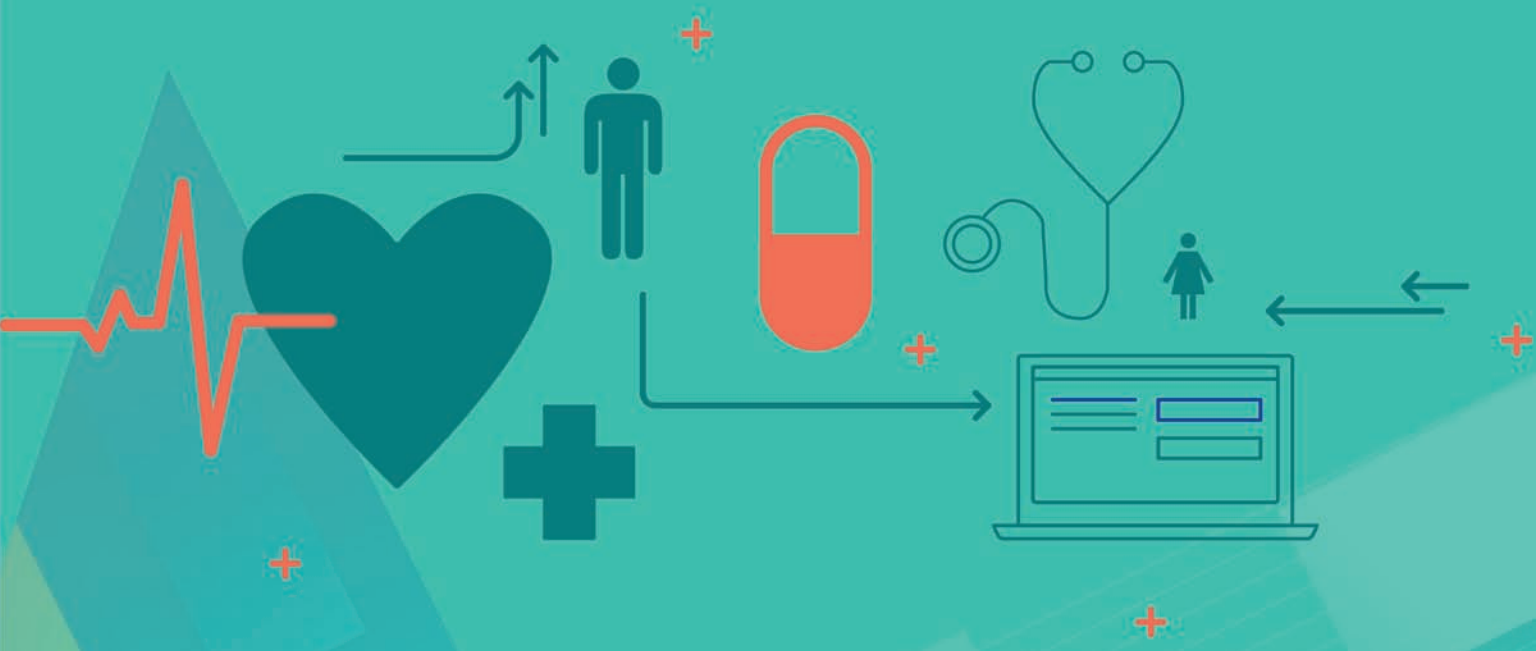
INTEGRATED DISEASE SURVEILLANCE PROGRAM (IDSP) IN BIHAR

A critical review of the program and assessment of knowledge, awareness and practice among key functionaries



INTEGRATED DISEASE SURVEILLANCE PROGRAM (IDSP) IN BIHAR

A critical review of the program and assessment of knowledge, awareness and practice among key functionaries

Centre for Health Policy, Asian Development Research Institute

Asian Development Research Institute (ADRI)

The Asian Development Research Institute (ADRI), a non-profit civil society organization, was established in 1991 as an academic institute in Patna to conduct research in social science. The scope of research expanded over the years and it now covers diverse disciplines, such as economics, sociology, history, statistics, environment, health, education, public administration, management and information science. Apart from conducting several researches on critical development issues, the Institute had significantly contributed to the field of rural development, human resource development, regional economics and public finance. ADRI society completed its wonderful journey of 25 years and celebrated its Silver Jubilee Celebrations during 2016-17, by organising three important International seminars: Growth & Development- Theories and Experiences (March, 2016), Social Statistics in India (June, 2016) and Bihar & Jharkhand: Shared history to Shared Vision (March, 2017). The operational activities of ADRI society are carried out mainly by its six divisions: ADRI (oldest and core), Centre for Economic Policy & Public Finance (CEPPF), Centre for Health Policy (CHP), Centre for Studies on Environment & Climate (CSEC) and Jan Shikshan Sansthan (JSS). The society is run by Board of Director, having 11 members.

The Centre for Health Policy (CHP)

The Centre for Health Policy (CHP) at the Asian Development Research Institute (ADRI) was established in 2017 as a policy think tank to support evidence-based policy decision by the Government of Bihar, in health and nutrition domains. This initiative is financially supported by the Bill and Melinda Gates Foundation (BMGF). The research committee of the Centre consists of renowned economist, demographer, epidemiologist and public health experts. The professionals at the Centre design analytical framework for the benefit of policy practitioners in the state. Initially, the primary objective was to bring clarity and information on ongoing health care programmes through quality research on global best practices and existing state-specific data to ensure that the government policies were implemented effectively. Subsequently, the role of think tank expanded to incorporate findings from primary research for supporting context-specific policy-decisions. Over the years, the think tank has conducted extensive research in various fields, ranging from demographic profiling, population projections, maternal and child health, reproductive health, infectious diseases, finance and mental health. Research findings have been disseminated through several ways which include briefing to senior-level functionaries, organizing workshops/lectures and conferences involving stakeholders and senior officials of the state health department.

This manual is prepared by the Centre for Health Policy (CHP) at the Asian Development Research Institute (ADRI). This research work is intended to strengthen the epidemic preparedness and outbreak response in the state through a comprehensive review of the ongoing Integrated Disease Surveillance Program (IDSP) and response systems in Bihar. The Bill and Melinda Gates (BMGF) funded this research work.

The Centre for Health Policy
Asian Development Research Institute
BSIDC Colony, Off Boring-Patliputra Road
Patna-800013
Phone: +91-612-2575649 | Fax: +91-612-2577102
Email: chp@adriindia.org | Web: www.adriindia.org

प्रत्यय अमृत, भा.प्र.से.
अपर मुख्य सचिव
Pratyaya Amrit, I.A.S.
Additional Chief Secretary

बिहार सरकार
स्वास्थ्य विभाग
विकास भवन, पटना-800015
GOVERNMENT OF BIHAR
HEALTH DEPARTMENT
VIKASH BHAWAN, PATNA - 800015
TEL : 0612-2215809 / FAX : 0612-2217608
E-mail : health-bih@nic.in

पत्रांक.....

दिनांक.....

FOREWORD

A well-functioning surveillance system is instrumental in providing necessary information for evidence-based decision making to improve public health practice. Priority setting, resource allocation, planning and implementation rely on accurate surveillance data. The Integrated Disease Surveillance Strategy was adopted to strengthen all surveillance activities for effective control of communicable disease at the national level in 2004. Later, the Integrated Disease Surveillance Program (IDSP) was established in Bihar in 2009 to leverage scarce resources to continuously improve epidemic preparedness and management when outbreaks strike.

It's my pleasure to share the findings of a research work on IDSP conducted by the Center for Health Policy (CHP) at the Asian Development Research Organization (ADRI). This research attempts to review the core activities and support functions under IDSP in Bihar. Further, knowledge, awareness and practices related to routine surveillance activities and outbreak response among key IDSP functionaries have also been reviewed. Findings from this assessment will be valuable to strengthen the surveillance effort and guide IDSP implementation process, not only in Bihar but in other States with similar settings.

I sincerely hope that recommendations will guide the policy-makers to improve program performance by addressing some of the identified gaps and missing strategies.

(Pratyaya Amrit)

Sanjay Kumar Singh, IAS
Executive Director

Message

Integrated Disease Surveillance Program (IDSP) is one of the largest infectious disease control programme running in Bihar since 2009. The primary objective of the programme is to detect and respond to outbreaks of epidemic-prone diseases in the state. In order to achieve that goal, continuous monitoring and evaluation of the program are essential. Further, the practice of mandatory real-time reporting of a suspected case of a communicable disease followed by its confirmation through laboratory tests and thereafter, informing the key health officials for immediate intervention are necessary for IDSP success.

The Center for Health Policy (CHP), Asian Development Research Institute (ADRI)has recently conducted an extensive research to evaluate the progress of the existing IDSP during last 10 years in Bihar. In addition, information was also gathered from key IDSP functionaries for assessment of their knowledge, awareness and practice regarding disease surveillance and outbreak response. This book presents the findings of research and it is intended to guide policy makers in identifying certain areas for intervention that will improve the program performance.

I sincerely hope that health personnel and decision makers would find the results of this research work useful to not just improve IDSP but to strengthen the overall epidemic preparedness of the state.

Yours sincerely

(Sanjay Kumar Singh)

Keshvendra Kumar, IAS
Additional Executive Director

Foreword

The most effective epidemiological tool for control and prevention of communicable diseases in resource-limited settings is the public health surveillance. Real-time surveillance data help to estimate the current disease burden, to monitor trend and to identify early outbreaks. Further, it can be used effectively to determine the need for any intervention, impact of such interventions and progress towards disease elimination. As part of early attempts to improve epidemic preparedness and outbreak response, the Government of Bihar launched the Integrated Disease Surveillance Program (IDSP) in 2009. Although some notable work in surveillance has been accomplished through IDSP in the state, these efforts are typically siloed and remain limited in scale.

A comprehensive research was undertaken by the Center for Health Policy (CHP) at the Asian Development Research Institute (ADRI) to have a deeper understanding of the existing core and support functions under IDSP. In addition, this initiative also documents knowledge and practices related to disease surveillance among key IDSP functionaries and identifies key implementation barriers. I believe these findings are critical and will be instrumental for strategic planning by decision makers to establish achievable goals and objectives under IDSP in Bihar, which will enhance the overall program performance.

Yours Sincerely

(Keshvendra Kumar)

कौशल किशोर भा.प्र.से,
अपर सचिव

Kaushal Kishore, I.A.S
Additional Secretary

बिहार सरकार

बिहार सरकार
स्वास्थ्य विभाग
विकास भवन, पटना 800 015
GOVERNMENT OF BIHAR
HEALTH DEPARTMENT
VIKASH BHAWAN, PATNA 800 015
(0612) 2215334 Mob : 9470003940
E-mail : js.health@bihar.gov.in

पत्रांक.....

दिनांक.....

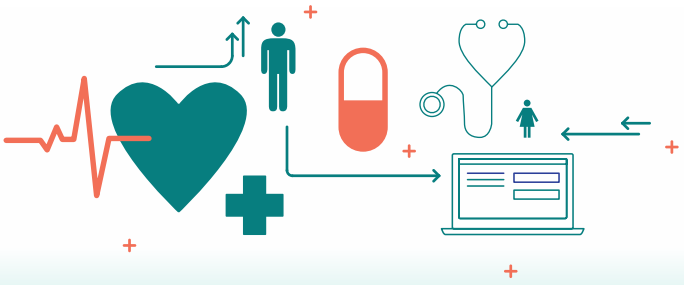
FOREWORD

It is a basic premise that all Public Health initiatives tailored to keep infectious diseases under control need robust surveillance systems that provide timely useful evidence. The primary objectives of a surveillance system are to detect disease outbreaks and to take prompt actions. Such surveillance data is essential to have a better understanding of diseases and their spread and to design appropriate prevention, containment and control measures. The Integrated Disease Surveillance Program (IDSP) was launched in Bihar to improve disease surveillance and outbreak response. Despite improvements in IDSP performance over the years, further progress needed identification of existing bottlenecks and probable solutions through quality research.

The Center for Health Policy (CHP) at the Asian Development Research Institute (ADRI) has conducted an extensive research on IDSP in Bihar focused on overview of IDSP performance, knowledge and practices of key IDSP functionaries with regard to disease surveillance and identifying critical gaps in the program. I believe this work contributes to a deeper understanding of contextual barriers that can be used to identify which strategy would best address the challenges. This baseline document on IDSP will provide guidance to policy-makers to improve planning and management decisions for better control of infectious diseases in the state.

5/7/11

(Kaushal Kishore)

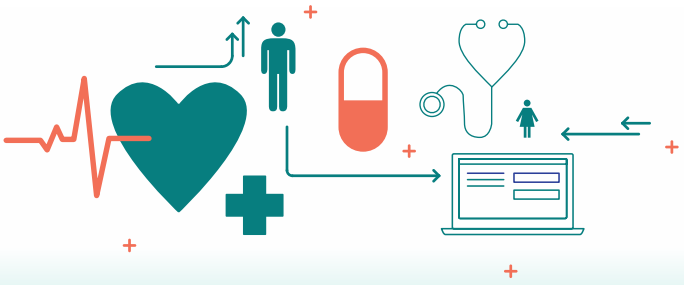


CONTENTS

List of Figures & Boxes

List of Tables

ANM (Chapter 4)



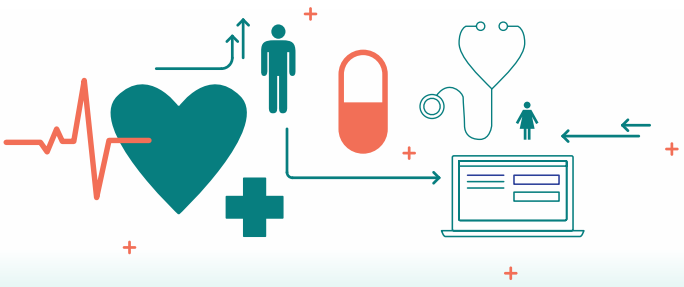
ACKNOWLEDGEMENTS

First and foremost, Centre for Health Policy (CHP) at the Asian Development Research Institute (ADRI) would like to take this opportunity to express gratitude to Shree Pratyaya Amrit and Shree Sanjay Kumar, both leading the Department of Health in recent years. We also like to extend our thanks to Shree Kaushal Kishore, Department of Health for his support. Additionally, we also record our thanks to many senior officials at the State Health Society, Bihar - Shree Lokesh Kumar Singh, Shree Manoj Kumar, Shree Sanjay Kumar Singh and Shree Keshvendra Kumar. From the state IDSP cell, we have also received substantial support from - Dr. Ranjeet Kumar, Dr. Ragini Mishra, Late Shree Kumar Kaustubh, Dr. Sweta Singh and Shreemati Sarita Prasad. We are grateful to the Bill and Melinda Gates Foundation (BMGF) for their continued support for this project on IDSP strengthening in the state.

We are also grateful to Civil Surgeons, ACMO-Cum-DSO, IDSP of Begusarai, Bhojpur and Darbhanga, Bihar and all IDSP officials of these three districts for providing necessary support. We also extend our sincere gratitude to the Principal and Superintendent, District Medical College and Hospital, Deputy Superintendent, District Hospital & Sub-Divisional Hospital, District Programme Manager, all Medical Officer-In charge, Medical Officers, Block Health Managers, Block Monitoring and Evaluation Officers and Block Community Mobilisers in these three districts for their support.

We are also glad to extend our thanks and gratitude to our Field Investigators in Begusarai, Darbhanga and Bhojpur for their contribution in data collection. This research would have never been possible without their support and continuous hard work. We would also like to acknowledge all our participants for their time and significant contributions in this research project.

We sincerely hope that this manual, based as it is on extensive research, will prove to be a valuable handbook for IDSP functionaries in Bihar.



EXECUTIVE SUMMARY

The burden of communicable diseases is still a sizeable and pressing problem in India. The best way to tackle is through an efficient integrated surveillance system, especially in less developed states. Bihar, one of the poorest states in the country, continues to experience frequent disease outbreaks related to acute diarrheal diseases, vaccine-preventable and vector-borne diseases and acute respiratory infections. The Integrated Disease Surveillance Program (IDSP) was implemented in 2009 as a comprehensive strategy to improve disease surveillance and response in the state. Although the IDSP performance in Bihar showed marked improvements since its inception but significant challenges still remained. Hence, to make an evidence-based argument to improve the performance of IDSP, good quality epidemiological research was needed. Furthermore, quantitative study related to knowledge and practice of key players under IDSP as well as in-depth qualitative deep dives exploring their views and perceived implementation barriers appeared essential for designing an effective disease surveillance strategy for Bihar. Given paucity of evidence, this research project identified gaps in the existing control program for infectious diseases, the Integrated Disease Surveillance Program (IDSP) in Bihar, one of the worst-affected states, so that lessons learnt could close evidence-practice gaps for its successful implementation.

Based on recommended IDSP performance score categories, one poor, average and good performing district (3 in total) were randomly chosen. A cross-sectional survey followed by in-depth interview based qualitative deep-dive were conducted among all consenting key service providers in IDSP- 253 physicians, 241 Auxiliary-Nurse-Midwives (ANMs), 62 lab technicians and 15 stakeholders during January-April, 2019. Information gathered included epidemic preparedness, outbreak response, their knowledge regarding surveillance activities, practices and barriers to IDSP implementation through an offline-online synchronized data collection application. All descriptive and regression analyses were performed using SAS version 9.4. In-depth interviews were conducted among consenting ANMs, physicians, lab technicians and stakeholders to gain specific insights into

the role and responsibilities during surveillance activities and outbreak investigation, motivation, job-related stress and barriers to successful IDSP implementation. Grounded theory principles were applied to inductively analyze the audio taped transcripts for extracting major themes and sub-themes. ATLAS. ti 8 software package was used for data storage, coding and analysis.

The findings revealed some system and individual level gaps in the current IDSP which were summarized below.

Overall there was either an absence or lack of standardization and implementation of mandates, protocol, guidelines and standard operating procedure, human resources, training, supervision and feedback. System-level preparedness was observed only in 22% health sub-centers (HSC) and outbreak preparedness in 33% of public health facilities at the block level. Approximately 9% HSCs were satisfactorily organized. About 17% block-level public health facilities showed good system readiness. However, facilities with better system readiness was strongly associated with better practices related to surveillance activities.

Of 62 surveyed public health labs, only 24% labs had good procedural and documentational readiness. Good overall cleanliness/condition of the incubator/freezers/microscopes/autoclave/ ELISA reader was observed in 31%. In about 34%, SOP or any recommended good practices were followed. Only 10% reported availability of consumables for culture. None had the ability to confirm Cholera, Shigellosis, Leptospirosis, Meningococcal meningitis, Japanese encephalitis, Diphtheria, Measles. Approximately, 40% had internal quality control, 23% reported bio-safety & bio-medical waste management process, 45% sent specimen to the referral lab for confirmation, only 18% had adequate supplies for collection of specimens during an emergency. A documented list of referral labs observed in 32%. Availability of consumables was found in 10% of the laboratories. None reported giving vaccination to the staff.

An estimated 83% of total 241 ANMs lived outside the catchment area. Only 23% received formal training on IDSP, 37% reported that their work was not monitored, 44% had poor IDSP related knowledge (mean knowledge score 4.4 out of 10) and IDSP related practice was also poor among 44% (mean practice score 14.4 out of 20). Although better knowledge was a strong predictor of better practice but the current training contributed to neither knowledge nor practice. Qualitative analyses revealed that majority of the respondents were not clear about their specific role and responsibilities under IDSP. Other job-related challenges identified included insufficient training, hostile working environment, difficulties in regular commute, inadequate compensation and lack of basic facilities at the sub-center.

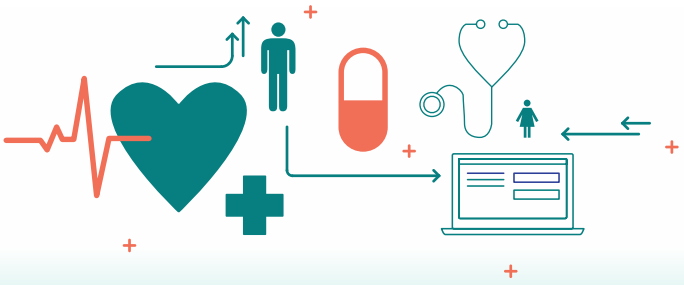
Of total 253 physicians interviewed, 64% hold a MBBS degree and 55% were contractual. Approximately, 86% had incorrect knowledge regarding disease surveillance, 42% knew the objectives of IDSP, 27% had good knowledge about diagnostic methods, 23% for case definition, 25% regarding outbreak and 25% overall knowledge related to IDSP in general. Good awareness regarding outbreak investigation was found among 17% respondents. Good IDSP related practice was observed among 25%. Only 19% regularly participated in analysis and interpretation while 57% never did so. Near about 78% received no IDSP related training during their tenure. Approximately, 70% never supervised IDSP related work and 47% never got supervised. Regression analysis showed that MBBS degree,

better knowledge, receiving IDSP-related training and system readiness were strong predictors of better practices. In-depth interviews indicated that most of the respondents did not have any idea related to IDSP and almost all emphasized the need for regular training on IDSP. Many participants reported job-related stress which included huge patient load, inadequate trained paramedics, extended working hours and lack of basic infrastructure.

About 90% of the respondents in 62 surveyed labs were contractual staffs and about 77% reported receiving formal training on IDSP. In both unadjusted and adjusted models, no significant associations were found between demographic factors (age, education), receiving formal training on IDSP, overall condition of the lab and correctness in filling up L form by lab technicians. Furthermore, participants shared the challenges to reach the affected communities during an outbreak in remote areas. Modification of the IDSP reporting format to include more information, clear and simple display of information regarding tests performed and those done free of cost outside the labs, strengthening infrastructure for preservation of samples/specimen or reagents and regular training on IDSP, particularly the emerging, re-emerging and newer pathogens were some of the possible solutions suggested by the participants

To conclude, analysis revealed a huge knowledge gap and lack of thorough understanding regarding communicable diseases and surveillance activities among key players involved in IDSP, Bihar. Epidemic preparedness and response plan were almost non-existent. Formal training, implementation through proper terms of reference, protocols/guidelines modification, real-time data visualization and regular data-driven review mechanism with timely feedback in an enabling infrastructure would likely strengthen implementation of IDSP mandates in Bihar with a subsequent reduction in the burden of preventable infectious diseases.

Chapter 1



INTRODUCTION

Rapid population growth, aging, urbanization, increased global travel and socio-environmental changes had facilitated the spread of infectious agent worldwide, particularly in developing countries [1]. HIV/AIDS, Malaria, Tuberculosis, Influenza, Severe Acute Respiratory Syndrome (SARS), Ebola virus, West Nile virus and Zika virus continued to pose a substantial threat to mankind worldwide [2, 3]. Despite unprecedented global efforts, communicable diseases remained the major contributor to morbidity and mortality in middle-to-low income countries including India [4, 5]. Apart from predictable burden of endemic diseases, the unpredictability of emerging and re-emerging diseases further deepened the situation in India [6]. Some of the major outbreaks that ravaged in recent times included Dengue in 2015 with approximately100000 reported cases and 220 deaths, encephalitis of unknown origin that infected more than 44000 people and killed 6000, particularly in Uttar Pradesh and Bihar, between 2008 and 2014 and Influenza A (H1N1) that affected 39000 people and claimed 2500 lives in 2015 [7]. Furthermore, rapid emergence of novel pathogens including 2011 detection of Crimean-Congo hemorrhagic fever (CCHF) in Gujrat, 2012 reporting of Kyasanur Forest Disease (KFD) in Western Ghats, 2018 Nipah virus outbreak in Kerala and ongoing 2020 COVID-19 pandemic were also recognized as potential threat to India's health security [8, 9] In addition, the Global Burden of Disease Study, 2016 revealed that a substantial proportion of the global disease burden were attributable to the neglected tropical diseases (NTDs) [10], which included Leprosy, Rabies, Leishmaniases, Lymphatic Filariasis, soil-transmitted helminthiases [11]. In India, the younger populations continued to suffer and die from communicable diseases [12]. Almost 81% of all deaths (age group 0-14 years) were attributable to communicable diseases in the country [5]. Recent upsurge in infectious disease outbreaks clearly indicated severe lack in epidemic preparedness to combat these health menace.

There are numerous disease-specific control programs at the national and state-levels (National Vector-Borne Disease Control Program, National AIDS Control Program, National Vaccine-Borne Disease Control Program, Revised National

Tuberculosis Control Program, Integrated Disease Surveillance Program, etc.) for strengthening the surveillance activities so that the overall disease burden becomes less. The Government of India established the operational Integrated Disease Surveillance Program (IDSP) during 2004 with financial assistance from the World Bank [13]. This decentralized state based IDSP's three-tier administrative structure consists of the National Surveillance Units (NSU), State Surveillance Unit (SSU) and the District Surveillance Units (DSU) comprising surveillance officers and supported by epidemiologists, microbiologists, data entry operators and data managers. The National Centre for Disease Control (NCDC) under the Directorate General of Health Service, Ministry of Health and Family Welfare is the nodal agency for IDSP in India. [13]. Although disease-specific vertical programs had been partially successful in achieving short-term targets, implementation progress for IDSP was moderate since its inception in 2004 at the national level [14]. Given such vertical programs consumed lots of resources, global experts identified the need for integration of specific disease control programs so that information related to multiple diseases utilizing similar infrastructure and other resources could be effectively synchronized [14, 15]. To enhance early warning and response to outbreaks, currently the Government of India is investing heavily on strengthening surveillance activities, laboratory support, data analysis and IT platform of the program for priority setting, informed decision-making, implementation, resource mobilization and monitoring. The key functionaries related to IDSP include community health worker (auxiliary nurse midwife, ANM), physicians and laboratory technicians. Information related to infectious diseases are gathered at district level from all public health centers which include health sub-centers (grass-root), primary or additional health centers, community health care centers, referral hospitals and district hospital. Weekly data captured in IDSP portal included syndromic, presumptive and laboratory surveillance on a weekly basis and physicians form the mainstay of disease reporting and outbreak detection [16].

The preparedness for effective response to communicable disease outbreaks requires an efficient and sensitive nationwide disease surveillance system. Of late, epidemic-prone emerging and re-emerging diseases have alerted the public health setup and surveillance systems all over the world to enhance operational readiness and communication.[17-19] Given that such pandemics could trigger devastating social, economic and health impacts, these should be tackled and contained at the earliest.[20] Therefore, accurate diagnosis through testing forms the backbone of infection control program and rapid outbreak response.[21-24] Initiation of appropriate treatment following early diagnosis prevents avoidable deaths and supports the practice of evidence-based medicine.[13] The role of laboratory surveillance appears critical for effective control of public health threats during an outbreak and emergency response. Laboratory information are important not only for early warning signals, outbreak detection, response and management but for monitoring disease trend, evaluation and monitoring progress of ongoing control measures.[24]

An important component of IDSP has been the contribution of community health workers (CHWs). Evidence indicated that ANMs continued to play a crucial role in addressing the health needs of the community at the village level [25, 26] [27]. They serve a large population, particularly the underserved or remote populations, and regarded as essential providers of crucial health care services [28]. In addition, they act as community-

level educators and educators communicating health concept to local people in a culturally appropriate way. A cross-sectional survey in Uttar Pradesh revealed that receiving counseling from CHWs significantly improved newborn practices among mothers [29]. This cadre may be better engaged in community-preparedness prior to outbreaks [30]. In view of this, adequate knowledge of communicable diseases among CHWs appears essential. Appropriate knowledge about disease surveillance among CHWs would facilitate timely epidemiological investigations, risk-assessment, formulation of policy tailored to local context and efficient implementation of programs at the community-level [31]. In addition to this, awareness about state-specific endemic diseases and seasonal outbreaks among them will help in the formation of priority framework for community-preparedness using limited resources.[32]

The existing disease surveillance and notification system in India for infectious disease outbreak prevention and control, especially at the ground level render the clinicians' indispensable because they are the ones who detect disease manifestations and conditions through clinical diagnosis and also supervise the other two surveillance components of the IDSP. The role of clinicians in ensuring a functional and responsive disease surveillance and notification system in IDSP are not limited to the presumptive disease notification and case management but also recommending laboratory examination and ensuring a proper laboratory reporting. Moreover, the ANMs undertaking syndromic notification are also supervised by the medical officers. As the initial point of contact for most outbreak cases, the medical officers also have the first opportunity to identify, diagnose, treat and control them. They form the backbone of Rapid Response Teams (RRT) in the IDSP that undertake outbreak investigations and response. As the physicians provide support to the designated surveillance officers by case detection, undertaking outbreak investigation, supervising syndromic reporting from the community and accurate laboratory diagnosis, their knowledge and awareness of the disease surveillance and outbreak management appears essential for the successful implementation of the integrated disease surveillance.[33-35]

Bihar and IDSP

Bihar is currently experiencing dual burden of communicable and non-communicable diseases. Among several communicable disease control programs, IDSP is the major program capturing 31 diseases for the state.[36] The IDSP was adopted by the Government of Bihar in 2007 and rolled out in phasic manner to all 38 districts of the state during 2008 and 2009.[36] The District Surveillance Unit (DSU) was established in 2009 along with the appointment of District and State Surveillance Officials. The major activities carried out under IDSP are weekly reporting of presumptive, laboratory and syndromic surveillance and outbreak reporting through a rapid response team. The IDSP has a provision which integrates both public and private sector by capturing data from private practitioners as well though reporting from private sector remained poor so far in the state.[36]

The State Surveillance Unit (SSU) supervises whether all forms are uploaded on time at IDSP portal at district level and data compilation, analysis, documentation and dissemination are done at the state level on monthly basis as well as annually. Manpower, consumables and equipment are provided by the state for the smooth running of the program at the next lower levels.

PLS forms collected from all reporting units [Health sub-center (HSC), Primary Health Centers (PHC), Additional Primary Health Centers (APHC), Community Health Centers (CHC), Rural Hospitals (RH), Sub-Divisional Hospitals (SDH), Districts Hospitals (DH), Public Health labs (PHL)] are uploaded into IDSP portal from each district on every Thursday or latest by Friday; No data can be incorporated after that as the system freezes. Analysis is conducted at district level as well as at state level. As off 2019, there were no reporting from five districts due to acute shortage of manpower: East Champaran, Lakhisarai, Gaya, Banka and Sitamarhi. Rumor Register is kept at every reporting unit for capturing information regarding any untoward event in the community.

There is one functional District Public Health Lab (DPHL): Patna Medical College and Hospital, Patna (PMCH) at present, and five newly sanctioned DPHL are in Jamui, Siwan, Rohtas, East Champaran and Purnia. The referral labs are strategically located in the medical colleges. There are five referral hospital/medical colleges: Nalanda Medical College and Hospital (NMCH, Patna), Jawahar Lal Nehru Medical College and Hospital (JLNMCH, Bhagalpur), Darbhanga Medical College and Hospital (DMCH, Darbhanga), Sri Krishna Medical College and Hospital (SKMCH, Muzaffarpur), Anugrah Narayan Magadh Medical College and Hospital (ANMCH, Gaya). Information are collected at three different levels: L1, L2, L3. L1 is filled in at the peripheral labs by Lab Assistants/Technician at PHC/CHC through Medical Officer in charge (MO-IC). Only three tests are done-Tuberculosis, Typhoid and Malaria at the peripheral level. At each level, IDSP lab register is maintained by the designated lab personnel. L1 forms are sent to DSU after checking with MO-IC. The L2 and L3 forms are sent directly to DSU by Tuesday. After confirmation from MO-IC, line listing for all positive cases is done and documented both in L forms and in lab register; Forms generated in two colors: Yellow (send to DSU) and Blue (kept at the lab).

For observing the disease trend, the number of new cases based on presumptive diagnosis are calculated for a particular week and compared with the previous weeks; if number of cases are more, then it is reported that incidence for that particular disease is increasing or vice-versa. This is done at the DSU and SSU, Patna, Bihar.

Each district and block have a Rapid Response Team (RRT) comprised of clinician, Epidemiologist, Entomologist, District Vector-borne disease control program officer, District Immunization Officer and respective program officers, Laboratory Technician, Animal Husbandry, Public Health Engineering Department, Food and Safety.

Usual intervention during an outbreak included RRT reaches the spot, starts investigation, provide treatment and generate community awareness. Laboratory technicians use to collect biological samples and send to the referral lab for confirmation; In case of any outbreak, data is collected in Early Warning Signal (EWS) format filled in by MO-IC at PHC/CHC/Private Hospital/Nursing homes or by ANM at sub-center and send to the next higher level; In absence of occurrence of any unusual case, health worker will report "0 outbreak" and send it to the supervising MOIC. Every week (Mon-Sun) MO-IC will send "0" reporting to DSU; For confirmation of the outbreak, DSU has to fill a verification form sent from the Central Surveillance Unit (CSU) and then re-submit to the center. Forms filled in three colors: Yellow (sent to DSU), Green (kept with MO-IC at PHC) and Blue (kept with ANM). Data collected on weekly basis are summarized as weekly, monthly

and annual reports of all diseases reportable under IDSP. Supervision and monitoring are done at the state-level on weekly basis specially focusing on timeliness and completeness of the forms.

Although the progress of IDSP in Bihar has been substantial since its inception in 2009, there are still some major gaps. Even today people are affected by communicable diseases, which are largely preventable through available intervention strategies. As per the annual reports on IDSP (2009 to 2019), some of the major outbreaks related to communicable diseases in Bihar included Acute Diarrheal Diseases, Measles, Dengue, Malaria, Acute Japanese Encephalitis and Chicken pox, which had led to severe negative socioeconomic impact [37]. This program was adopted by the state to strengthen district-level surveillance capacities for detecting, confirming and responding to priority diseases that afflict the population.

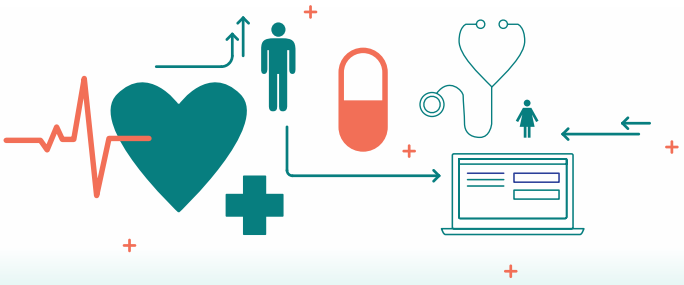
Rationale

Prevention of disease occurrence in the first place is probably a more cost-effective approach to disease containment. A large part of the burden caused by infectious diseases can be reduced by early detection and timely intervention through appropriate surveillance. To make an evidence-based argument to improve the performance of the surveillance program, good quality epidemiological research seems critical. Surveillance of communicable diseases is an integral part of the national disease control program. Timely and reliable information is the cornerstone for designing, planning and evaluating interventions. This appears particularly important for infectious disease surveillance and response system. In some cases, traditional disease-specific vertical programs co-exist with the routine surveillance program. Data coming from these multiple sources use different surveillance methods, codes, reporting forms and frequency. In addition, these data are of poor quality due to lack of supervision at the collection level and inadequate feedback. The primary objective of IDSP is integration of data from multiple vertical programs and feeding surveillance data in real-time data for immediate public health action. But in reality, operation of such surveillance systems is ineffective. Apart from epidemic and endemic prone diseases, the emergence of newer pathogens and re-emergence of old diseases have resulted in reviewing public health surveillance system. Detection of disease specific cases through standard case definition and follow-up intervention, out-break investigation, designing prevention and control programs/policies remain the other objectives of the surveillance program.

A well-functioning disease surveillance system is instrumental for priority setting, informed decision-making, planning, implementation, resource mobilization and monitoring. Thus, efforts towards improvement of a surveillance system is critical for control of communicable disease. Therefore, a comprehensive review of ongoing IDSP and response systems of Bihar was conducted to develop insights regarding burden of epidemic- and endemic prone diseases, outbreak investigation process, changes in disease epidemiology, their impact, emergence of new diseases, logistic support, private sector reporting and dissemination of surveillance data. Furthermore, assessment of gaps in existing expertise regarding routine surveillance activities and outbreak investigation process among key IDSP functionaries would guide to develop different strategy to bridge any competency gaps. Lessons learnt from the initial assessment would help to

design a comprehensive intervention framework for implementation of proposed changes in the pilot districts during the next phase. In addition, it would also guide to develop a comprehensive checklist which will highlight the bare-minimum pre-requisites of a functional IDSP for the state of Bihar tailored to specific needs and context. The recommended IDSP policy would ensure epidemic preparedness and quick response to outbreak by estimating infectious disease burden, risk factor mapping, predicting trend and change in disease trend in a prospective manner.

Chapter 2



METHODOLOGY

For initial gap identification of the existing IDSP in Bihar, an extensive research was conducted using both secondary data and primary data.

Secondary data

All published literature related to IDSP in Bihar and official documents on statistics, budget, reportable diseases and human resources available in Government departments were taken into consideration to identify system-level gaps in the program

Primary data

To assess knowledge, awareness and practices related to routine surveillance activities and outbreak investigation among key IDSP functionaries, information were collected from ANMs, physicians, laboratory technicians and other stakeholders. In addition, their perspectives regarding the program, job related stress and other implementation challenges were also sought to have a deeper understanding of identifying and addressing the existing gaps in expertise.

Study setting

The primary research was conducted in the State of Bihar which is located in the eastern part of India. A land–locked state between West Bengal in the east and the Uttar Pradesh in the west, bounded by Nepal in the north and by Jharkhand in the south. Bihar's lifeline is the river Ganga which flows from west to east. The state covers a population of 103 million and is divided into nine administrative units covering 38 districts, 534 community-development blocks [37]. (Box 1)

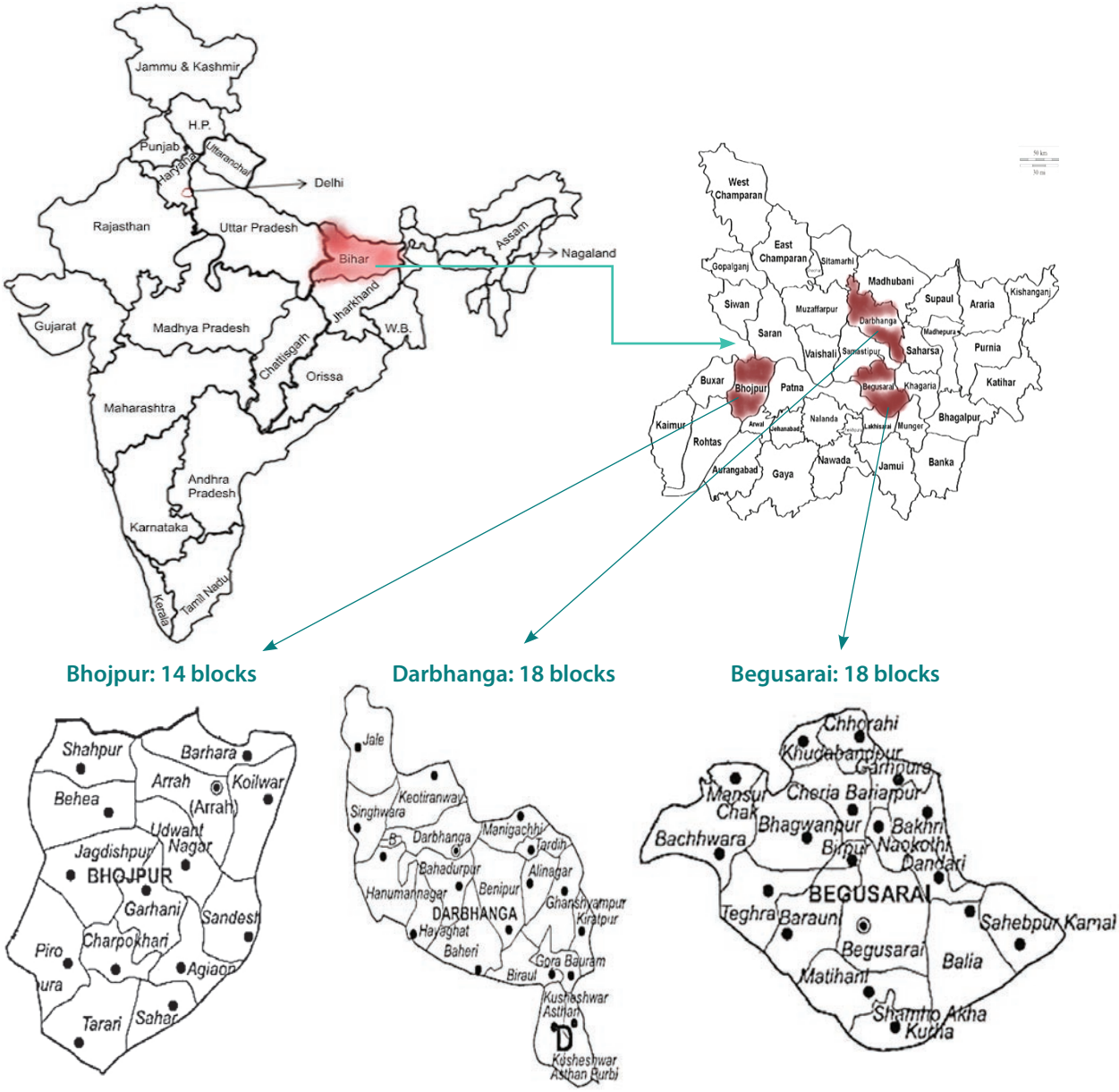
Study design

A mixed method approach (cross-sectional survey followed by in-depth-interview based qualitative deep dive) was employed to cover key areas to IDSP in Bihar- program objectives, core and support functions and preparedness.

Timeframe

January and April 2019

BOX 1: Depicting three selected districts (Bhojpur, Darbhanga and Begusarai)



Sampling method and selection of respondents

All the 38 districts of Bihar were eligible to be included in the study. For measuring performance of IDSP in Bihar, modified version of WHO/CDC guidelines and protocol for evaluating national surveillance system for communicable diseases were deployed as reported elsewhere.[38] Given less variation in terms of timeliness and

completeness of P and L reporting forms over the past year, S form was considered for district selection in the current study. Initially, the district weekly performance (completeness & timeliness of "S" reporting forms) of one-year (July 2017 to June 2018; total 52 weeks) was assessed for each district using District weekly performance for completeness and was categorized [as per WHO/ Centers for Disease Control and Prevention (CDC)/ Government of Bihar (GoB) cut-offs] into poor (<60%), average (=>60% & <80%) & good (=>80%). All of the districts were assigned an individual score based on the above criteria [good=3, average=2, poor=1].The weekly score was then summed up providing a total performance or Infectious Diseases Surveillance Quality Index (IDSQI) score (max score-156, minimum score-52) and re-scaled within 100.These IDSQI scores were log transformed and after normality check and based on its tertile distribution, districts were categorized into good, average and poor performing groups with lowest tertile being poor. Among 38 districts, 14 were identified as poor performing districts and 12 each as average and good performing districts. From the district list in each of these strata, one district was selected randomly for the intervention: Begusarai (good performing), Darbhanga (average performing), Bhojpur (poor performing). (Box 1)

Following selection of districts across performance status, complete list of all functional reporting units for PLS forms were enlisted. All 92 functional reporting units (health facilities) in 46 blocks of the three selected districts for PLS forms (Primary Health Care Centre=45, Urban Primary Health Centre=1, Additional Primary Health Centre=34, Community Health Centre=3, Sub-divisional Hospital=2, District Hospitals=2, Referral hospitals=5) that report P-forms to the IDSP in 46 blocks of the three selected districts were selected. A total 253 (Begusarai=63, Darbhanga=90, Bhojpur=100) on-duty consenting physicians who were present in designated health facilities covering all 46 blocks as mentioned earlier were included.

It was estimated there are about 400 health sub-centers in each of the selected district. Given lack of logistic support and time constraint, sampling was done to select sub-centers in each district. Empirically assuming the poorest level of completeness of 40% to be improved to at least 80% as the intended impact to measure the performance change with 80% power and 95% precision for a before-after comparison, 56 HSCs from each district were supposed to be included. Considering the attrition rate of 30%, the sample size for HSC was inflated to 80/district, hence 240 altogether from the list of functional HSCs in these 3 districts, 240 subcenters were selected in a stratified random sampling using a block-wise proportional distribution. One consenting on-duty ANM of the selected subcenter was interviewed.

In three selected districts, all 62 designated laboratories for IDSP were visited (Begusarai=23, Bhojpur=17 & Darbhanga=22) and one consenting on-duty technician was interviewed in each selected lab.

Data collection

Interviews were conducted at each designated reporting unit for IDSP involving ANM, physicians and lab technicians using an offline-online synchronized data collection application. Information were collected regarding 1. core functions which included case detection, case registration, case confirmation, case notification, data management, data analysis, outbreak preparedness, outbreak response and feedback 2. Support functions which included presence

of manuals, guidelines, laboratory capacity, supervision, training, resources and coordination. In addition, knowledge, awareness, perception and practices related to IDSP related job were also assessed for ANM and physicians. An observation checklist was prepared for each designated reporting unit for PLS forms to indicate system-level preparedness for carrying out routine surveillance activities and outbreak management.

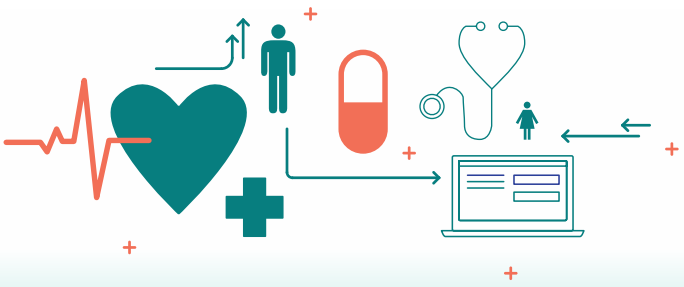
In-depth interviews were conducted among consenting ANMs after completion of the quantitative part following a semi-structured qualitative interview guide. A series of open-ended questions pertaining to specific domains like job responsibilities, motivation, support from supervisor, stress management, job-related difficulties and suggestions for improving current IDSP for Bihar were asked with necessary probing. All interviews were conducted in local language and audio-recorded with participant permission. In addition, written notes were taken to capture the non-verbal expressions. Each interview on average lasted for 30-45 minutes. Likewise, qualitative in-depth interviews were also conducted among physicians to have a comprehensive knowledge regarding their idea about existing burden of infectious diseases in Bihar, common presenting symptoms of a suspected infectious case, treatment modality, IDSP objectives, current status of this program, suggestion for improving IDSP, job-related challenges, stress, happiness and motivation. Qualitative evidence was also gathered from lab-technicians regarding routine investigation process, outbreak investigation, laboratory support in terms of basic equipment, reagent and other essential procedural documents, procurement system, job-related challenges, motivation, stress-management and suggestions for improving existing IDSP program.

Data analysis

Quantitative data analysis was performed using SAS software version 9.4. All the numerical (continuous or discrete) variables were summarized for mean, maximum and minimum values. Categorical variables were tabulated for frequency, percentage and 95% confidence interval (CI) of each category. Categories were clubbed if needed based on logic and literature review ensuring sufficient power. For measuring knowledge, individual domain-specific score was calculated (1=correct response & 0=incorrect response and do not know). Then, domain-specific scores were added to obtain a total knowledge score, which was log-transformed and re-scaled to 100. Based on tertile distributions of total knowledge score, categories of knowledge were done, lowest tertile being the poor-knowledge. Likewise, practice was also classified into good/average/poor groups based on tertile distributions of the total practice score. Logistic regressions were conducted for determining predictors of good knowledge and better practice among ANMs and physicians and associations were expressed in odds ratio, both unadjusted and adjusted after considering potential covariates. The significance level for all analysis was fixed at 5%.

Qualitative analyses were performed using audio recordings and notes taken during the in-depth interviews. The audio-recordings were transcribed within 24 hours of each interview. Transcriptions were reviewed and checked by experts for accuracy and consistency. Atlas.ti software package was used for data storage, coding and analysis. Grounded theory principles were used to inductively analyze the audiotaped transcripts for extracting major themes. Recurrent ideas, themes and concepts were identified following open and axial/thematic coding. Discrepancies in coding were resolved by discussing with the research team.

Chapter 3



A CRITICAL REVIEW OF IDSP BETWEEN 2009-2019

A critical review of IDSP between 2009-2019

Summary

The burden of communicable diseases is still a sizeable and pressing problem in India. The best way to tackle is through an efficient integrated surveillance system, especially in less-developed states. Bihar, one of the poorest states in the country, continues to experience frequent disease outbreaks caused by acute diarrhoeal diseases, vector-borne diseases, acute respiratory infections and acute encephalopathy syndrome. The Integrated Disease Surveillance Programme (IDSP) was implemented in 2009 as a comprehensive strategy to improve disease surveillance and response in the state. This paper is based on available IDSP-related documents published in the public domain and in-depth interviews with stakeholders to assess the performance of the IDSP in Bihar over 10 years since its inception in 2009. Findings revealed an increase in reporting of priority diseases in the state. In absolute number under presumptive surveillance, the reporting of the follwing disease/conditions increased over time - acute respiratory infections, fever of unknown origin and acute diarrhoeal diseases. Among the vaccine-prevetable diseases, measles and chicken pox were mostly reported. Lab-confirmed Dengue cases appeared to be high in 2019 (approximately 3232 cases). However, there is lot of discrepancies observed in data captured under presumptive and laboratory surveillance over the years. Although the completeness of all the three ('S' syndromic; 'P' probable; & 'L' laboratory) reporting formats showed improvement over the last 10 years (S reporting improved from 0 to 40%, P from 58% to 77% and L from 32% to 75% but a dip was observed particularly for S reporting since 2013. While outbreak detection improved since the launch of the programme in the state (increased from 3 in 2009 to 589 in 2019) but it appeared reporting of few outbreaks might have missed. The major outbreaks reported were related to vector-borne diseases (dengue), vaccine preventable disease (measles and chicken pox) and acute diarrhoeal cases. Adequate financial and human resources had been a challenge. The involvement of private sector improved from 0 in 2009 to 103 in 2019. Dissemination of data on diseases at the right time to inform public health action seemed missing. Low budget created challenges for training opportunities

among key IDSP functionaries resulting in poor knowledge and expertise. In conclusion, the IDSP performance in Bihar showed marked improvements but significant challenges remained which needed serious consideration. A number of challenges related to IDSP implementation have been identified in the state. These included insufficient data management platform, limited trained human resources at the district level, limited use of digital platform, lack in accountability, poor monitoring and supervision. Given a well-functioning disease surveillance system is instrumental for priority setting and resource allocation, addressing the identified gaps through focused approach in alignment with local context may improve IDSP performance in Bihar.

Background

The burden of communicable diseases is still a sizeable and pressing problem in India. The best way to tackle is through an efficient integrated surveillance system, especially in less-developed states. Bihar, one of the poorest states in the country, continues to experience frequent disease outbreaks caused by acute diarrheal diseases, vector-borne diseases, acute respiratory infections and acute encephalopathy syndrome. [36, 37] The Integrated Disease Surveillance Program (IDSP) was implemented in 2009 as a comprehensive strategy to improve disease surveillance and response in the state.[36]

Surveillance of infectious diseases in Bihar is done through mandatory case reporting from government facilities including sub-centers, primary health centers, public health laboratories, district hospitals and other private health providers in all 38 districts of Bihar under the IDSP. Beginning in 2009, the program was implemented in the state and involved case-reporting predominantly paper-based. At present, the IDSP collects information on acute diarrheal disease (including acute gastroenteritis), bacillary dysentery, viral hepatitis, enteric fever, malaria, dengue/dengue hemorrhagic fever (DHF)/ dengue shock syndrome (DSS), chikungunya, acute encephalitis syndrome (AES), meningitis, measles, diphtheria, pertussis, chicken pox, fever of unknown origin (PUO), acute respiratory infection (ARI)/ influenza-like illness (ILI), pneumonia, leptospirosis, acute flaccid paralysis (AFP) among children below 15, dog bite, snake bite, up to five state-specific diseases and unusual syndrome (not being captured by any of the above).[36] The operational structure for IDSP data capture is divided into three levels, the syndromic cases done by the ANM at the subcenter, the presumptive surveillance at the primary health center and other secondary and tertiary health facilities by physicians and the laboratory-confirmed disease reporting by personnel in public health laboratories.[36] For each disease under surveillance, the ANMs fill out a standardized S (syndromic)-form reporting syndromic information and the doctors report on presumptive diagnosis via the P-Form. Finally, according to national guidelines, laboratories report to the IDSP through the L-Form on confirmed cases of diseases under surveillance. Information from district and sub-district units are shared with the state surveillance unit, where all compiled surveillance data are stored in an electronic database. The surveillance data is collated and analyzed at state level and is made available in the form of weekly reports, monthly reports and annual reports. Microsoft excel was used to analyze and present the results in this study obtained from the available IDSP-related documents published by the State Health Society, Bihar in public domain and from qualitative interviews of stakeholders in the state.

Findings

The progress of IDSP at the state level for the current research work was evaluated through analysis of the core IDSP indicators, human resource, private sector involvement, medica scanning, funding and

dissemination of research. Analysis of IDSP core indicators involved completeness and timeliness of weekly epidemiological data, morbidity and mortality data for few infectious diseases as a proxy of IDSP performance from 2009 to 2019. Completeness was computed based on proportion of reporting units per district which submitted completely filled PLS forms in a week. Timeliness was computed based on proportion of districts that submit reports on time in a week. Reports was at the district level expected to be submitted on Thursday following the end of the previous epidemiological week. Attack rates (AR) could not be calculated as population at risk could not be determined from the IDSP reports and case fatality rates (CFR) were reported as available in the IDSP documents, Bihar. In addition, prorportion of probable cases under presumtive and laboratory surveillance were also included in the report. Descriptive analyses were conducted using SAS version 9.4.

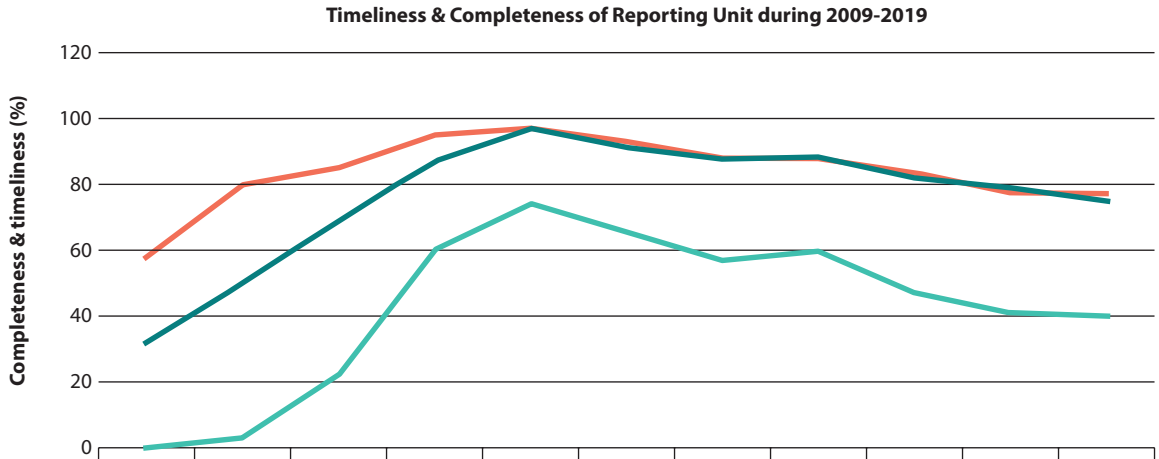
Timeliness and completeness

Currently in the public health system, 664 units report P Form (presumptive surveillance), 597 units report L Form (laboratory surveillance) and 9792 units report S Form (syndromic surveillance) to the IDSP in all 38 districts of Bihar. At the sub-center (HSC), Auxiliary Nurse Midwives (ANM) with the aid of multi-purpose health workers (MPHW) and Accredited Social Health Activists (ASHA) undertake data collection and notify through Form-S (based on syndromic approach) on a weekly basis (mostly on Tuesday) to the concerned persons (medical officers, block-level managers) at the health center. The paper-based syndromic surveillance reports collected at each Primary Health Centers (PHC) are collated at district-level and get uploaded in the IDSP portal. Provisional diagnosis of reportable diseases is notified by the clinicians at the PHC/Additional Primary Health Center (APHC)/ Sub-divisional Hospital (SDH)/District hospital (DH)/ Medical College and Hospital (MCH) via Form-P (presumptive cases). Similarly, for the lab-confirmed cases laboratory personnel under the supervision of Medical Officer-in charge report through the Form-L. The timeliness of weekly data reporting has to be maintained at all levels as the IDSP portal freezes after the weekly deadline and no further entries can be made. Therefore, weekly reporting remains incomplete if timeliness is not maintained. The average completeness of weekly Syndromic surveillance increased gradually from 2009 (when the IDSP was launched) till 2013 when it peaked to 74%. Thereafter, the completeness and timeliness of reporting declined over the years to 60% in 2016, 47% in 2017 and 41% in 2018. A similar pattern was observed for weekly presumptive surveillance-completeness increased from 80% in 2010 to 95% in 2012 and 97% in 2013 followed by a dip to 88% in 2015-2016, 83% in 2017 and 78% in 2018. With regard to laboratory reporting, as observed with S and P reporting, there was a gradual increase in reporting from 2009 (32%) to 2013 (97%) thereafter that it declined and reporting fell to 88% in 2015-2016 and 79% in 2018. Though the low reporting observed in 2018 might be due to the closure of the IDSP portal from July to October 2018 for upgradation at the Central Unit. In 2019, the average reporting was 36% for S-Form, 71% for P-Form and 69% for L-Form. (Figure 1).

Private sector

A key area of the IDSP has been to incorporate reporting from the private sector as large portion of the state's population seek treatment from them. Engagement with the private health providers and sustained reporting from the sector was picked up from 2014 onwards. Though involvement of private sector improved since 2013, reporting remained poor with 103 units in 2019. (Figure 2)

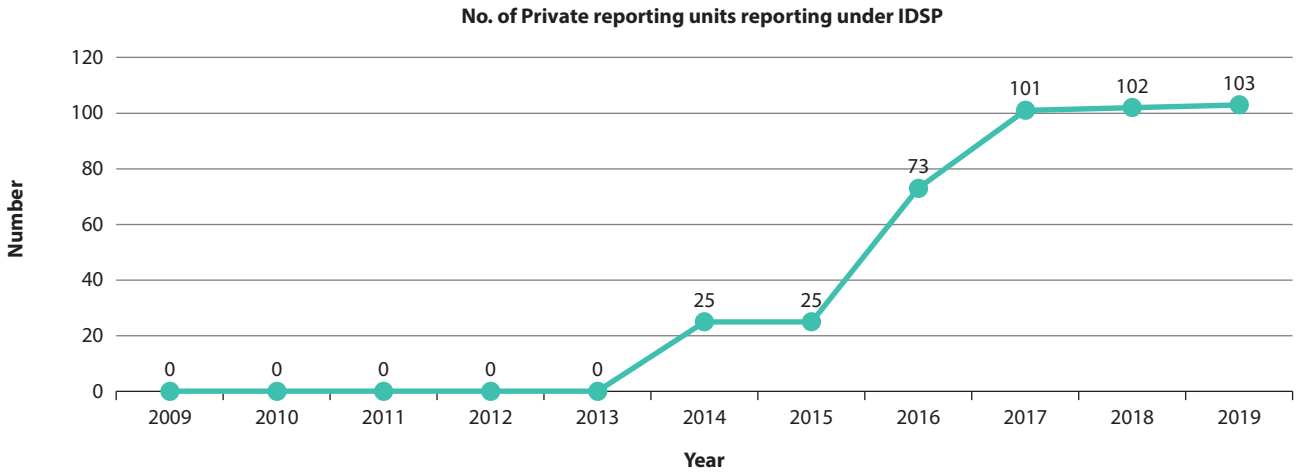
FIGURE 1 Yearly performance of PLS reporting under IDSP in Bihar during 2009-2019



	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Syndromic	0	3	22	60	74	65	57	60	47	41	40
Presumptive	58	80	85	95	97	93	88	88	83	78	77
Laboratory	32	50	69	87	97	91	88	88	82	79	75

Source : State Health Society, Bihar

FIGURE 2 Reporting of private sector to the IDSP in Bihar from 2009 till 2019



Source : State Health Society, Bihar

Reported disease-specific cases under P and L forms

Viral hepatitis

The number of new cases of viral hepatitis in presumptive surveillance increased from 13271 in 2011 to 18413 in 2012 followed by further increase of 25225 cases in 2015. Compared to 2016, the number of viral hepatitis increased in 2017 but the proportion of the respective cases out of total reported cases (reporting fraction) remained the same.

Lab confirmation and reporting of Hepatitis A also showed an increase with 142 cases in 2011 and 239 cases in 2012. Viral Hepatitis A constituted 3% of the total reported cases in 2016 while it increased to 4% in 2017. The low number of Hepatitis E reporting via the laboratory surveillance might be due to poor lab facility to confirm it rather than low incidence of the disease. In 2012, 22 cases of lab-confirmed Hepatitis E were reported in Bihar, higher compared to 2011 when only 5 cases were reported. A total of 711 lab-confirmed Viral Hepatitis A and 158 cases of Viral Hepatitis E were reported in 2015 while it was 232 and 173 cases, respectively, in 2014. Viral Hepatitis E constituted 0.9% of the total reported cases in 2016 while it constituted 1.5% respectively in 2017.

Acute Diarrheal Disease

Lab-confirmed Shigella cases were 278 in 2018 5/+ -963versus 52 in 2019. No cholera-positive diarrhea was reported after 2014 in the state.

Typhoid

Cases show gradual increase from 3% in 2012 to 5% of the total cases reported under IDSP in 2013 and 6% in 2014. A gradual increase in number of cases was observed between 2010 and 2016, followed by a slow decline since 2017.

Laboratory-confirmed cases constituted 20% of the total cases of all diseases captured under IDSP in 2012 which increased to 35% in 2013. Typhoid cases constituted 40% of the total reported cases in 2016 and 41% in 2017, which further increased in 2018 and 2019.

Measles

For vaccine-preventable diseases, the number of Measles cases reported from Bihar in 2010 was 2519 which slightly decreased since 2010 when 2153 cases were reported annually in 2011. While the number of Measles cases reported in 2012 (5990) again increased when compared to 2011 figures. In 2017, 340 cases were reported under the presumptive surveillance.

No laboratory confirmation was observed in annual or monthly reports published by the State Health Society, Bihar.

Chicken pox

The number of chicken pox cases under presumptive surveillance over the years (2010 and 2019) varied between 1200 and 5000 with a sudden dip (931) in 2018. In 2019, the number observed was 2294.

No laboratory confirmation was noted in the dataset or annual reports.

Diphtheria

From 2014 onwards, there was a gradual decline in the number of Diphtheria cases in Bihar; while in 2010, 582 cases were reported annually.

However, as per the lab surveillance, 23 confirmed cases of Diphtheria were reported in 2012, which was only 2 in 2011. No confirmed Diphtheria case was captured after 2014.

Pertussis

The number of Pertussis presumptive cases reported in 2012 was 1342. However, a marked discrepancy in the number of reported cases was observed across the years.

Acute Respiratory Infection or Pneumonia

Respiratory diseases such as pneumonia under presumptive surveillance showed a steady rise with 54927 cases in 2010, 70076 cases in 2011, 104556 cases in 2012 followed by a marginal decline in 2013. It constituted 1% of the total reported cases in 2016 and <1% in 2017.

Acute Respiratory Infection or Influenza like Illness

The number of Influenza-like illness captured in P forms increased over years, amounting to 1157977 cases in 2017; while it was 837456 in 2010, 1590227 in 2011, and 3512752 in 2012. ARI cases constituted 38% of the total reported cases in 2013 and 35% of the total cases reported in 2016, while it was 36% in 2017.

Malaria

Approximately, 67282 cases of Malaria were reported under presumptive surveillance which drastically increased since the last two years i.e. in 2011 when 34692 cases were reported and 21294 cases in 2010. In 2012, total malaria cases [Plasmodium vivax, (Pv) & Plasmodium falciparum (Pf)] were 3402, which were 2624 in 2011.

The lab-confirmed Malaria (*Pv*) and (*Pf*) constituted 10% & 3% of the total reported cases in 2013, 11% & 5%, respectively, in 2012, 7% & 3% in 2014, 10% & 4% in 2016, and 9% & 3% respectively in 2017.

Dengue

Dengue cases showed a sporadic rise and fall over the years as captured in IDSP surveillance. Dengue cases constituted 9% of the total reported cases in 2013 while it constituted 2% in 2012. In 2017, 1651 cases of Dengue were reported while in 2016 it was 2166.

Under Lab Surveillance, 350 cases of Dengue were reported in 2012, which was only 46 in 2011 while 1201 and 640 cases were detected in 2016 and 2017, respectively.

Acute Encephalitis Syndrome (AES)

In 2010, 1794 cases of AES were reported which increased to 2065 in 2011. From 2015 to 2017, 495, 396 and 383 cases of AES were reported, respectively, which show a relatively slight decline. In 2019, about 971 cases were captured in IDSP.

Under Lab Surveillance, 63 cases of JE were reported in 2012, which was 159 in 2011. JE cases showed a confusing trend with 30, 55, 39 cases in 2015, 2016 and 2017, respectively.

Acute Flaccid Paralysis (AFP)

In 2010, 3280 cases of AFP were reported in Bihar. In 2012, 3615 cases were captured. However, the proportion of cases of AFP out of 20 reportable diseases under presumptive surveillance accounted for less than 1% of total cases between 2014 and 2019. Although the number of new cases of AFP increased in 2017 than reported in 2016, the proportion of AFP cases out of total reported cases remained the same.

Dog bite

Out of 20 reportable diseases under IDSP, dog bite cases contributed to 703925 (6%) of all the reported cases in 2012. Dog bite cases showed a slight decrease in 2013. Dog bite cases constituted 10% of the total cases reported in 2016 and 11% in 2017.

Snake bite

In 2011, 5981 cases of snake bite were reported in Bihar while in 2010, 3329 cases were reported. When compared to 2016, the number of cases in 2017 increased but the proportion of the cases out of total reported cases remained the same as in 2016.

Leptospirosis

Few cases of lab-confirmed leptospirosis were also reported from the state between 2009 and 2019. (Table 1a & 1b and Table 2)

TABLE 1A: Probable cases of priority disease over the years (2009-2019) as per annual, monthly and weekly reports of IDSP, Bihar

Cases of Priority disease over the years as per IDSP annual, monthly and weekly reports, Bihar												
Surveillance type	**Disease**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Presumptive Surveillance	Viral Hepatitis	4083	9904	13271	18413	13015	22084	25225	25837	26258	23068	18632
	Acute Diarrhoeal Disease	70464	263583	518333	1124108	661067	697593	512843	416444	376739	269993	287180
	Bacillary Dysentery	54460	184396	273221	646531	378567	385316	275217	222701	196683	139992	148398
	Enteric fever	35440	116083	143085	304768	287066	308831	264646	216592	199591	113750	130476
	Measles	921	2519	2153	5990	737	260	446	577	340	467	943
	Chickenpox	1345	4868	3630	12546	3244	1218	1443	4842	2215	931	2294
	Pertussis	2911	3329	3295	1342	577	1615	466	491	1042	22	193
	Diphtheria	293	582	384	961	89	172	75	43	25	7	19
	Tetanus	477	387	387	403	303	373	393	310	592	NA	NA
	Meningitis	250	1770	2553	943	1939	1940	1940	1282	1013	342	1048
	Pneumonia	20678	54927	70076	104556	72055	52063	41543	34497	29874	16375	14816
	ARI/ILI	223100	837456	1590227	3512752	2132525	1821698	1353975	1149492	1157977	854864	959453
	Malaria	10202	21294	34692	67282	33676	29277	28535	25781	24574	13327	20004
	Acute Encephalitis Syndrome	234	1794	2065	1912	957	976	495	396	383	115	971
	Chikungunya	105	109	232	146	84	12	46	739	600	88	1009
	Dengue	42	2963	255	332	4018	990	2963	2166	1651	306	2429
	Dog Bite	38912	156442	268953	703925	419503	401291	262776	341065	364204	222069	343259
	Snake Bite	1908	3329	5981	1342	10556	8250	7995	6911	8660	3491	3651
	Leptospirosis	549	673	490	3318	481	201	45	24	13	0	40
	Acute Flaccid Paralysis<15 years	1013	3280	2906	3615	1096	718	626	581	873	426	856
	Fever of Unknown Origin (PUO)	225353	757740	1192277	2384936	1589956	1385610	1036710	847706	841509	661052	868115

NA Not Available; Source : State Health Society, Bihar

TABLE 1B: Laboratory-confirmed cases of priority disease over the years (2009-2019) as per annual, monthly and weekly reports of IDSP, Bihar

Cases of Priority disease over the years as per IDSP annual, monthly and weekly reports, Bihar												
Surveillance type	**Disease**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Laboratory Surveillance	Hepatitis A	27	91	149	239	389	232	711	566	520	155	321
	Hepatitis E	6	0	5	22	152	173	158	153	211	3	20
	Cholera	0	20	0	0	0	4	0	0	0	0	0
	Shigella Dysentery	36	59	122	93/89	220	129	447	450	376	278	52
	Typhoid	279	857	2398	4571	9088	8239	9499	6790	5596	4811	8857
	Chikungunya	0	0	80	10	4	2	3	378	186	21	238
	Diphtheria	0	0	2	23	17	8	0	0	0	0	0
	Meningococcal Meningitis	10	59	122	63	219	126	306	319	229	253	1
	Malaria Pv	311	566	1567	2373	2505	1258	1610	1618	1286	620	937
	Malaria Pf	1025	528	1079	1029	888	524	781	596	423	252	196
	Japanese Encephalitis	1	0	159	63	37	15	30	55	39	12	3
	Dengue	16	1125	46	350	2206	284	1296	1201	640	807	3232
	Leptospirosis	0	0	2	6	7	4	1	0	0	0	1

NA Not Available; Source : State Health Society, Bihar

TABLE 2 : Year-wise proportional distribution of individual diseases among all reported suspected cases under IDSP, Bihar (2009-2019)

Proportion* of cases for all reportable diseases in Bihar as per IDSP Reports											
Surveillance type	**Disease under surveillance**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Presumptive surveillance	Viral Hepatitis	<1	<1	<1	<1	<1	<1	<1	<1	<1	1
	Acute Diarrhoeal Disease	10	12	13	12	14	13	13	12	12	10
	Bacillary Dysentery	8	7	7	7	8	7	7	6	6	5
	Enteric fever	5	3	3	5	6	7	7	6	5	5
	Measles	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Chickenpox	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Pertussis	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Diphtheria	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Meningitis	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Pneumonia	2	2	1	1	1	1	1	<1	<1	1
	ARI/ILI	34	38	39	38	36	35	35	36	37	34
	Malaria	<1	<1	<1	<1	<1	<1	<1	<1	<1	1
	Acute Encephalitis Syndrome	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Dengue	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Dog Bite	6	6	8	7	8	7	10	11	10	12
	Snake Bite	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Leptospirosis	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Acute Flaccid Paralysis<15 years	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Fever of Unknown Origin (PUO)	31	29	27	28	27	27	26	26	28	31

Proportion* of cases for all reportable diseases in Bihar as per IDSP Reports											
Surveillance type	**Disease under surveillance**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Lab surveillance	Hepatitis A	<1	<1	1	2	1	3	3	4	2	3
	Hepatitis E	0	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Cholera	<1	0	0	0	<1	0	0	0	0	<1
	Shigella Dysentery	<1	<1	<1	<1	<1	2	3	3	4	<1
	Typhoid	3	8	20	35	44	44	40	41	67	70
	Diphtheria	0	<1	<1	<1	<1	0	0	0	0	2
	Meningococcal Meningitis	<1	<1	<1	<1	<1	1.5	2	2	3.5	0
	Malaria Pv	2	5	10	10	7	7	10	9	9	<1
	Malaria Pf	2	4	5	3	3	4	4	3	3	0
	Japanese Encephalitis	0	<1	<1	<1	<1	<1	<1	<1	<1	0
	Chikungunya	0	<1	<1	<1	<1	<1	2	1	<1	<1
	Dengue	4	<1	2	9	2	6	7	5	11	25
	Leptospirosis	0	<1	<1	<1	<1	<1	0	0	0	<1

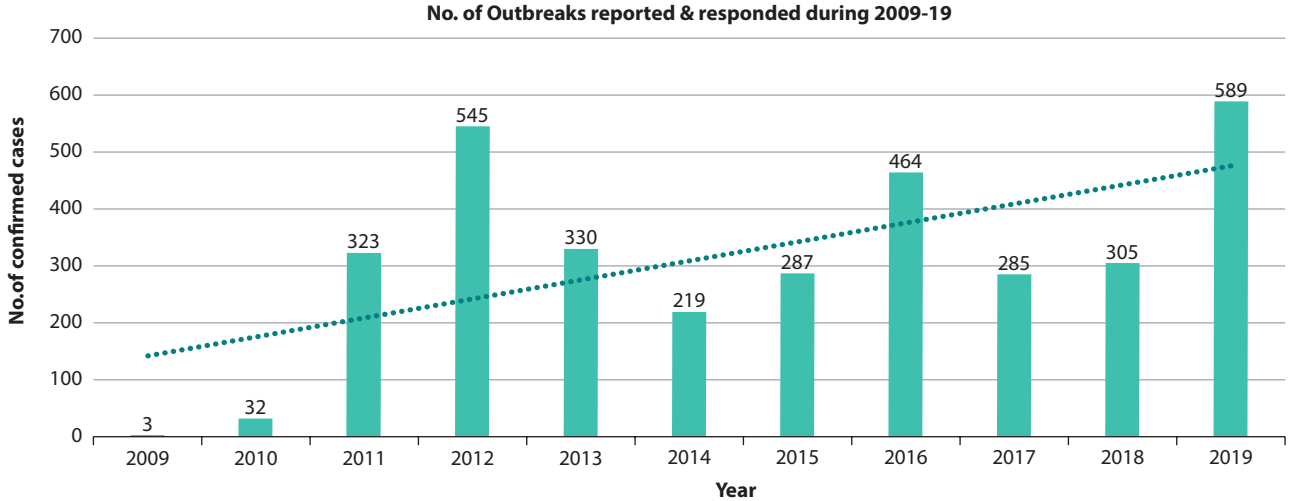
Source : State Health Society, Bihar
**Numerator = Symptom positive or laboratory confirmed cases of a particular disease condition*
Denominator = Cumulative aggregate of all potential cases reported at OPD or sent for testing in that particular year

Detection of epidemics and outbreaks

Outbreaks are initially recorded at the local level on a standardized Outbreak Report Form known as Early Warning Signal (EWS) form with a provision of updating further data when all information become fully available. Outbreak reports are available both at the IDSP portal as well as the State Surveillance Unit, but the data source is primarily at the sub-district and district units. The likelihood of outbreak reporting increases if it involves a large number of cases, unusual pathogens, notifiable diseases or geographically accessible. Also, the disparity in resource allocation across the reporting units also have an impact on outbreak reporting at the local level. In mid-2009, when the IDSP was launched in Bihar, only 3 outbreaks were reported with 0 deaths. A year later, 32 outbreaks involving 2564 cases and 30 deaths were reported with another 6676 cases and 370 deaths attributed to different outbreaks in 2011. In 2013, 335 outbreaks involving 6653 cases resulted in 170 deaths, which was less than the 2012 figures where 542 outbreaks involved 9033 cases and 138 deaths. Similar pattern was observed in 2015 where 287 outbreaks involved 3978 cases and 51 deaths, much less compared to 2014 (4241 cases and 260 deaths). In 2016, 464 outbreaks involving 10048 cases and 62 deaths were reported and responded by the State, followed by 285 outbreaks involving 5945 cases and 61 deaths in 2017. In 2018, 305 outbreaks had been reported, while the state reported highest number of outbreaks in 2019- 589 outbreaks involving 6417 cases. (Figure 3). The commonly reported outbreaks included acute diarrheal disease, Dengue, Chicken pox, Measles, Malaria, Acute encephalitis Syndrome, Chikungunya, Enteric fever and food poisoning.

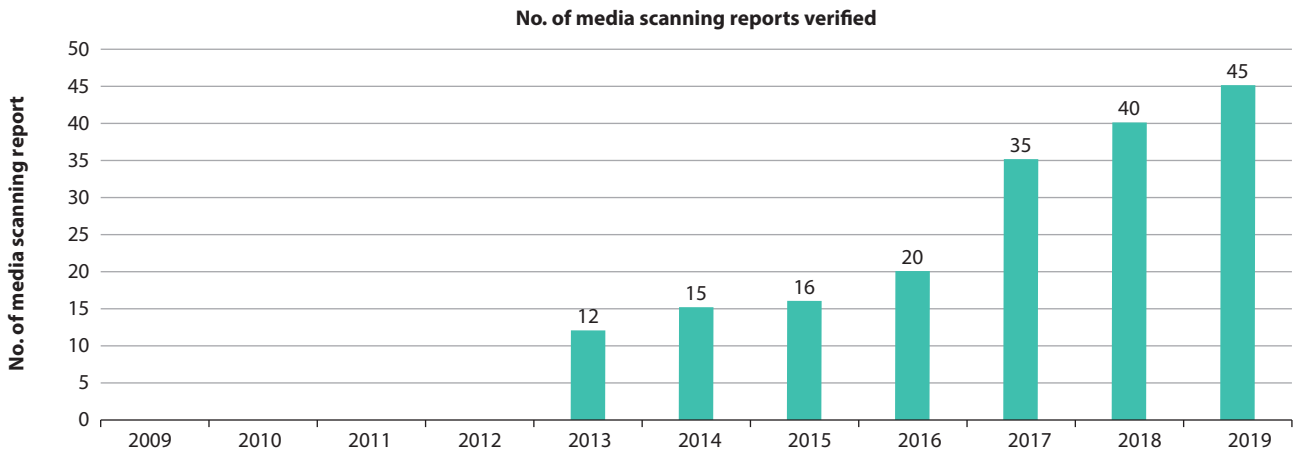
The media scanning and verification cell was established under IDSP in July 2008 at the national level. It detects and shares media alert with the concerned state/district for verification and response. The media scanning and verification cell of the IDSP, Bihar started collecting and investigating media reports of outbreaks from 2013, and between 2013 and 2019, a growing number of media reports were captured and investigated by the unit. Majority of the alerts were related to diarrheal diseases and vector-borne diseases. (Figure 4)

FIGURE 3 Total disease outbreaks detected by the IDSP, Bihar over the years (2009-2019)



Source : IDSP, Bihar

FIGURE 4 Total number of media reports on disease outbreaks identified and investigated by the IDSP, Bihar over the years (2009-2019)



Source : IDSP, Bihar

Reported Death

Vertical programs have an advantage in this regard as program such as the National Vector-borne Disease Control Program (NVBDCP) have an inbuilt system that captures fatality. Therefore, the case fatality of only those diseases under vertical control programs get reflected in the IDSP reports. Of the major diseases under surveillance in the IDSP, the reported case fatality of AES clinically-diagnosed (reported under IDSP) over the years in Bihar was 20 in 2011, 36 in 2012, 35 in 2013, 36 in 2014, 25 in 2015, 25 in 2016, 21 in 2017, 26 in 2018 and 22 in 2019.

While for Dengue, the case fatality could not be determined due to discrepancies in data captured under IDSP and NVBDCP. Hence, only absolute numbers are captured over the study period. 4141 cases and 6 deaths were reported in 2013, 342 cases and 1 death in 2014, 1648 cases with no deaths in 2015, 2479 cases and 4 deaths in 2016, 2854 cases with 3 deaths in 2017, 2203 cases with 1 death in 2018, and 8554 cases with 1 death in 2019.

Budget & Utilization

IDSP was launched during 2004-05 with the World Bank assistance (loan of USD 68.00 million) and financial allocation of Rs. 408.36 crore. The World Bank loan amounting to 306.27 crore provided 75% of the total budget, while the Government of India provided funding for the rest 25% to the tune of 102.09 crore. When the program was implemented in 2009, 75% of the annual budget earmarked for IDSP in Bihar was provided by the Centre, with the rest 25% of funds falling on the State's shoulders. This ratio of fund sharing carried on till 2013-14, following which the central share of the total budget decreased to 60%. For Bihar, 75% of the sanctioned budget of approx. 2 crores (2007-2008 to 2011-2012) was approved for human resources and the rest 25% was earmarked for operational activities of the program. Till 2012-2013, the central share of the yearly funds was usually released by the Government of India after receiving utilization certificate at the end of last quarter. This led to a delay in the entire process of implementing the program. The budget for

2015-2016 was Rs. 756 lakhs (included committed figures), while for 2016-2017 it was Rs. 760 lakhs (included committed figures) and the funds for these years were received by the state IDSP unit in 2018-19. Commenting on the delays of receiving funds, a state-level stakeholder of the program stated. Apart from inadequate budget allocation, utilization of allotted funds for IDSP remained poor except for the year 2017-18. (Table 3)

TABLE 3: Budget, expenditure & Utilization of allotted fund under IDSP during 2016-2020

NHM (in Rs. Crore)	Year			
IDSP overall	**2016-17**	**2017-18**	**2018-19**	**2019-20**
Budget	7.61	7.6	1.68	1.23
Expenditure	2.3	6.15	0.37	0.78
Utilization (%)	30	81	22	63
Public Health Lab				
Budget	5.02	5.02	6.06	6.23
Expenditure	4.2	4.97	5.11	4.96
Utilization (%)	84	99	84	80

Human Resource

The Government of India created and approved the positions of Epidemiologists, Microbiologist, Data Manager, Data Entry Operators and District Surveillance Officers under the IDSP. Of the three sanctioned posts under the IDSP in Bihar (District Epidemiologist, District Data Manager and Data Entry Operator), majority were currently vacant. The challenge presently is to fill in these posts urgently with motivated individuals and arrange for their induction training along with necessary field epidemiology and microbiology training. The critically high attrition rate among the staff of the IDSP is a major setback for the continued performance of the program. Moreover, in addition to the routine program-related training on public health, IDSP training has to cater to the larger need of Epidemiologists and Microbiologists, enabling them to organize and oversee program activities at state and district levels. At present, a two-week Field Epidemiology training along with an introductory training is the norm at the time of joining, but a very number of the IDSP staffs working at the district and hospital settings

FIGURE 5 Human resource scenario of IDSP, Bihar in 2019

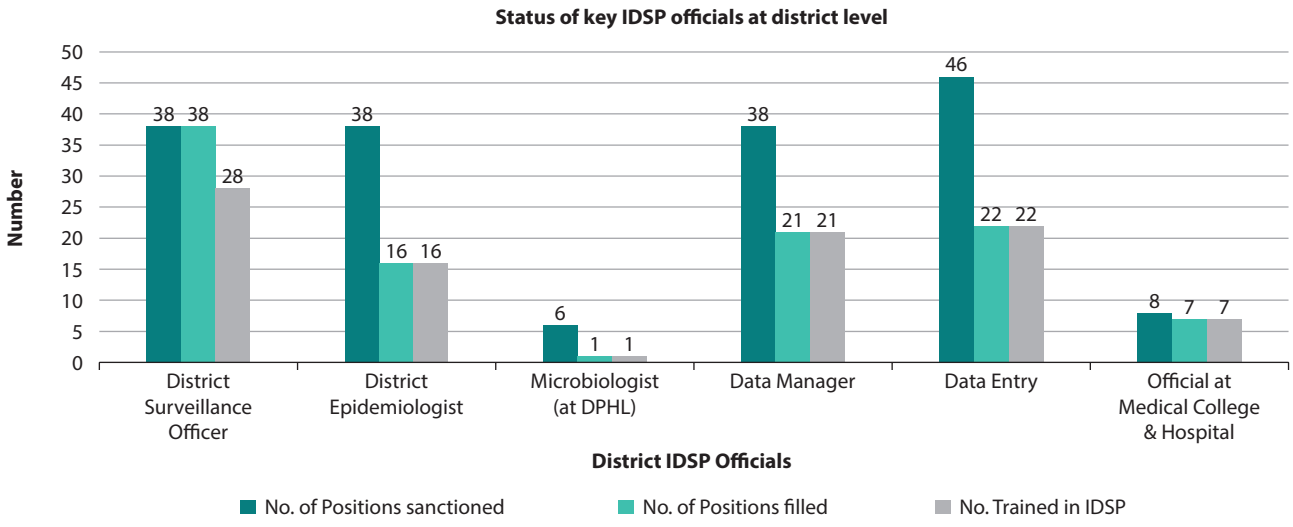
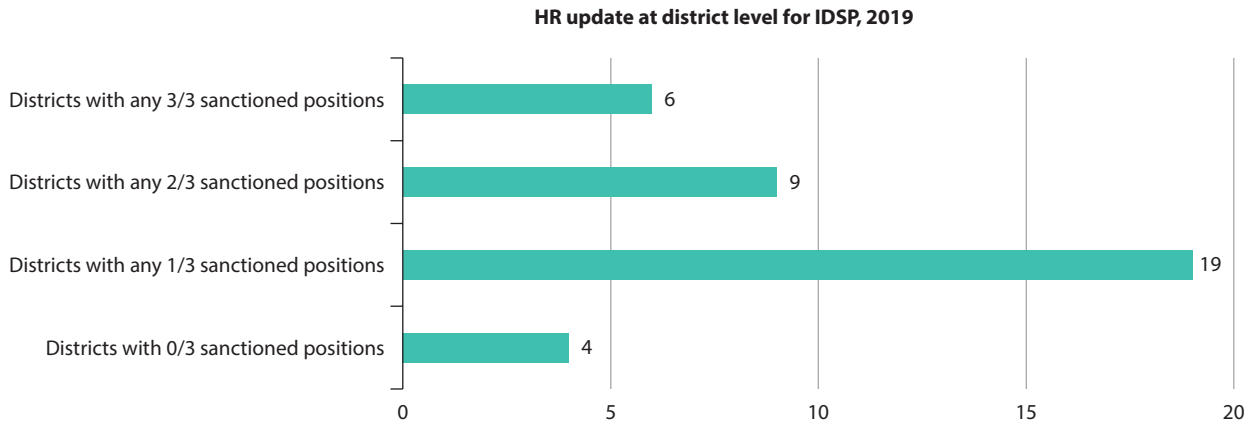


FIGURE 6 Human Resource (HR) availability at the District Surveillance Units of IDSP, Bihar in 2019



acknowledged receiving them. (Figure 5) In majority of the cases, the sanctioned posts were not completely filled. Of the 38 districts in Bihar, 19 districts had one position filled and 4 districts did not have any position filled in 2019. (Figure 6)

As no separate funds for training were provided before 2016, no training sessions were conducted for Medical Officers (MO), health workers, nurses/ pharmacists before 2015-16 for IDSP. From 2017 onwards, ASHAs were also being trained in IDSP, though they did not do any reporting still date but appeared crucial for identification of syndromic cases reported in the S-Form. (Table-4)

Dissemination of data

The infectious diseases reported in Presumptive, Lab-confirmed and Syndromic surveillances and data collected from other vertical disease control programs are collected, compiled and presented by the IDSP Bihar state unit in its weekly, monthly and annual reports.

The annual reports published by the IDSP Bihar update on previous and current annual summaries of reportable communicable disease data for the state collected under IDSP. These include information on new cases, existing diseases, occurrences of

TABLE 4 : Personnel trained by the IDSP, Bihar over the years (2009-2018)

Personnel received training under IDSP											
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
ASHA	-	-	-	-	-	-	-	-	533	393	521
MO* (PHC/DH/RH/SDH)	-	-	-	-	-	-	-	105	200	151	173
MO (MCH)	-	-	-	-	-	-	-	182	93	270	31
Pharmacist/Nurse	-	-	-	-	-	-	-	78	490	578	1507
Block Health Manager	-	-	-	-	-	-	-	189	178	232	3310
Lab technician	-	-	-	-	-	-	-	-	38	-	-

*Source : IDSP, Bihar *MO=Medical office*

outbreaks and other core activities of IDSP. Monthly and weekly data are also available through specific formats from the IDSP cell in Bihar and act as a source of information for disease pattern of reportable diseases in the state.

The annual reports were available till 2017 and the annual report of 2011 included data from 2009 and 2010. Monthly reports are not available for the first three years of IDSP in Bihar (2009-2011) and are incomplete for later years too. There are several months between 2012 and 2017 for which reports are missing. Weekly reports are available from 2013 onwards and provides a summary of reportable disease under IDSP. (Table-5)

Limitations

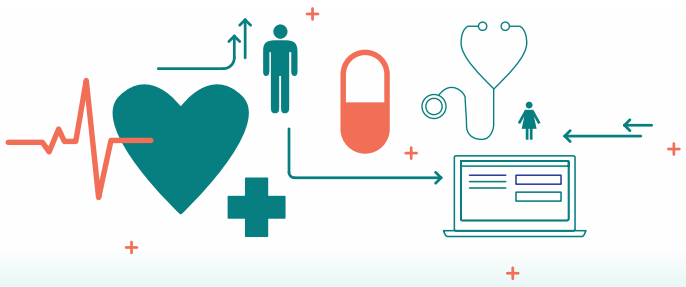
Reporting bias is a probability as data captured under IDSP might be related to program success/ failure and, hence, there might be under-reporting or over-reporting. As this paper is based on secondary data analyses, some of the grey literature might have missed. Despite these limitations, we believe this study may be considered as the first baseline document on evaluation of IDSP for the Government of Bihar and the findings can effectively guide the planning and effective implementation of disease surveillance in the state.

TABLE 5 : Availability of monthly and annual reports of the IDSP in Bihar (2009-2019)

Availability of IDSP monthly and annual reports													
IDSP year	January	February	March	April	May	June	July	August	September	October	November	December	Annual report
2009	X	X	X	X	X	X	X	X	X	X	X	X	-
2010	X	X	X	X	X	X	X	X	X	X	X	X	-
2011	X	X	X	X	X	X	X	X	X	X	X	X	√
2012	X	X	X	X	X	X	X	X	√	√	√	√	√
2013	√	√	√	√	√	√	√	√	√	√	√	√	√
2014	√	√	√	√	√	√	√	√	X	√	√	√	√
2015	√	√	√	√	√	√	√	√	√	√	√	√	√
2016	√	√	√	√	√	√	√	√	X	√	√	X	√
2017	√	√	√	√	√	√	√	√	X	√	X	√	√
2018	X	X	X	X	X	X	√	√	√	√	√	√	X
2019	X	X	X	X	X	X	X	X	X	X	NA	NA	X

X = Not Available; √ = available; Annual report of 2011 includes 2009 and 2008; Source: IDSP, Bihar

Chapter 4



KNOWLEDGE, PRACTICE & PERSPECTIVES REGARDING IDSP AMONG AUXILIARY NURSE MIDWIFE IN BIHAR

Summary

To the best of our knowledge, this was the first study in Bihar that assessed the level of knowledge, practice and perspectives of Auxiliary Nurse Midwife (ANM)s regarding IDSP in Bihar. The overall knowledge of ANMs with regard to syndromic conditions was inadequate. Complexity of filling the syndromic form (S-form), technical inefficiency, lack of supervision and monitoring and timely feedback on reported cases as well as due to false perception that it was only a weekly reporting of just numbers together culminated into the poor knowledge regarding IDSP among ANMs in Bihar.

Findings revealed that overall practices related to routine surveillance activities and outbreak investigation process were poor among ANMs in Bihar. However, ANMs with relatively better knowledge related to IDSP showed good practices. It appeared that current training program provided by the government did not significantly improve their practices related to routine surveillance activities.

A multiprong integrated approach with support and collaborations from various related public health departments, government medical colleges, community-based organizations and local physicians is pertinent to enhance the sensitivity of disease surveillance at the local levels. Sustained and careful planning is required so that ANMs can understand their specific role in IDSP, increase their engagement and can mobilize community towards better epidemic preparedness. Improving practice among ANMs through adequate training, monitoring, supervision and timely feedback could probably help in effective implementation of IDSP in Bihar, and subsequent control of communicable diseases. Qualitative research indicated that improving access to transportation, ensuring safety and adequate formal training on IDSP were some of the critical areas that needed immediate attention for proper implementation of IDSP at the grassroots.

Background

To improve the overall performance of IDSP in Bihar, a community-level motivated health

workforce (CHW) having the right capacity would be critical. Currently, the program is being managed by Auxiliary Nurse Midwife (ANMs), physicians and laboratory technicians at the grass-root levels. Given ANM are selected from the community they serve, it is a great opportunity to utilize them to cater to the unique and diverse needs of the vulnerable population in the rural areas [39]. Furthermore, they can be appropriately trained for effective implementation of essential health interventions tailored to local needs, which are likely to improve the health outcomes [39]. However, poorly-defined job responsibilities and lack of clarity in accountability often led to underutilization of ANMs' work capacity, culminating into their underperformance [39, 40].

Although ANM have been traditionally involved in maternal and child health services, their engagement in prevention and control of infectious disease outbreaks is limited [30]. Several training modules on community-case management of influenza and acute respiratory infections were released by the World Health Organization for community health workers [41, 42]. Despite these recommendations, there are gaps in the evidence with regards to contribution of community-health workers and volunteers in epidemic preparedness. Only few reported from African countries which included Ebola outbreak [43], Malaria control [44] and HIV care [45]. Alike in other countries, the potential role of community-health workers in infectious disease surveillance and outbreak response never received its due priority in India. Therefore, ANMs were under-utilized in the response to the infectious disease outbreaks and during routine surveillance activities and little attention had been given to their potential in contributing community-preparedness for control or prevention of communicable diseases. Therefore, a good quality epidemiological research appeared critical to identify the gaps in skill, capacity and capability of this existing workforce and future training needs. However, such data were limited in India and almost non-existent in Bihar.

Bihar, one of the most impoverished and densely populated Indian states [37, 44], continues to experience recurrent outbreaks of water and vector-borne diseases despite several control programs are in place including the Integrated Disease Surveillance Program (IDSP).[36] According to the Government report, it appeared that the risk of many vector and waterborne diseases (Dengue, Malaria, Japanese encephalitis, Leishmaniasis, Typhoid, Hepatitis, Diarrhea, Dysentery) as well as vaccine-preventable diseases (Chicken-pox, Measles, Diphtheria, Mumps) are still high in the state.[36] Majority of these diseases are reported from rural areas, where approximately 90% of the population reside [37, 44]. Therefore, it is crucial to better understanding the role and responsibilities of ANM in epidemic preparedness in the state as they are the first point of care for the rural people. Till date, only one study assessed the feasibility of engaging village health workers for control of Kala-azar in Bihar [46]. Against this backdrop and paucity of information, the current study made an attempt to assess ANM's knowledge regarding the IDSP and surveillance activities among ANMs in Bihar so that the findings could guide policy makers in designing effective strategy for appropriate implementation of IDSP in Bihar using this workforce.

Findings

A total of 241 on-duty consenting ANMs from 241 health sub-centers were interviewed across the

three districts- Begusarai, Darbhanga and Bhojpur. Information on socio-demographic characteristics, job-related factors, general knowledge regarding surveillance, disease syndromes, reporting formats, conditions for immediate referral and outbreak investigation were collected through an offline-online synchronized data collection application. In addition, 225 in-depth interviews were conducted to capture the real-life work experiences of ANMs in rural Bihar, including challenges and facilitators of the IDSP program.

Socio-demographic profile and job-related factors

The mean age was 45 years and the majority belonged to 41-50 years age category. The average length of service as ANM was 16 years and the mean duration of work related to IDSP was little over 6 years. The distributions of age and job duration differed across districts. On an average, about 2 ANMs were working at each sub-center [Table-1A].

Overall, about 71% ANMs were permanent employees and rest were contractual. The majority completed education at least up to the 8th standard, were married and belonged to the Hindu religion. Similar distributions were observed across all districts. [Table 1B].

Approximately 83% ANMs lived outside their catchment area, more so in Begusarai. An estimated 64% availed public transport to reach their workplace and 20% reached on foot. However, in Darbhanga about 28% were using their own vehicle. On an average, in the majority, one-way commute time ranged from less than an hour to an hour in all three districts. Almost all respondents said that the field visit was a part of their routine activities [Table 1C].

IDSP-related knowledge

Nearly, all ANMs knew about the name of IDSP running in their block. More than 50% of the respondents were unaware of the specific name of the reporting form (Syndromic or S form). Knowledge regarding the number of reporting forms generated at the center was also poor, particularly in Darbhanga. Further, more than 50% of ANMs did not have any knowledge regarding the reporting week under IDSP in Darbhanga and Bhojpur. Overall knowledge regarding the syndromes captured under IDSP among ANMs appeared to be good in Begusarai, average in Darbhanga and poor in Bhojpur. Approximately 88% and 70% of respondents in Darbhanga and Bhojpur, respectively, did not have the knowledge regarding the number of syndromes captured under IDSP. Considering the individual syndromes to be captured under IDSP, it was observed that only a small proportion of participants were aware that cases experiencing the other symptoms like fever less than 7 days with bleeding, daze/semi-/unconscious, loose watery stool of less than 2 weeks duration with bleeding, jaundice of less than 4 weeks and unusual symptoms leading to death or hospitalization, also needed to be captured. The most concerning fact was that almost all respondents did not have the correct knowledge regarding an outbreak [Tables 1D & 1E1&2].

The overall knowledge regarding conditions which required immediate referral was also poor. The majority of the ANMs were also not aware that cases for example, diarrhea with blood in stools, fever with bleeding, fever with a complete or partial loss of consciousness and convulsions required immediate referral to nearby health facilities [Tables 1F].

Overall knowledge about IDSP was poor in Darbhanga. Approximately 77% of respondents did not receive proper training under the IDSP program, particularly in the Bhojpur district. Nearly 92% ANMs did not receive any feedback from their supervisors at the district level over the last 6 months [Table 1G].

Regression analyses revealed a positive association between age and overall knowledge related to IDSP. With an advance in age, the odds of having relatively better IDSP-related knowledge increased in both unadjusted and adjusted models. No significant associations were found with education or the current formal training program on IDSP in general **[Table 2].**

IDSP-related practice

The majority showed a good practice related to capturing the potential cases at the facility (sub-center) level (97.5%) and from the community (92.5%). Nearly all respondents stated reporting of unusual clustering of cases or unusual events to the designated medical officers. About 94% participants admitted weekly submission of S forms to the next higher levels. However, record keeping of cases having two or more than two symptoms appeared poor. The overall practice regarding the maintenance of office copy of S reporting form (79%) and community-based data (43%) was unsatisfactory, more so in Darbhanga [Table 3].

Findings indicated that overall practice related to IDSP routine surveillance among ANM was poor. Only 22% of the respondents showed good practice. Near about 50% of the respondents in Darbhanga and 58% in Bhojpur reported that their works were not monitored by their supervisors. Monitoring of data collection by supervisor appeared poor in poor in Bhojpur (42%) followed in Darbhanga (52%) **[Table 4].**

Logistic regression analyses revealed a positive association between the overall IDSP-related knowledge and practices related to routine surveillance activities in both unadjusted and adjusted models. In addition, ANMs having relatively better IDSP-related knowledge and those who received formal training on IDSP were more likely to fill S forms correctly. It was also observed that the likelihood of filling S forms accurately was higher in health sub-centers with better system preparedness [Table 5 & 6].

IDSP-related perspectives

Qualitative findings for ANM of the current study were presented under two broad categories: (1) Role of ANMs (2) Factors influencing ANMs' performance. Several contextual factors were identified in the current analysis displayed in [Table 7].

Role of ANMs in Bihar

ANMs acted as a health care provider, mentor of ASHA, community-level educator, a key implementer of specific health programs like IDSP and a crucial link between ASHA and communities as shown in Figure 1. The current study showed that ANMs were the first contact and had direct interaction with the communities and also played a crucial role in addressing the health needs of the community at the local level. They continued to disseminate health-related information, generate awareness regarding maternal and child health, and importance of hygienic practices.

> *"We (ANMs) create a link between the community and public health center. If we find any serious patient, we refer them to the public health centers and also, we do regular check-up of pregnant women, like anemia, hemoglobin, and other blood tests." (Interviewee no. 8; 53, married; Begusarai).*

ANMs were considered as a mentor of ASHA, Anganwadi and Mukhiya during the Village Health Sanitation and Nutrition Day (VHSND) meeting. ANMs trained them for several activities including hygienic practices, signs and symptoms related to infectious diseases, maternal health, and immunization, particularly in remote areas, while ASHA and Anganwadi, and Mukhiya were also regarded as important health informers for ANMs.

> *"I teach ASHA, and Anganwadi regarding identification of sign and symptoms of infectious diseases, while ASHA, Anganwadi and Mukhiya provide me information related to communicable diseases or any illness in their villages." (Interviewee no. 17; 32, married; Bhojpur and Interviewee no. 1; 55, married; Begusarai).*

Findings revealed that ANMs were trained for providing immunization and were also capable of using basic equipment at the facility, including weighing machine, blood pressure machine. They were able to treat minor illnesses and provide basic health care services.

> *"The patients, elderly person and pregnant women visit me (ANM) to seek my service during the outdoor time. We measure their weight, blood pressure, and provide some basic medicines, ORS, give suggestions regarding warning signs related to pregnancy complications, etc." (Interviewee no. 2; 54, married; Begusarai).*

Analysis indicated that respondents were not much aware of IDSP in general. The majority of the participants said that they used to submit a syndromic (S)-Form during the Tuesday meeting, although, most of the ANMs expressed the need for further training for IDSP. They were mostly instructed to achieve immunization target, included the Measles-Rubella program, Polio program, maternal health program, etc. Some of them narrated that they also asked symptoms related to common infectious diseases during their routine field visits.

> *"When I go to field, we ask the community-people, ASHA, Anganwadi for any potential case with regard to communicable diseases. If I find a child with fever, cough, dehydration, I note it down in a register or if required, I refer the child to PHC, after that I fill S-form so that I could submit during the Tuesday meeting, although, we need training to improve our knowledge about IDSP". (Interviewee no. 24; 55, married; Begusarai) & (Interviewee no. 21; 35, married; Bhojpur).*

Factors influencing ANMs' performance (Figure 1 and Box 2)

Training

Most of the respondents shared that formal training on IDSP was inadequate and was never a priority to health officials. They expressed their desire for additional training to improve their knowledge, skills, and performance, so that IDSP could be implemented in an efficient manner.

> *"I don't know much about IDSP. It would be great if I could have additional training about IDSP. so that the S-Form reporting skill can be immediately improved." (Interviewee no. 22; 49, married; Bhojpur).*

Motivation

The majority of the participants narrated that opportunity to serve society and family

support were the main sources of motivation for them.

> *"Public service is a social work and also my family said that you are serving your own people. This will help you in future. (Interviewee no. 9; 51, married; Bhojpur) and Interviewee no. 19; 57, married; Begusarai).*

Supervision

Findings showed that supportive supervision by the medical officer-in-charge (MOIC) and medical officers (MO)s were irregular at the health sub-center level. The supervision was only done at the district level. ANMs were supposed to attend weekly and monthly meetings organized at PHC for submission of weekly reports, although IDSP-specific topics were usually not discussed during these meetings. However, majority of the ANMs provided positive feedback about their supervisors, probably due to fear of losing their jobs.

> *"Yes, sir, our supervisor sir always helps us. When we are in trouble, we call him and sir gives us suggestions." (Interviewee no. 25;43, married; Bhojpur).*

Monetary incentives

Monetary compensation was noted as an important factor that influenced the performance of ANMs. They stated that salary was insufficient and irregular, and the situation was very frustrating for them. The majority of ANMs were financially supporting their families for their children's education, and for such irregularities they used to experience huge stress both at the job place and in family. They felt that an increase in salary and regularity in payment were likely to reduce their stress and likely to have a positive impact on their performance.

> *"Sir, we get very low monetary incentives for our job. We have many family responsibilities. Money is the most important thing for us. If we get payment on time, it will motivate us for doing hard work. (Interviewee nos. 18,20;52,30, married; Darbhanga) and (Interviewee no. 25; 52, married; Begusarai).*

Attitude & cultural beliefs

Several ANMs mentioned that villagers' rude behavior often prevented them from exercising their routine work. Sometimes villagers passed discriminatory comments. They also stated that public in general are very gender-biased and as a woman they felt humiliated during field visits.

> *"I don't feel safe. Villagers pass discriminatory comments, but nevertheless I go for the regular field visit." (Interviewee no. 17; 31, married; Begusarai).*

Transportation

Interactions with ANMs revealed they used to waste enough time (on an average, 2-3 hours) to reach allotted villages due to lack of proper road connectivity and availability of public transport, particularly in Darbhanga. Due to lack of public transport, they could not reach the targeted beneficiaries, especially pregnant women and children in remote areas.

> *"Every day I have to face difficulties due to long commute time. Sometimes my allotted village is far from sub-center and primary health center. Many a times, no public vehicles are available and I go on foot and also, I reach home very late." (Interviewee nos. 12 and 24;41 and 47, married; Bhojpur)*

"Yes, sir we face difficulties in reaching our work place. Need to walk a long distance." (Interviewee no. 51;52, widow; Darbhanga)

Basic Infrastructure at sub-center

Most of the ANMs highlighted that there was a lack of basic necessities, including drinking water, toilet facilities and sitting arrangement, especially in Bhojpur. They also shared that measuring instruments including blood pressure machine, weighing machine were not available, and even if available, mostly were not functional.

"There is problem of drinking water and toilets facilities at both PHC (primary health centre) and HSC (health subcenter). The chairs are broken and weight and blood pressure machine are not working properly. Sometimes it becomes a reason for squabble between public and health personals." (Interviewee no. 21; 35, married; Bhojpur)

TABLE 1A: Distributions (overall and stratified) of age and job-duration of respondents (ANM) working in IDSP, Bihar, 2019

Indicator	Stratified table by District							
	Overall		Begusarai		Darbhanga		Bhojpur	
	N	Mean (95% CI)	N	Mean (95% CI)	N	Mean (95% CI)	N	Mean (95% CI)
Age (in years)	241	44.95 (43.84-46.06)	80	46.40 (44.42-48.38)	80	43.76 (41.86-45.66)	81	44.69 (42.75-46.63)
Job duration as ANM (in months)	241	194.87 (179.46-210.28)	80	230.16 (200.76-59.57)	80	163.31 (138.63-188.00)	81	191.17 (166.34-216.00)
Job duration in IDSP (in months)	241	74.57 (69.10-80.04)	80	67.38 (62.21-72.54)	80	73.10 (63.06-83.14)	81	83.12 (71.21-95.04)
Total number of staff at health subcenter	241	1.39 (1.32-1.47)	80	1.70 (1.56-1.84)	80	1.15 (1.06-1.24)	81	1.33 (1.22-1.45)

TABLE 1B: Socio-demographic distributions (overall and stratified) of the respondents (ANM) working in IDSP, Bihar, 2019

Indicator	Category	Categorical variables		Stratified table by District					
				Begusarai		Darbhanga		Bhojpur	
		N	% (95% CI)	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)
Employment contract	Permanent	170	70.54 (64.74-76.34)	64	80.00 (71.04-88.96)	52	65.00 (54.32-75.68)	54	66.67 (56.18-77.16)
	Contractual	71	29.46 (23.66-35.26)	16	20.00 (11.04-28.96)	28	35.00 (24.32-45.68)	27	33.33 (22.84-43.82)
Education	Beyond 8th standard	205	85.06 (80.53-89.59)	68	85.00 (77.00-93.00)	67	83.75 (75.49-92.01)	70	86.42 (78.80-94.04)
	Graduate/Post-graduation	36	14.94 (10.41-19.47)	12	15.00 (7.00-23.00)	13	16.25 (7.99-24.51)	11	13.58 (5.96-21.20)
Marital status	Married	225	93.36 (90.20-96.53)	75	93.75 (88.33-99.17)	76	95.00 (90.12-99.88)	74	91.36 (85.11-97.61)
	Unmarried	3	1.24 (0.00- 2.65)	1	1.25 (0.00-3.74)	_	_	2	2.47 (0.00-5.92)
	Widow	13	5.39 (2.52- 8.27)	4	5.00 (0.12-9.88)	4	5.00 (0.12-9.88)	5	6.17 (0.82-11.53)
Religion	Hindu	237	98.34 (96.72-99.96)	80	100.0 (100.0-100.0)	78	97.50 (94.00-100.0)	79	97.53 (94.08-100.0)
	Muslim	2	0.83 (0.00- 1.98)	_	_	_	_	2	2.47 (0.00-5.92)
	Christian	1	0.41 (0.00- 1.23)	_	_	1	1.25 (0.00-3.74)	_	_
	Other	1	0.41 (0.00- 1.23)	_	_	1	1.25 (0.00-3.74)	_	_

TABLE 1C: Distributions (overall and stratified) of job-related factors of respondents (ANM) working in IDSP, Bihar, 2019

Indicator	Category	Categorical variables		Stratified table by District					
				Begusarai		Darbhanga		Bhojpur	
		N	% (95% CI)	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)
Living in same catchment area	Yes	42	17.43(12.60-22.25)	10	12.50 (5.09-19.91)	19	23.75 (14.22-33.28)	13	16.05 (7.88-24.22)
	No	199	82.57(77.75-87.40)	70	87.50 (80.09-94.91)	61	76.25 (66.72-85.78)	68	83.95 (75.78-92.12)
Mode of transport to work place	By foot	47	19.50(14.46-24.54)	13	16.25 (7.99-24.51)	20	25.00 (15.30-34.70)	14	17.28 (8.87-25.70)
	By public transport	155	64.32(58.22-70.41)	56	70.00 (59.74-80.26)	38	47.50 (36.32-58.68)	61	75.31 (65.71-84.90)
	By own vehicle	39	16.18(11.50-20.87)	11	13.75 (6.04-21.46)	22	27.50 (17.50-37.50)	6	7.41 (1.58-13.23)
Field visit required	Yes	229	95.02(92.25-97.79)	80	100.0 (100.0-100.0)	68	85.00 (77.00-93.00)	81	100.0 (100.0-100.0)
	No	12	4.98(2.21- 7.75)	_	_	12	15.00 (7.00-23.00)	_	_

TABLE 1D: Knowledge and awareness related to IDSP in general (overall and stratified) of respondents (ANM) working in IDSP, Bihar, 2019

Indicator	Category	Categorical variables		Stratified table by District					
				Begusarai		Darbhanga		Bhojpur	
		N	% (95% CI)	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)
Aware of IDSP in the block	Yes	236	97.93(96.11-99.74)	80	100.0 (100.0-100.0)	75	93.75 (88.33-99.17)	81	100.0 (100.0-100.0)
	No	5	2.07(0.26- 3.89)	_	_	5	6.25 (0.83-11.67)	_	_
Knowledge regarding reporting format	Incorrect	28	11.62(7.54-15.69)	_	_	23	28.75 (18.61-38.89)	5	6.17 (0.82-11.53)
	Correct	213	88.38(84.31-92.46)	80	100.0 (100.0-100.0)	57	71.25 (61.11-81.39)	76	93.83 (88.47-99.18)
Knowledge regarding name of reporting form	Incorrect	122	50.62(44.27-56.98)	40	50.00 (38.80-61.20)	44	55.00 (43.86-66.14)	38	46.91 (35.81-58.02)
	Correct	119	49.38(43.02-55.73)	40	50.00 (38.80-61.20)	36	45.00 (33.86-56.14)	43	53.09 (41.98-64.19)
Knowledge regarding number of reporting form generated at HSC	Incorrect	136	56.43(50.13-62.74)	25	31.25 (20.87-41.63)	80	100.0 (100.0-100.0)	31	38.27 (27.46-49.09)
	Correct	105	43.57(37.26-49.87)	55	68.75 (58.37-79.13)	_	_	50	61.73 (50.91-72.54)
Knowledge regarding reporting week of IDSP	Incorrect	98	40.66(34.42-46.91)	_	_	57	71.25 (61.11-81.39)	41	50.62 (39.49-61.74)
	Correct	143	59.34(53.09-65.58)	80	100.0 (100.0-100.0)	23	28.75 (18.61-38.89)	40	49.38 (38.26-60.51)

TABLE 1E1: Knowledge related to specific syndromes to be captured under IDSP (overall and stratified) among respondents (ANM), Bihar, 2019)

Indicator	Category	Stratified table by District							
		Categorical variables		Begusarai		Darbhanga		Bhojpur	
		N	% (95% CI)	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)
Knowledge regarding the number of syndromes captured under IDSP	Incorrect	161	66.80 (60.82-72.79)	34	42.50 (31.43-53.57)	70	87.50 (80.09-94.91)	57	70.37 (60.21-80.53)
	Correct	80	33.20 (27.21-39.18)	46	57.50 (46.43-68.57)	10	12.50 (5.09-19.91)	24	29.63 (19.47-39.79)
Knowledge regarding syndromes under IDSP: Fever less than 7 days only	Incorrect	66	27.39 (21.72-33.06)	_	_	57	71.25 (61.11-81.39)	9	11.11 (4.12-18.10)
	Correct	175	72.61 (66.94-78.28)	80	100.0 (100.0-100.0)	23	28.75 (18.61-38.89)	72	88.89 (81.90-95.88)
Knowledge regarding syndromes under IDSP: Fever less than 7 days with rash	Incorrect	104	43.15 (36.86-49.45)	2	2.50 (0.00-6.00)	56	70.00 (59.74-80.26)	46	56.79 (45.77-67.81)
	Correct	137	56.85 (50.55-63.14)	78	97.50 (94.00-100.0)	24	30.00 (19.74-40.26)	35	43.21 (32.19-54.23)
Knowledge regarding syndromes under IDSP: Fever less than 7 days with bleeding	Incorrect	216	89.63(85.75-93.50)	68	85.00 (77.00-93.00)	72	90.00 (83.28-96.72)	76	93.83 (88.47-99.18)
	Correct	25	10.37(6.50-14.25)	12	15.00 (7.00-23.00)	8	10.00 (3.28-16.72)	5	6.17 (0.82-11.53)
Knowledge regarding syndromes under IDSP: Fever less than 7 days with daze/semi-/un-consciousness	Incorrect	191	79.25(74.10-84.41)	42	52.50 (41.32-63.68)	74	92.50 (86.60-98.40)	75	92.59 (86.77-98.42)
	Correct	50	20.75(15.59-25.90)	38	47.50 (36.32-58.68)	6	7.50 (1.60-13.40)	6	7.41 (1.58-13.23)
Knowledge regarding syndromes under IDSP: Fever greater than 7 days only	Incorrect	72	29.88(24.06-35.70)	1	1.25 (0.00-3.74)	60	75.00 (65.30-84.70)	11	13.58 (5.96-21.20)
	Correct	169	70.12(64.30-75.94)	79	98.75 (96.26-100.0)	20	25.00 (15.30-34.70)	70	86.42 (78.80-94.04)
Knowledge regarding syndromes under IDSP: Cough with or without fever less than 2 weeks	Incorrect	85	35.27(29.19-41.35)	12	15.00 (7.00-23.00)	36	45.00 (33.86-56.14)	37	45.68 (34.60-56.76)
	Correct	156	64.73(58.65-70.81)	68	85.00 (77.00-93.00)	44	55.00 (43.86-66.14)	44	54.32 (43.24-65.40)
Knowledge regarding syndromes under IDSP: Cough with or without fever greater than 2 weeks	Incorrect	109	45.23(38.90-51.56)	12	15.00 (7.00-23.00)	51	63.75 (52.98-74.52)	46	56.79 (45.77-67.81)
	Correct	132	54.77(48.44-61.10)	68	85.00 (77.00-93.00)	29	36.25 (25.48-47.02)	35	43.21 (32.19-54.23)

TABLE 1E2: Knowledge related to specific syndromes to be captured under IDSP among respondents (ANM), Bihar, 2019)

Indicator	Category	Categorical variables		Stratified table by District					
				Begusarai		Darbhanga		Bhojpur	
		N	% (95% CI)	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)
Knowledge regarding syndromes under IDSP: Loose watery stools of less than 2 weeks duration with no dehydration	Incorrect	125	51.87(45.51-58.22)	3	3.75 (0.00-8.00)	64	80.00 (71.04-88.96)	58	71.60 (61.57-81.64)
	Correct	116	48.13(41.78-54.49)	77	96.25 (92.00-100.0)	16	20.00 (11.04-28.96)	23	28.40 (18.36-38.43)
Knowledge regarding syndromes under IDSP: Loose watery stools of less than 2 weeks duration with some/much dehydration	Incorrect	126	52.28(45.93-58.63)	4	5.00 (0.12-9.88)	65	81.25 (72.51-89.99)	57	70.37 (60.21-80.53)
	Correct	115	47.72(41.37-54.07)	76	95.00 (90.12-99.88)	15	18.75 (10.01-27.49)	24	29.63 (19.47-39.79)
Knowledge regarding syndromes under IDSP: Loose watery stools of less than 2 weeks duration with bleeding	Incorrect	208	86.31(81.94-90.68)	64	80.00 (71.04-88.96)	73	91.25 (84.92-97.58)	71	87.65 (80.34-94.97)
	Correct	33	13.69(9.32-18.06)	16	20.00 (11.04-28.96)	7	8.75 (2.42-15.08)	10	12.35 (5.03-19.66)
Knowledge regarding syndromes under IDSP: Jaundice cases of less than 4 weeks	Incorrect	190	78.84(73.64-84.03)	39	48.75 (37.56-59.94)	75	93.75 (88.33-99.17)	76	93.83 (88.47-99.18)
	Correct	51	21.16(15.97-26.36)	41	51.25 (40.06-62.44)	5	6.25 (0.83-11.67)	5	6.17 (0.82-11.53)
Knowledge regarding syndromes under IDSP: Acute Flaccid Paralysis cases in less than 15 years	Incorrect	124	51.45(45.10-57.81)	14	17.50 (8.99-26.01)	66	82.50 (73.99-91.01)	44	54.32 (43.24-65.40)
	Correct	117	48.55(42.19-54.90)	66	82.50 (73.99-91.01)	14	17.50 (8.99-26.01)	37	45.68 (34.60-56.76)
Knowledge regarding syndromes under IDSP: Unusual symptoms leading to death or hospitalization	Incorrect	146	60.58(54.37-66.79)	11	13.75 (6.04-21.46)	80	100.0 (100.0-100.0)	55	67.90 (57.51-78.29)
	Correct	95	39.42(33.21-45.63)	69	86.25 (78.54-93.96)	_	_	26	32.10 (21.71-42.49)
Overall knowledge regarding syndromes captured under IDSP	Poor	92	38.17(32.00-44.35)	1	1.25 (0.00-3.74)	58	72.50 (62.50-82.50)	33	40.74 (29.81-51.67)
	Average	74	30.71(24.84-36.57)	16	20.00 (11.04-28.96)	22	27.50 (17.50-37.50)	36	44.44 (33.39-55.50)
	Good	75	31.12(25.23-37.01)	63	78.75 (69.59-87.91)	_	_	12	14.81 (6.91-22.72)

TABLE 1F: Knowledge and practice related to capture of probable cases and referral conditions among respondents (ANM), Bihar, 2019

Indicator	Category	Categorical variables		Stratified table by District					
				Begusarai		Darbhanga		Bhojpur	
		N	% (95% CI)	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)
Practice: capturing a case with 2 or more symptoms	Poor	42	17.43(12.60-22.25)	66	82.50 (73.99-91.01)	34	42.50 (31.43-53.57)	8	9.88 (3.24-16.51)
	Average	129	53.53(47.18-59.87)	14	17.50 (8.99-26.01)	25	31.25 (20.87-41.63)	38	46.91 (35.81-58.02)
	Good	70	29.05(23.27-34.82)			21	26.25 (16.40-36.10)	35	43.21 (32.19-54.23)
Knowledge regarding an outbreak	Incorrect	240	99.59(98.77-100.0)	79	98.75 (96.26-100.0)	80	100.0 (100.0-100.0)	81	100.0 (100.0-100.0)
	Correct	1	0.41(0.00- 1.23)	1	1.25 (0.00-3.74)				
Practice: reporting unusual clustering of cases or unusual events	Poor	4	1.66(0.04- 3.28)	1	1.25 (0.00-3.74)	3	3.75 (0.00-8.00)		
	Average	19	7.88(4.46-11.31)	4	5.00 (0.12-9.88)	11	13.75 (6.04-21.46)	4	4.94 (0.12-9.76)
	Good	218	90.46(86.72-94.19)	75	93.75 (88.33-99.17)	66	82.50 (73.99-91.01)	77	95.06 (90.24-99.88)
Person to whom ANM reports unusual clustering of cases or unusual events	Poor	1	0.42(0.00- 1.25)			1	1.30 (0.00-3.89)		
	Good	236	99.58(98.75-100.0)	79	100.0 (100.0-100.0)	76	98.70 (96.11-100.0)	81	100.0 (100.0-100.0)
Condition requiring immediate referral: Diarrhea with dehydration	Incorrect	44	18.26(13.35-23.17)	1	1.25 (0.00-3.74)	36	45.00 (33.86-56.14)	7	8.64 (2.39-14.89)
	Correct	197	81.74(76.83-86.65)	79	98.75 (96.26-100.0)	44	55.00 (43.86-66.14)	74	91.36 (85.11-97.61)
Condition requiring immediate referral: Diarrhea with blood in stools	Incorrect	206	85.48(81.00-89.96)	58	72.50 (62.50-82.50)	71	88.75 (81.67-95.83)	77	95.06 (90.24-99.88)
	Correct	35	14.52(10.04-19.00)	22	27.50 (17.50-37.50)	9	11.25 (4.17-18.33)	4	4.94 (0.12-9.76)
Condition requiring immediate referral: Fever with bleeding	Incorrect	215	89.21(85.27-93.16)	67	83.75 (75.49-92.01)	72	90.00 (83.28-96.72)	76	93.83 (88.47-99.18)
	Correct	26	10.79(6.84-14.73)	13	16.25 (7.99-24.51)	8	10.00 (3.28-16.72)	5	6.17 (0.82-11.53)
Condition requiring immediate referral: Fever with partial or complete loss of consciousness	Incorrect	145	60.17(53.94-66.39)	39	48.75 (37.56-59.94)	54	67.50 (57.01-77.99)	52	64.20 (53.53-74.86)
	Correct	96	39.83(33.61-46.06)	41	51.25 (40.06-62.44)	26	32.50 (22.01-42.99)	29	35.80 (25.14-46.47)
Condition requiring immediate referral: Convulsions	Incorrect	166	68.88(62.99-74.77)	34	42.50 (31.43-53.57)	68	85.00 (77.00-93.00)	64	79.01 (69.95-88.07)
	Correct	75	31.12(25.23-37.01)	46	57.50 (46.43-68.57)	12	15.00 (7.00-23.00)	17	20.99 (11.93-30.05)

TABLE 1F: Knowledge and practice related to capture of probable cases and referral conditions among respondents (ANM), Bihar, 2019 *(Contd...)*

Indicator	Category	Categorical variables		Stratified table by District					
				Begusarai		Darbhanga		Bhojpur	
		N	% (95% CI)	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)
Condition requiring immediate referral: Unusual diseases/cases	Incorrect	78	32.37(26.42-38.31)	5	6.25 (0.83-11.67)	66	82.50 (73.99-91.01)	7	8.64 (2.39-14.89)
	Correct	163	67.63(61.69-73.58)	75	93.75 (88.33-99.17)	14	17.50 (8.99-26.01)	74	91.36 (85.11-97.61)
Overall knowledge regarding conditions for referral	Poor	128	53.11(46.77-59.46)	15	18.75(10.01-27.49)	68	85.00 (77.00-93.00)	45	55.56 (44.50-66.61)
	Average	54	22.41(17.10-27.71)	23	28.75(18.61-38.89)	7	8.75 (2.42-15.08)	24	29.63 (19.47-39.79)
	Good	59	24.48(19.01-29.95)	42	52.50(41.32-63.68)	5	6.25 (0.83-11.67)	12	14.81 (6.91-22.72)

TABLE 1G: Overall IDSP-related knowledge and training/supervision among respondents (ANM), Bihar, 2019

Domain	Indicator	Category	Categorical variables		Stratified table by District					
					Begusarai		Darbhanga		Bhojpur	
			N	% (95% CI)	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)
OVERALL KNOWLEDGE		Poor	105	43.57(37.26-49.87)	5	6.25 (0.83-11.67)	69	86.25 (78.54-93.96)	31	38.27 (27.46-49.09)
		Average	72	29.88(24.06-35.70)	24	30.00 (19.74-40.26)	11	13.75 (6.04-21.46)	37	45.68 (34.60-56.76)
		Good	64	26.56(20.94-32.17)	51	63.75 (52.98-74.52)	_	_	13	16.05 (7.88-24.22)
TRAINING & SUPERVISION	Received formal training on IDSP	No	185	76.76(71.39-82.13)	59	73.75 (63.90-83.60)	55	68.75 (58.37-79.13)	71	87.65 (80.34-94.97)
		Yes	56	23.24(17.87-28.61)	21	26.25 (16.40-36.10)	25	31.25 (20.87-41.63)	10	12.35 (5.03-19.66)
	Monitoring of data collection by Supervisor	No	90	37.34(31.19-43.50)	5	6.25 (0.83-11.67)	38	47.50 (36.32-58.68)	47	58.02 (47.04-69.01)
		Yes	151	62.66(56.50-68.81)	75	93.75 (88.33-99.17)	42	52.50 (41.32-63.68)	34	41.98 (30.99-52.96)
	Frequency of monitoring data collection process among those who reported daily monitoring	Weekly	16	84.21(66.15-100.0)	8	72.73 (41.35-100.0)	7	100.0 (100.0-100.0)	1	100.0 (.-.)
		Monthly	3	15.79(0.00-33.85)	3	27.27 (0.00-58.65)	_	_	_	_
	Received feedback from supervisor at the district-level	Yes	20	8.30(4.79-11.81)	5	6.25 (0.83-11.67)	12	15.00 (7.00-23.00)	3	3.70 (0.00-7.91)
		No	221	91.70(88.19-95.21)	75	93.75 (88.33-99.17)	68	85.00 (77.00-93.00)	78	96.30 (92.09-100.0)

TABLE 2: Association between overall knowledge related to IDSP and socio-demographic factors as well as training among respondents (ANM, n=241) in Bihar, 2019

Description	Categories	Type*	Overall Knowledge (Reference=Poor)			
			Average		Good	
			OR (95% CI)	P-Value	OR (95% CI)	P-Value
Age	-	UOR	1.04(1.01-1.08)	0.0181	1.02(0.98-1.05)	0.3305
		AOR	1.05(1.01-1.10)	0.0078	1.02(0.98-1.06)	0.2737
Education (Reference=Beyond 8th standard)	Graduate/Post-graduation	UOR	0.97(0.41-2.29)	0.9406	1.25(0.53-2.91)	0.6125
		AOR	1.31(0.52-3.27)	0.5631	1.47(0.60-3.58)	0.4026
Received formal training on IDSP (Reference=No)	Yes	UOR	0.77(0.37-1.61)	1.6130	1.16(0.57-2.36)	2.3630
		AOR	0.61(0.28-1.30)	0.1997	1.06(0.50-2.23)	0.8813

***UOR= Unadjusted Odds Ratio*
AOR= Adjusted Odds Ratio, adjusted for age and education

TABLE 3: Practice related to job-responsibilities (overall and stratified) of respondents (ANM) working in IDSP, Bihar, 2019

Indicators	Category	Categorical variables (Overall)		Stratified table by District					
				Begusarai		Darbhanga		Bhojpur	
		N	% (95% CI)	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)
Practice: Capture potential cases of infectious diseases at subcenter	Poor	6	2.49(0.51- 4.47)	–	–	2	2.50 (0.00-6.00)	4	4.94 (0.12-9.76)
	Good	235	97.51 (95.53-99.49)	80	100.0 (100.0-100.0)	78	97.50 (94.00-100.0)	77	95.06 (90.24-99.88)
Practice: Record keeping of potential cases at facility	Poor	26	10.79 (6.84-14.73)	–	–	26	32.50 (22.01-42.99)	–	–
	Average	214	88.80 (84.79-92.81)	79	98.75 (96.26-100.0)	54	67.50 (57.01-77.99)	81	100.0 (100.0-100.0)
	Good	1	0.41 (0.00- 1.23)	1	1.25 (0.00-3.74)	–	–	–	–
Practice: submission of forms	Poor	15	6.22 (3.15- 9.30)	–	–	14	17.50 (8.99-26.01)	1	1.23 (0.00-3.69)
	Average	–	–	–	–		–	–	–
	Good	226	93.78 (90.70-96.85)	80	100.0 (100.0-100.0)	66	82.50 (73.99-91.01)	80	98.77 (96.31-100.0)

TABLE 3: Practice related to job-responsibilities (overall and stratified) of respondents (ANM) working in IDSP, Bihar, 2019 *Contd...)*

Indicators	Category	Stratified table by District							
		Categorical variables (Overall)		Begusarai		Darbhanga		Bhojpur	
		N	% (95% CI)	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)
Practice: day of submission	Poor	31	12.86 (8.61-17.12)	8	10.00 (3.28-16.72)	19	23.75 (14.22-33.28)	4	4.94 (0.12-9.76)
	Average	1	0.41 (0.00- 1.23)			1	1.25 (0.00-3.74)	–	–
	Good	209	86.72 (82.41-91.04)	72	90.00 (83.28-96.72)	60	75.00 (65.30-84.70)	77	95.06 (90.24-99.88)
Practice: Maintenance of office copy of reporting forms	Poor	190	78.84 (73.64-84.03)	49	61.25 (50.34-72.16)	78	97.50 (94.00-100.0)	63	77.78 (68.53-87.03)
	Good	51	21.16 (15.97-26.36)	31	38.75 (27.84-49.66)	2	2.50 (0.00-6.00)	18	22.22 (12.97-31.47)
Practice: Capturing cases from community	No	18	7.47 (4.13-10.81)	–	–	18	22.50 (13.15-31.85)	–	–
	Yes	223	92.53 (89.19-95.87)	80	100.0 (100.0-100.0)	62	77.50 (68.15-86.85)	81	100.0 (100.0-100.0)
Practice: Ways of capturing cases from community	Poor	92	41.26 (34.74-47.77)	1	1.25 (0.00-3.74)	40	64.52 (52.27-76.77)	51	62.96 (52.22-73.71)
	Average	117	52.47 (45.86-59.07)	78	97.50 (94.00-100.0)	20	32.26 (20.29-44.23)	19	23.46 (14.03-32.88)
	Good	14	6.28 (3.07- 9.49)	1	1.25 (0.00-3.74)	2	3.23 (0.00-7.75)	11	13.58 (5.96-21.20)
Practice: Record keeping of community-based data	Poor	103	42.74 (36.45-49.03)		–	38	47.50 (36.32-58.68)	65	80.25 (71.39-89.11)
	Average	137	56.85 (50.55-63.14)	79	98.75 (96.26-100.0)	42	52.50 (41.32-63.68)	16	19.75 (10.89-28.61)
	Good	1	0.41 (0.00- 1.23)	1	1.25 (0.00-3.74)	–	–	–	–
Practice: Incorporation of community-based data	Poor	182	75.52 (70.05-80.99)	46	57.50 (46.43-68.57)	72	90.00 (83.28-96.72)	64	79.01 (69.95-88.07)
	Good	59	24.48 (19.01-29.95)	34	42.50 (31.43-53.57)	8	10.00 (3.28-16.72)	17	20.99 (11.93-30.05)
Practice: Verification of community-based data	Poor	4	1.66 (0.04- 3.28)	–	–	3	3.75 (0.00-8.00)	1	1.23 (0.00-3.69)
	Average	104	43.15 (36.86-49.45)	7	8.75 (2.42-15.08)	71	88.75 (81.67-95.83)	26	32.10 (21.71-42.49)
	Good	133	55.19 (48.86-61.51)	73	91.25 (84.92-97.58)	6	7.50 (1.60-13.40)	54	66.67 (56.18-77.16)
Practice: Analysis of community-based data	Poor	30	12.45 (8.25-16.65)		–	24	30.00 (19.74-40.26)	6	7.41 (1.58-13.23)
	Good	211	87.55 (83.35-91.75)	80	100.0 (100.0-100.0)	56	70.00 (59.74-80.26)	75	92.59 (86.77-98.42)

TABLE 3: Practice related to job-responsibilities (overall and stratified) of respondents (ANM) working in IDSP, Bihar, 2019 *Contd...)*

Indicators	Category	Categorical variables (Overall)		Stratified table by District					
				Begusarai		Darbhanga		Bhojpur	
		N	% (95% CI)	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)
Practice: capturing a case with 2 or more symptoms	Poor	42	17.43 (12.60-22.25)	66	82.50 (73.99-91.01)	34	42.50 (31.43-53.57)	8	9.88 (3.24-16.51)
	Average	129	53.53 (47.18-59.87)	14	17.50 (8.99-26.01)	25	31.25 (20.87-41.63)	38	46.91 (35.81-58.02)
	Good	70	29.05 (23.27-34.82)		–	21	26.25 (16.40-36.10)	35	43.21 (32.19-54.23)
Practice: reporting unusual clustering of cases or unusual events	Poor	4	1.66 (0.04- 3.28)	1	–	3	3.75 (0.00-8.00)	–	–
	Average	19	7.88 (4.46-11.31)	4	5.00 (0.12-9.88)	11	13.75 (6.04-21.46)	4	4.94 (0.12-9.76)
	Good	218	90.46 (86.72-94.19)	75	93.75 (88.33-99.17)	66	82.50 (73.99-91.01)	77	95.06 (90.24-99.88)
Person to whom ANM reports unusual clustering of cases or unusual events	Poor	1	0.42 (0.00- 1.25)	–	–	1	1.30 (0.00-3.89)	–	–
	Good	236	99.58 (98.75-100.0)	79	100.0 (100.0-100.0)	76	98.70 (96.11-100.0)	81	100.0 (100.0-100.0)

TABLE 4: Overall IDSP-related practice and training/supervision among respondents (ANM), Bihar, 2019

Indicator	Category	Categorical variables		Stratified table by District					
				Begusarai		Darbhanga		Bhojpur	
		N	% (95% CI)	Ny	% (95% CI)	N	% (95% CI)	N	% (95% CI)
Overall practice	Poor	107	44.40 (38.08-50.72)	5	6.25 (0.83-11.67)	66	82.50 (73.99-91.01)	36	44.44 (33.39-55.50)
	Average	80	33.20 (27.21-39.18)	39	48.75 (37.56-59.94)	13	16.25 (7.99-24.51)	28	34.57 (23.99-45.15)
	Good	54	22.41 (17.10-27.71)	36	45.00 (33.86-56.14)	1	1.25 (0.00-3.74)	17	20.99 (11.93-30.05)
Received formal training on IDSP	No	185	76.76 (71.39-82.13)	59	73.75 (63.90-83.60)	55	68.75 (58.37-79.13)	71	87.65 (80.34-94.97)
	Yes	56	23.24 (17.87-28.61)	21	26.25 (16.40-36.10)	25	31.25 (20.87-41.63)	10	12.35 (5.03-19.66)
Monitoring of data collection by Supervisor	No	90	37.34 (31.19-43.50)	5	6.25 (0.83-11.67)	38	47.50 (36.32-58.68)	47	58.02 (47.04-69.01)
	Yes	151	62.66 (56.50-68.81)	75	93.75 (88.33-99.17)	42	52.50 (41.32-63.68)	34	41.98 (30.99-52.96)
Frequency of monitoring data collection process	Weekly	16	84.21 (66.15-100.0)	8	72.73 (41.35-100.0)	7	100.0	1	100.0
	Monthly	3	15.79 (0.00-33.85)	3	27.27 (0.00-58.65)	–	–	–	–
Received feedback from supervisor at the district-level	Yes	20	8.30 (4.79-11.81)	5	6.25 (0.83-11.67)	12	15.00 (7.00-23.00)	3	3.70 (0.00-7.91)
	No	221	91.70(88.19-95.21)	75	93.75 (88.33-99.17)	68	85.00 (77.00-93.00)	78	96.30 (92.09-100.0)

TABLE 5: Association between overall practice related to IDSP and socio-demographic factors as well as training among respondents (ANM, n=241) in Bihar, 2019

Description	Categories	Type*	Overall Practice (Reference=Poor)			
			Average		Good	
			OR (95% CI)	p-value	OR (95% CI)	p-value
ANM's Age	–	UOR	1.01 (0.98-1.04)	0.5950	1.03 (0.99-1.07)	0.1186
		AOR	0.99 (0.96-1.04)	0.9682	1.02 (0.97-1.07)	0.4714
Education of the ANM's (Reference=Beyond 8th standard)	Graduate/Post-graduation	UOR	0.93 (0.42-2.09)	0.8682	0.79 (0.31-2.04)	0.6233
		AOR	0.81 (0.33-2.03)	0.6583	0.66 (0.21-2.10)	0.4776
Overall Knowledge (Reference=Poor)	Average	UOR	3.81 (1.89-7.70)	0.0002	20.93 (5.68-77.09)	<.0001
		AOR	3.83 (1.88-7.81)	0.0002	20.11 (5.42-74.61)	<.0001
	Good	UOR	8.77 (3.51-21.91)	<.0001	101.33 (25.25-406.71)	<.0001
		AOR	8.90 (3.55-22.31)	<.0001	103.12 (25.53-416.56)	<.0001
Received formal training on IDSP (Reference=No)	Yes	UOR	1.04 (0.51-2.13)	0.9085	1.78 (0.85-3.73)	0.1289
		AOR	0.99 (0.48-2.07)	0.9885	1.57 (0.73-3.37)	0.2501

**UOR=Unadjusted Odds Ratio*
AOR=Adjusted Odds Ratio adjusted for age and education

TABLE 6: Predictors of overall practice related to IDSP-related work among respondents (ANM, n=241) in Bihar, 2019

Description	Categories	Type*	S form correctly filled or not (Reference=No)		Overall practice related to prescribed reporting format (Reference=Poor)			
			Yes		Average		Good	
			OR (95% CI)	P-Value	OR (95% CI)	P-Value	OR (95% CI)	P-Value
Age	–	UOR	1.02(0.99-1.06)	0.2650	1.02(0.98-1.05)	0.3407	1.01(0.97-1.05)	0.7413
		AOR	1.02(0.98-1.06)	0.4150	1.01(0.98-1.05)	0.4502	1.00(0.96-1.05)	0.8697
Education (Reference=Beyond 8th standard)	Graduate/Post-graduation	UOR	0.86(0.35-2.09)	0.7360	0.74(0.33-1.67)	0.4692	0.91(0.35-2.35)	0.8412
		AOR	0.80(0.29-2.21)	0.6610	0.81(0.35-1.89)	0.6246	0.90(0.31-2.62)	0.8483
Received formal training on IDSP (Reference=No)	Yes	UOR	1.46(0.73-2.93)	0.281	–	–	–	–
		AOR	1.35(0.66-2.75)	0.4150	–	–	–	–
Knowledge regarding reporting format (Reference=No)	Yes	UOR	7.87(3.98-15.65)	<.0001	1.53(0.79-2.97)	0.2088	9.04(4.13-19.77)	<.0001
		AOR	7.94(4.00-15.74)	<.0001	1.53(0.79-2.97)	0.2113	9.04(4.13-19.78)	<.0001
System readiness (Reference=No)	Yes	UOR	2.41(1.22-4.77)	0.0110	–	–	–	–
		AOR	2.42(1.22-4.80)	0.0120	–	–	–	–

**UOR=Unadjusted Odds Ratio*
AOR=Adjusted Odds Ratio adjusted for age and education

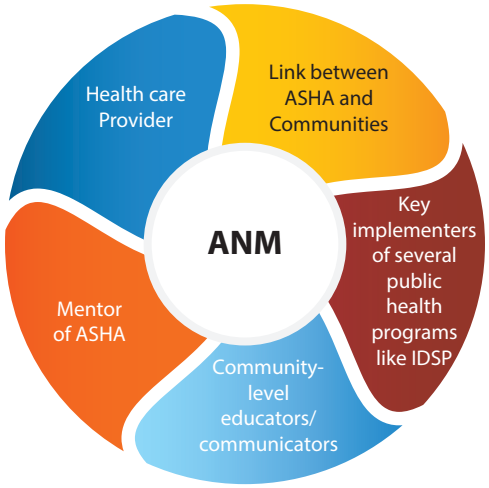
TABLE 7: Illustration of themes, sub-themes with literatim of respondents of the current study, Bihar, 2019

S.N.	Theme	Sub-theme	Verbatim/Literatim
1	**Job responsibilities**	Routine activities	*# Yes, Sir, I do all work such as OPD, field visit, immunization, distribution of medicine, ORS, registration, and delivery of pregnant women, Prenatal and postnatal care of mother-child, suggestion for tubectomy and also meeting with senior officials, ASHA, and Anganwadi – Interviewee 3, (56), married, Begusarai; Interviewee 1, (20), married, Darbhanga.*
		Role in IDSP	*# Yes, Sir, I report all infectious diseases such as fever, diarrhea, vomiting, cough, jaundice, malaria or even death event and provide basic medicines, and refer serious patients to PHC during outdoor. I also submit S-form on every Tuesday meeting at PHC levels- Interviewee 13, (49), married, Darbhanga; Interviewee 3, (50), married, Bhojpur.*
		Feeling about the current job	*# Yes, Sir, I feel very good sir- Interviewee 2, (42), married, Bhojpur.*
		Reasons for feeling good about the job	*# Sir, this job provides opportunities to serve public especially mother-child and also its a social work, and noble work sir- Interviewee5, (37), married, Begusarai.* *#Sir, I like to care children and I really enjoy doing my work as ANM particularly immunization- Interviewee 9,13, (52,49), married, Darbhanga.*
		Organization of activities over a typical week	*# Yes, Sir, I can explain sir,* *Monday: OPD,* *Tuesday: Meeting,* *Wednesday: Immunization,* *Thursday: Immunization, Meeting with ASHA and Anganwadi, also go to Outdoor,* *Friday: Immunization* *Saturday: OPD, Regular Immunization, also go to field* *Sunday: Leave but sometime also do immunization under MR Program- Interviewee 10, (42), married, Darbhanga; Interviewee 8, (53), married, Begusarai.*
		Perceived that doing good job	*# Yes, I understand from public viewpoint because public said Didi you are good. Public are giving respect sir, public said Didi you give injection in a good manner. So, I realized that I am doing good sir- Interviewee 4, (51), married, Begusarai.* *#And I realized my-self that my work is perfect- Interviewee 24, (49), married, Darbhanga.*
		Importance of meeting targets set by supervisors	*# Yes, this is very important for us to fulfil the targets given by our supervisor sir- Interviewee20, (51), married, Bhojpur.*
		Reasons for missing the target	*# Yes, Sir, sometimes we fail due to workload sir.* *Sir, this time Rubella vaccination is going on therefore, we have enough workload. Sir, sometimes children missed vaccination because the child is not available in the village or sometime go to the maternal grandmother's home. So, we often fail to reach our targets, sir- Interviewee 2, (45), married, Darbhanga; Interviewee 15, (40), married, Begusarai.*
		Ways to catch up on an accumulated backlog of work	*# Yes, Sir, we do our backlog work the next day, next week or Saturday or on a monthly basis or as per priority Sir- Interviewee 1, (55), married, Begusarai; Interviewee 1, (40), married, Darbhanga; Interviewee 15, (47), married, Bhojpur.*
		In your past experience, have you noticed any process that was being done incorrectly? How did you come to notice it?	*# Yes, Sir, senior officials informed us during meeting at PHC- Interviewee 5, (32), married, Darbhanga.*

TABLE 7: Illustration of themes, sub-themes with literatim of respondents of the current study, Bihar, 2019 *(Contd...)*

S.N.	Theme	Sub-theme	Verbatim/Literatim
		Information regarding community	*# Sir, ASHA, Anganwadi, Sevika and Vikash mitra inform us on the phone. Sir, we also ask villagers during field visits. Interviewee 3, (50), married, Bhojpur; Interviewee 29, (59), married, Darbhanga. #We see the OPD register and also ask those people who come to Health sub-centers- Interviewee 2, (54), married, Begusarai;*
2	**Motivation**	Reasons for motivation	*#Jee, Sir, this is a public service job, sir. We do social work sir- Interviewee 16, (52), married, Bhojpur.* *#Jee, Sir, this is a public service job, we are self-motivated. Also, we have to earn for the family. so that my child can get a better education- Interviewee 13, (42), married, Begusarai.*
3	**Support**	Supportive supervision	*# Yes, Sir, our Supervisor sir always helps us. When we are in trouble, we call him and sir give suggestions. I want to give 10 points- Interviewee 4, (44), married, Bhojpur.*
		Compensation	*# No Sir, the current salary is not sufficient for us, and also the salary is not given on time, sir. This should be increased in the future, sir. We are contractual workers, did not get equal pay in comparison to permanent staff. We are fighting for equal pay. Hope it will be fulfilled in the future- Interviewee 7, 25, (42,52), married, Begusarai; Interviewee 6, (42), married, Darbhanga.*
4	**Stress management**	Perceived fear of contracting diseases	*# Sir, there is no any fear, sir, we use protection such as gloves, mask, etc- Interviewee 15, (40), married, Begusarai.*
		Perceived job pressure	*#Yes, Sir, we have enough workload due to different public health programs such as MR, Polio, etc. we have more public pressure because public behavior is very unpredictable, rigid for immunization. They pass discriminatory comments and also create tension during monitoring of senior officials. Sir, there is a lack of transport facilities in rural areas, so to reach the workplace on time also create tension for us- Interviewee 6, 17, 19, (57,31,57), married, Begusarai*
5	**Difficulties**	Job-related challenges	*# Yes, Sir, there are so many difficulties, including Public behavior in field, although Panchayat Sewak including Mukhiya help us -; Interviewee 14 (56), married, Begusarai;* *# There are many like lack of transport facilities, basic infrastructure, and manpower, etc- Interviewee 6,8, (42,48), married, Darbhanga, Interviewee 10, (51), married, Bhojpur*
6	**Suggestions for**	Improving IDSP performance	*# Yes, Sir, there should be training program so I can increase my knowledge about IDSP, and there should also be coordination with ASHA, Anganwadi, and also to increase the manpower so that workload could be managed. Awareness program is necessary for communities at village levels- Interviewee 2, (42), married, Bhojpur; Interviewee 8, (48), married, Darbhanga; Interviewee 12, 18 (41,59), married, Begusarai.* *#Frequent field visit and door to door campaign as well as Aarog Diwas celebration should be promoted- Interviewee 3, 6, (56,57), married, Begusarai.*
		Skill development	*#Jee, Sir, we can increase our skill through training, timely feedback, learning during field visit; increase the frequency of meeting with senior officials, ASHA, Anganwadi, Sevika etc- Interviewee 7, (52), married, Bhojpur; Interviewee 11, 22, (45,56), married, Begusarai; Interviewee 17,20, (48, 30), married, Darbhanga*

FIGURE 7 Depicting the role of Auxiliary nurse midwives (ANM) in the current study



BOX 2: Showing the meeting, training and supervision pattern among ANMs in the current study

ANMs' Meeting

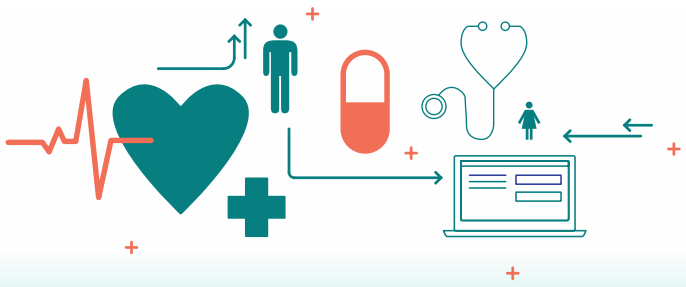
At district level
- Meeting with MOIC, BHM, MO
- Team leader/Supervisor: DM/CS
- Duration: Monthly
- Content: Job and Programs-related activities

District Health Network

At primary health center level
- Meeting with MO, BHM, MOIC
- Team leader/Supervisor were MOIC/BHM/ MO
- Duration: Weekly
- Content: Job and Programs-related activities

Block Health Network

MOIC: Medical Officer In-Charge, BHM: Block Health Manager, MO: Medical Officer, DM: District Magistrate. CS: Civil Surgeon



Chapter 5

KNOWLEDGE, PRACTICE & PERSPECTIVES RELATED TO IDSP AMONG PHYSICIANS IN BIHAR

Summary

A relatively high percentage of physicians in Bihar had insufficient knowledge of surveillance activities, names of reportable diseases, standard case definitions of diseases endemic to Bihar, trigger-levels for epidemic-prone diseases and reporting format of notifiable communicable diseases under the Integrated Disease Surveillance Program (IDSP). Surveillance and outbreak-related practices appeared poor among physicians engaged with IDSP in Bihar. Major gaps in communicable disease surveillance activities, operational logistics, outbreak detection and response capacity were also identified. However, physicians with professional MBBS degree and those who received formal training on IDSP showed relatively better IDSP related knowledge. In addition, participants with relatively better IDSP related knowledge, working in facilities with better system readiness and receiving formal training on IDSP showed good practices with regards to routine surveillance and outbreak investigation.

Findings from in-depth interviews revealed that the general idea regarding the burden of communicable diseases in Bihar was limited among the respondents. Few of them stated that probably the incidence of the infectious diseases had decreased over the years. Majority of them expressed their difficulties in putting provisional diagnosis due to overcrowding, lack of laboratory support and complicated list of reportable diseases under IDSP. It appeared that the majority of the participants did not have any clear understanding of the IDSP running in the state and their specific role in it. Inadequate training and lack of supervision were the two major complains put forward by almost all the respondents. Most of them narrated that although they respect their profession but also mentioned job-related stress.

Regular training of physicians regarding surveillance in general, case-definition and diseases notification appeared crucial, particularly among the non-MBBS degree holders. Some of the essential steps that could be adopted to better performance of physicians of the state included a. orientation of recently recruited medical doctors to overall

scenario of communicable diseases in Bihar, existing control programs including IDSP and workflow by experienced senior doctors (Civil Surgeon, Additional Chief Medical officers) at the district level is essential b. organizing physician-training programs at the district and state-level clarifying their specific roles and responsibilities related to routine surveillance activities and outbreak investigation process c. Awareness generation regarding basic case definition of communicable diseases endemic to Bihar and management of probable cases and d. Provision of basic hands-on training regarding data related to IDSP, data-base management, analysis and interpretation of disease trend, any outbreak etc. e. Establishment of data-driven review mechanism, performance appraisals and regular feedback would likely to improve the data quality captured in IDSP portal.

Background

The increasing burden of mortality and morbidity attributable to communicable diseases continues to be a major public health concern globally, largely in low-and-middle-income countries. Therefore, early detection of probable cases through a robust surveillance system involving physicians and appropriate case-specific management are essential steps to reduce the burden of preventable deaths due to infectious diseases. Physicians are the first point of contact for a patient in a complex health care system and are responsible for providing health care and directions to the patients. The physicians are responsible for implementing disease containment measures in case of outbreaks. Hence, the physicians have to remain vigilant as they are responsible for reporting the presumptive cases and also supervise the syndromic and laboratory surveillance activities. Physicians' knowledge about the disease surveillance and outbreak investigation appeared essential for early diagnosis, case-specific management and timely reporting of reportable diseases to the designated officials. Some of the major challenges of the integrated approach towards surveillance system in developing countries were lack of awareness, ignorance of notifiable diseases, outbreak detection and management among medical officers.[35]

Despite the fact that the Integrated Disease Surveillance Program (IDSP) is in place for over a decade, engagement of physicians in disease surveillance had been limited. Though the underlying reasons might be multifactorial, the published literature on this issue is limited. In addition, although the international standards recommend evaluation of the surveillance programs, the systematic review of IDSP has been limited in the country, especially from the eastern part of the country. This poses a serious impediment to monitoring the progress of the program. Thus, a comprehensive assessment of the practices among physicians reporting to IDSP would help to develop important insights regarding the physicians' role and responsibilities during routine surveillance and outbreak response. Identified gaps and recommended policy based on study findings would ensure better and reliable disease surveillance, predicting trend, risk factor mapping, epidemic preparedness and quick response to outbreak in the future.

Findings

A total of 253 on-duty consenting physicians from 92 government health facilities in 46 blocks were interviewed across the three selected districts-Begusarai, Darbhanga and Bhojpur. Information gathered regarding the physicians' knowledge about the surveillance system for infectious diseases, standard case definition, case reporting,

trigger level of any impending infectious disease outbreak, outbreak preparedness and database management. The overall knowledge score of each sub-domain (correct response=1, incorrect response=0) was categorized into good, average and poor based on its tertile distributions, the lowest tertile represented the poor knowledge. In addition, 230 in-depth interviews were conducted to capture the real-life work experiences of physicians in rural Bihar including challenges and facilitators of the IDSP program.

Demographic profile and job-related factors

A total of 253 physicians were included in the study. The mean age of the physicians was 46 years with a mean job duration of 5 years in the IDSP. Though majority of the physicians had MBBS degree (N=161, 64%), a significant number of the respondents practiced Indian system of medicine, AYUSH (N=73, 29%). The distribution of allopathic to non-allopathic doctors differed across the districts, with Bhojpur having the highest proportion of MBBS-degree holders (80%). The respondents were mostly from Bihar (N=251, 99%) and were contractual employees (N=139, 55%). The physicians were mostly posted at the Primary Health Centre (N=156, 62%) and the rest at Additional Primary Health Centre (N=42, 17%), Community Health Centre (N=11, 4%) and Urban Hospital (N=1, 0.40%). It took on average 18 minutes for the physicians to reach their work place and most availed personal transport (62%). [Table 1]

Knowledge and awareness regarding IDSP

About 86% respondents did not have adequate knowledge regarding disease surveillance in general. The majority of the participants heard about the IDSP (86%). Near about 90% physicians in Begusarai knew about the objectives of IDSP while less than one-third (28%) in Bhojpur could mention them. However, 59% of the participants in Bhojpur were aware of the approaches recommended to capture probable cases reporting to the facility. [Table 2]

Most of the clinicians in Darbhanga had poor overall knowledge (91%) about the names of the communicable diseases reported under IDSP. Considering knowledge regarding the names of specific disease reportable under IDSP appeared mixed across the three studies districts. Knowledge about the name of bacillary dysentery and acute respiratory infection appeared correct among less than 40% of the physicians in Bhojpur. Similarly, knowledge about leptospirosis was lacking (73%) among most of the physicians across all three districts. [Table 3]

Compared to the other two districts, knowledge of standard case definitions was lacking in Darbhanga, only 7% showed good knowledge. Majority of the physicians had incorrect knowledge regarding standard case definition of acute encephalitis syndrome in Begusarai (59%). In addition, knowledge regarding standard case definition of enteric fever or typhoid was also inadequate among the physicians of Darbhanga (47%) and Bhojpur (41%). [Table 4]

Overall knowledge regarding trigger-levels for epidemic prone diseases was quite low in the districts of Darbhanga (3%) and Bhojpur (25%), particularly for diseases including acute diarrheal disease (27%), viral hepatitis (24%) and enteric fever or typhoid (11%). [Table 5]

Knowledge regarding the prescribed reporting format of IDSP was surprisingly low among the

participants in all the three districts (13%). The majority did not know about the number of reporting forms generated (74%) and were unable to name the specific reporting formats (87%). In Darbhanga and Bhojpur, most medical officers had no knowledge regarding data collection (Darbhanga=88%, Bhojpur=76%), collation (Darbhanga=64%), Bhojpur=71%) and storage (Darbhanga=90%), Bhojpur=78%). [Table 6]

The majority of the respondents identified a usual response time of less than 24 hours to an outbreak occurrence (94%) to be ideal. The respondents generally mentioned clustering of cases from the same locality on a given day or consecutive days (42%) followed by information from the affected community (29%) as means of outbreak detection. Most of the physicians in Darbhanga and Bhojpur informed that usually Pharmacist/Block Health Manager informed the district surveillance office over phone about an outbreak (Darbhanga=63%; Bhojpur=91%). [Table 7]

Overall knowledge/awareness regarding outbreak preparedness and response was poor among respondents in Darbhanga (87%). As outbreak didn't appear to occur during the service tenure of majority of the participants, knowledge regarding exploration of risk factors during an outbreak could not be assessed for all. [Table 8]

Regression analysis revealed that the odds of having better overall knowledge about the IDSP was higher among the MBBS degree holders when compared to AYUSH practitioners ($AOR_{Average}$ 2.20(95%CI 1.14- 4.27) and AOR_{Good} 4.96(2.14-11.47); reference=poor knowledge). Knowledge and awareness were also found to be more among those physicians who received formal training on IDSP (AOR 3.25(1.39-7.65), reference=poor knowledge). [Table 9]

Physicians' practices related to disease surveillance activities under IDSP

Almost all of the (98%) physicians in Begusarai reported a practice of putting provisional diagnosis in case registration, which was not observed in Darbhanga (30% reported doing so) and Bhojpur (36% did so). Out-patient registers were well maintained (>90%) in all the three districts, but maintenance of inpatient register was improper in Darbhanga (39%). Overall, the practices of case detection using standard case definition of diseases under IDSP was limited in Darbhanga (74%) and Bhojpur (42%). [Table 10]

A large number of clinicians in Darbhanga (79%) and Bhojpur (70%) did not perform any analysis of the reported IDSP data ever. Regarding outbreak readiness, the Rapid Response Teams (RRT) were mostly present in all three districts during an outbreak (76%). In all the three districts, documents pertaining to verification of an outbreak were unavailable (86%). Similarly, emergency fund for outbreak management was mostly inaccessible in Begusarai (89%) and Darbhanga (71%). In case of outbreak, availability of appropriate supplies (30%) and allowance for vehicle use (37%) were found to be absent in about one-third of the health Centres/ Hospitals in Darbhanga. In contrast, all the districts had access to emergency stocks (80%) during an outbreak. Overall outbreak preparedness was poor in 33% of the surveillance units in Begusarai and 63% in Darbhanga. About 82% physicians in Begusarai and 59% in Darbhanga were not aware of their outbreak coordinator in the district. In the three districts, 88% of the clinicians could not mention the number of outbreaks reported over 6 months, while only 36% had themselves undertaken any outbreak investigation during their tenure. Among those who had undertaken an outbreak investigation in

Darbhanga recounted that it took more than 48 hours to get a response following the submission of an outbreak report. [Table 11, Figure 2]

Altogether 59% medical officers had undertaken exploration of risk factors during an outbreak in the three districts. Of the 19 physicians in Darbhanga who had undertaken control measures following an outbreak, 11 reported prevention and control measures with respect to water purification was not undertaken. Awareness campaigns, keeping stock of medication, commencement of mass chemoprophylaxis were the most common interventions deployed for outbreak preparedness in the districts, with the exception of Darbhanga. [Table 12]

In Bhojpur, 94% of the physicians had not receive any formal training on IDSP. The figures were slightly less in Darbhanga (77%) and in Begusarai (56%). Supervision duties were given a miss by 69% of the clinicians and only 17% reported themselves being supervised by the District Surveillance Unit. The majority (64%) reported that regular feedback from the district unit was not given. Approximately, more than 80% medical officers in Darbhanga and Bhojpur said that organization of workshop and training were mostly overlooked by the district team, but in case a workshop was held, majority were satisfied with the content. [Table 13]

Though Outpatient Department (OPD) register was present in almost all facilities, it was correctly filled by few. Similarly, Inpatient Department (IPD) register was found to be correctly filled by 70 participants. Furthermore, disease summary was mostly absent for both OPD (Begusarai= 48%, Darbhanga=98%, Bhojpur=83%) and IPD (Begusarai=27%, Darbhanga=99%, Bhojpur= 90%) registers of the health facilities in the districts. Standard case definition was not displayed in 80 of the 92 health facilities (OPDs) of the Darbhanga district, while trigger levels were not displayed in 98% of the health facilities in all the studied districts. Nearly all the reporting health units in the three studied districts did not maintain a rumour register, did not correctly fill the Early Warning System (EWS) form and did not have a training manual for medical officers. In almost all the health facilities of Begusarai, IDSP P-Forms were incorrectly filled. Furthermore, most of the reporting health units failed to correctly fill the P Form in Darbhanga and majority of the health units did not have a functional desktop/laptop. On the whole, health units in Darbhanga had the least favourable performance when it came to reporting to the IDSP (Poor=89%). [Figure 3a, 3b]

Regression analyses showed that professional physicians (Adjusted Odds Ratio, AOR=4.86, (95%CI 2.02-11.68), p-value=0.0004) and physicians with better overall IDSP-related knowledge (AOR $_{\text{Average}}$ 4.98(2.37-10.44), <.0001 and AOR $_{\text{Good}}$ 2.32 (1.02-5.28), 0.0456; reference=poor knowledge) were more likely to correctly fill the prescribed reporting format, P-Form. System readiness increased the chance of correctly filling in the P-Forms (AOR=2.73(1.46-5.12),0.0017). Appropriate system-level readiness led to higher likelihood of putting provisional diagnosis (AOR=5.78 (3.17-10.54), <.0001). Finally, better overall IDSP-knowledge (AOR $_{\text{Average}}$ 10.06(3.46-29.23), <.0001 and AOR $_{\text{Good}}$ 53.64(16.61-173.2), <.0001; reference=poor knowledge), system-level readiness (AOR $_{\text{Average}}$ 12.00(4.74-30.43), <.000 and AOR $_{\text{Good}}$ 94.95(25.44-354.3), <.0001; reference=poor readiness) and receiving formal training on IDSP (AOR $_{\text{Average}}$ 2.36(1.06-5.24), 0.0358 and AOR $_{\text{Good}}$ 3.75(1.63- 8.61) 0.0018; reference=poor practice) were associated with better odds of having good overall practices. [Tables 14, 15, 16]

Physicians' perspectives of IDSP

Qualitative assessment was based on 230 in-depth interviews of the consenting physicians in the three studied districts. The domains and major themes assessed were summarized below with supporting verbatim.

A. Existing burden of infectious diseases and potential risk factors

Majority of the medical officers perceived that the menace of infectious diseases had curbed to a large extent but challenges still remained in the state.

> *"burden of infectious diseases reduced by about 90%" — Physician, Darbhanga (Female, AYUSH, contractual)*

The interviewees' perception was that burden of infectious diseases varied in different geographical areas. They viewed that geographical variation may be associated with factors such as regional climate, socioeconomic conditions, local population density and risk-behavior of community.

The participants reported that spread of infectious diseases was more in areas of poverty and where unhygienic conditions existed along with limited access to safe drinking water.

> *"the situation in Bihar currently with regards to infectious diseases is that it is occurring in places where unhygienic conditions exist. It is where the people are suffering from infectious disease" — Physician, Bhojpur (Female, AYUSH, contractual)*

> *"the reason is that cleanliness is not that good, people do not care much on cleanliness. The standard of drinking water is also not as good as it should be that is why diarrhea or viral diseases are happening" — Physician, Darbhanga (Male, MS, permanent)*

Another reason attributed to the existing problem of infectious diseases in their opinion was the lack of information and awareness among sections of the population.

> *"many people are effected by HIV and Tuberculosis due to lack of information because medicines are given in the PHC to the patient but he doesn't know that he is spreading the disease to 10 more by not taking precautions. Moreover, when the person feels better after taking medicine for some time he stops and causes infection to re-establish and spreads to others too"* — Physician, Darbhanga (Male, AYUSH, contractual)

Many agreed that proper awareness led to the decrease in the burden of infectious diseases than in earlier times. In addition, they also said that many patients irrespective of severity of disease/condition were coming to clinics early now-a-days and as a result appropriate treatment could be initiated and outbreaks could be prevented.

> *"very few cases are due to infectious agents as awareness among the people has increased. If anyone is aware of outbreaks or shows symptoms, they immediately come to us for treatment and we take action rapidly. Rapid Response Teams remain ready and visit the area to initiate control and hence it does not spread much"* — Physician, Bhojpur (Male, MBBS, permanent)

High population density and malnutrition emerged as important factors for spread of infectious diseases from the physician interviews.

"All these infectious diseases are happening because of overcrowding and declining health such as low levels of hemoglobin and weakened immune system" — Physician, Darbhanga (Male, AYUSH, contractual)

The most frequently encountered infectious diseases reported by the clinicians were respiratory infections and symptoms of vaccine preventable diseases.

"we have tried very hard and also have done a good job in controlling the infectious diseases but still instances of water borne diseases crop up and secondly care of children is neglected often in the region leading to flare up of vaccine preventable diseases and other infectious diseases" — Physician, Begusarai (Female, BDS, contractual)

"infectious disease such as measles are coming now recently and other respiratory and viral fevers" — Physician, Bhojpur (Male, MBBS, permanent)

"In few places such as in my block there are cases where children have died from measles and many others were suffering. Earlier when I was in Buxar, I had cases of whooping cough" — Physician, Bhojpur (Male, MBBS, permanent)

B. Proportion of clinically suspected cases of infective origin in the out-patient department

The attendance at the Out-Patient Department (OPD) for infectious diseases showed varied distribution with Begusarai appeared to have a larger burden of infectious diseases in OPD. The most common suspected infectious disease cases reported were scabies, tuberculosis, measles and skin diseases.

"about 30-40% of the patients attending the OPD suffer from infectious diseases" — Physician, Begusarai (Male, AYUSH, contractual)

"suppose among 100 OPD patients about 10 will be suspected infectious disease cases" — Physician, Darbhanga (Male, AYUSH, contractual)

"50 to 60 cases of suspected infectious disease cases coming to OPD out of 200 overall patients" — Physician, Bhojpur (Male, MBBS, contractual)

"so in about 100 OPD patients 10 may be suffering from communicable diseases generally" — Physician#19, Bhojpur (Female, AYUSH, contractual)

"weekly about 20-25 cases come which are infectious in origin. Many cases with skin disease comes which might be scabies" — Physician, Darbhanga (Female, AYUSH, contractual)

"infectious disease is rampant in our area with about 50% of our OPD cases suspected to be infectious in origin like scabies, TB (Tuberculosis) etc" — Physician, Begusarai (Male, MD, contractual)

C. Most common symptoms among patients in general and with potential communicable diseases present with

The participants narrated examples of patients presenting with symptoms indicating diseases of infectious origin which varied with time and locale. All the doctors interviewed recognized that presentations with symptoms like cough, fever, pain and diarrhea formed a large number. Other symptoms which were pointed out less frequently were weight loss, anorexia etc.

"the most common seasonal diseases like in summers include diarrhea and during rainy seasons are flu like illness and many other seasonal disease symptoms also exist" — Physician, Bhojpur (Male, MBBS, contractual)

"currently cases of hemophilia, symptoms of cough and weight loss, joint pain, night sweating are most common" — Physician, Darbhanga (Male, AYUSH, contractual)

"the common symptoms that are seen are cough, cough with fever and diarrhea" — Physician, Begusarai (Male, MBBS, contractual)

"for infectious disease the first complain patients present is fever; secondly weight loss and at times loss of appetite. These symptoms are repeated only" — Physician, Bhojpur (Male, MBBS, contractual)

D. Difficulties while putting the provisional diagnosis for suspected cases and how to overcome

The study identified three reasons that contributed for not providing provisional diagnosis in advice slips and why practitioners experienced difficulties in diagnosing and managing infectious disease: firstly, too many patients and time constraints along with huge administrative workload for general practitioners; secondly, the non-availability of confirmatory diagnostic testing facility; and thirdly, patients being lost to follow-up.

"see when you are working in rural areas you cannot expect things to be like medical colleges…it is very challenging working here… diagnosing patients properly is not an easy job… as number of patients is more there is a crowd… for this we feel disturbed…we face hardship in properly diagnosing definitely" — Physician, Darbhanga (Male, AYUSH, contractual)

"for diagnosing the problem is the lack of manpower and lots of work…secondly patients' mentality they do not want to give the time" — Physician, Bhojpur (Male, BDS, contractual)

"the thing is that the patient does not come for the second time, the follow-up treatment is missed as they do not return"— Physician, Bhojpur (Male, MBBS, permanent)

The physicians suggested that problems with putting provisional diagnosis could be overcome with decreased workload enabling the physicians allot more time to each patient.

"for putting provisional diagnosis, it is important that we get time with the patients, it is very important to have clear interaction with the patients" — Physician, Bhojpur (Male, MBBS, permanent)

E. Biological tests for all potential cases of communicable diseases

Most participants mentioned that they recommended laboratory test/s to the patient only if it was absolutely warranted for diagnosis. They also mentioned that the economic condition of the patient and access to laboratory also played an important role while considering advising diagnostics test/s. An important observation that came out from the study was that even for diseases that required mandatory laboratory confirmation, if provisional diagnosis could be made by the physicians and if the tests were not available in the facility, it was not advised to the patients.

"not for everyone, I recommend even when I feel it needs to be done. If a patient is suffering for

more than 4-5 days and has not responded to treatment then only I advise test" — Physician, Bhojpur (Male, MBBS, contractual)

"for those like patients with infection like HIV or TB or even malaria, I advise and make them undergo lab test"— Physician, Darbhnaga (Male, MBBS, permanent)

"when I cannot figure out which disease the patient is suffering from then only, I recommend laboratory tests" — Physician, Begusarai (Male, MBBS, contractual)

"not needed in every case, when there is a serious problem in diagnosis, then lab tests are recommended" — Physician, Bhojpur (Male, MBBS, permanent)

"recommend tests when there is a need and if available in the facility. For those tests which are not available at the facility and if the family is well to do, I recommend doing the tests from outside" — Physician, Begusarai (Female, MBBS, permanent)

F. Approach to treatment of potential cases of communicable diseases

Similar pattern emerged from the present study regarding the physicians' approach to treatment, including the symptomatic treatment for suspected viral cases and not prescribing antibiotics. Socio-economic condition and underlying medical condition appeared the two most important factors that influenced decision-making process for recommendation of antibiotics. The most notable finding observed in this study was to refer complicated cases to other centers for further management.

"first of all, 2-3 general medicines are prescribed…this is a rural area so the patients want to get well early and few say that you only do whatever you can do where will we go…So for them we treat them and tell them that if they do not improve by some period then you have to visit referral center" — Physician, Darbhanga (Male, AYUSH, contractual)

"firstly, we manage the patients symptomatically…if the patient has some complications then sometimes we give antibiotics…but it is not that we use antibiotics all the time…if I feel there is a need of antibiotic and we can cure them at the primary level then only we advise antibiotics" — Physician, Bhojpur (Male, MBBS, permanent)

"any suspected infectious disease case needs to be cured first…if there is fever then we will give medicine for that as safe medicines are available for that, next for diarrhea or other conditions where chances are that they are viral then we focus more on symptomatic treatment" —- Physician, Darbhanga (Male, MBBS, permanent)

G. Patient adherence to the recommended treatment

Based on qualitative assessment, it was observed that a considerable proportion of patients did not adhere to treatment. When asked about the exact proportion of patients who are non-adherent to treatment, majority of them could not give a definite answer and the reported percentage of patient adherence to treatment varied considerably.

"adherence is about 50-50" — Dr. Physician, Begusarai (Male, AYUSH, contractual)

"generally, what is instructed to patients, they do follow but sometimes some patients do not follow too. You know it is difficult to say the exact

percentage" — Physician, Bhojpur (Male, AYUSH, contractual)

"yes, they do, about 50% come back for follow-up" — Physician, Begusarai (Male, MD, permanent)

H. Physicians' role in IDSP

Awareness about their role in IDSP appeared poor among the respondents. Majority of the participants told that lack of training resulted into poor IDSP related knowledge

"in IDSP.… Look for which sector there is more cases…. the prevalence and take control measures...we have been told" — Physician, Darbhanga (Male, MBBS, permanent)

"my role in IDSP I cannot say as I have not been told as of now. Only the in-charge has received training and I have not received any training. When I will receive any training, I will definitely work accordingly"— Physician, Darbhanga (Male, AYUSH, contractual)

"in my sector all the divisions are located so specifically I have not been told what I have to do for except for treating patients which I have to do anyway" — Physician, Bhojpur (Male, MBBS, permanent)

The situation was a bit better in Begusarai

"yes, we have been told about the program, it is about surveillance we have to keep an eye of major health events in our sector" — Physician, Begusarai (Female, AYUSH, contractual)

"it has been told in IDSP that in outdoor patient register put details of any the suspected case and report" — Physician (Male, MBBS, permanent)

I. Proportion of potential cases of communicable diseases captured in the system

The reporting of the notifiable diseases under IDSP was mainly dependent on the number of cases reporting to the public health care as private sector involvement in the IDSP seemed low. The approximate proportion of diseases reported by the responding medical officers was between 10% to 70%.

"about 10% of cases might come in the system" — Physician, Bhojpur (Male, MBBS, permanent)

"of all the cases may be about 50% is captured" — Physician, Darbhanga (Male, MBBS, permanent)

"10 % comes to our sector" — Physician, Darbhanga (Male, AYUSH, contractual)

"so about 60-70% of the cases are captured by the public system" — Physician, Begusarai (Male, MBBS, contractual)

"in my opinion about 70 percent is captured by the government" — Physician, Darbhanga (Male, MBBS, permanent)

J. Involvement of private sector in IDSP

The private sector dominates health care services in the state and all the respondents indicated the importance of involving the private sector for reporting notifiable diseases under IDSP. The possible solutions presented by the respondents were generating awareness regarding disease notification among private practitioners in the state. A massive state-wide campaign to build support, providing training and improving engagement and motivation for real-time reporting of suspected

cases by private practitioners to IDSP were proposed by many as possible and effective ways of involving the private sector in the IDSP. Like the RNTCP, a simple, user-friendly platform for notification linked to an action to persuade the private health sector to prompt action was also suggested.

> *"in the private sector, if physicians find a case of the reportable disease, they should inform their higher official and the district authorities like we do in case of Tuberculosis, there is an app where the private practitioners can update the case reporting…something like that has to be done" — Physician, Bhojpur (Male, MBBS, contractual)*

> *"Private sector can be involved by making them aware that those patients who visit them with seasonal diseases or any other suspected infection must be followed and reported to the government unit. This type of information is provided only if there is an outbreak type of situation" — Physician (Female, AYUSH, contractual)*

> *"to involve the private sector, they also need training like what we receive on surveillance, they should also receive the information about surveillance" — Physician, Bhojpur (Male, MBBS, permanent)*

K. Perception of the IDSP performance in Bihar

Almost all the respondents were very cautious in declaring the programme to be a success. Few declared the programme to be performing much below expectation while most agreed that the programme was performing at a satisfactory level though much improvements are needed to make the program fully functional. Stated problems ranged from lack of awareness and training among medical officers to inadequate knowledge of case definitions and lack of familiarity with notifiable diseases. Lack of facilities like confirmatory laboratory diagnosis was also reported to be a deterrent in the successful reporting of infectious diseases to the IDSP.

> *"yes, it is going on and there is need of some improvements…the new Medical officers who are joining do not know about the IDSP, so regular workshops and training should be given for them"— Physician, Bhojpur (Male, MBBS, contractual)*

> *"no, I don't think it is going very well…if the program is not running well then many cases are missed out and this is happening…in the facility I am working many people are not aware of the IDSP…what is it? What diseases have been included and categorized as what? What modifications have been made; what are the case definitions…all of the doctors and key IDSP officials need training for that …" — Physician, Darbhanga (Male, MBBS, permanent)*

The major themes that emerged to improve the IDSP were to ensure awareness among the general public, improved infrastructure and other logistic support to deal with epidemic prone diseases, fixing accountability among the officials engaged in the public health system, regular training and workshops for all those responsible with IDSP reporting and functioning.

> *"to better the IDSP I think it is important to create awareness among the people…if we make the public aware about the infectious diseases and about their symptoms and tell them to inform the doctors at CHC or PHC when required without delay…this will result in more reporting and will better the IDSP" — Physician, Bhojpur (Male, MBBS, permanent)*

"to improve the IDSP the most important thing is to make the public aware. As long as the infrastructure is not improved there will be hurdles. A nodal person should be made responsible… Every type of emergency medicine, arrangement of transport should be available separately…the teams should be trained at regular intervals…if we have these, we can make the IDSP successful" — Physician, Begusarai (Male, MBBS, permanent)

L. Support and coordination from supervisor

A supervisory system contributes towards professional regulation and provide means of ensuring safe and accountable practice. Inevitably, supervisory support greatly impacts on performance and this is true with physicians undertaking surveillance activities too. It appeared physicians in the state were not getting reasonable support expected from their senior level managers and therefore to carry out necessary actions under surveillance or any emergency response were frequently unclear and often ineffective.

"I want to make it clear that the feedback you (supervisor) are taking is only feedback from the patients...you are not taking my feedback… the medical officer doesn't have a voice…does the person have a place for staying here? Is he getting salary in time?.so how can I say that support is good" — Physician, Darbhanga (Male, MBBS, permanent)

When asked to rate on a scale of 10 the support respondents received from their supervisors the scoring differed across the respondents.

"let give 1" — Physician, Bhopur (Female, MBBS, permanent)

"can give 8" — Physician, Begusarai (Male, AYUSH, contractual)

"about 50% so let's give 5" — Physician, Bhojpur (Male, BDS, contractual)

"yes 7" — Physician, Darbhanga (Female, MBBS, permanent)

M. Compensation in the current job

Response regarding satisfaction with remuneration among the respondents varied considerably but there were some commonalities too. Satisfaction differed with type of employment, services rendered and job setting. Type of employment and medical background appeared to be the most important factors influencing satisfaction with salary.

"we are permanent employees and what the government gives is okay" — Physician, Darbhanga (Male, MBBS, Permanent)

For both allopathic and AYUSH practitioners in public sector, physicians in permanent service rated more satisfaction with salary than those under contractual employment.

"no absolutely not. We get ₹52000 after working day and night" — Physician, Darbhanga (Male, MBBS, contractual)

"no, it is not enough. What contractual medical officers earn in other states is much more than what we get. We work as hard and as much as those in permanent employment but receive much less pay" — Physician, Begusarai (Male, MBBS, contractual)

Similarly, discordance between the compensation received for their service and the perceived workload were highest among AYUSH practitioners.

Working the same hours, doing the same duty and having different salary structure and benefits along with temporary nature of employment severely impacted contractual respondents' satisfaction with remuneration.

> *"no absolute not, with the amount of work I do, I do not receive sufficient salary. That is why I remain sad and do not feel like working" — Physician, Bhojpur (Female, AYUSH, contractual)*

N. Pressure in the job

Most of the physicians indicated some stress in their jobs. The important factors that emerged from the current study included unrealistic workload coupled with staff shortages, extended working hours and demand of quality work with no or minimum logistic support. Other issues which emerged were that physicians felt undervalued and frustrated due to insufficiently trained paramedical manpower, intensive workload and a perceived lack of power to influence change.

> *"of course, we feel the pressure. With the shortage of manpower, you have to do more and more work and that to within the short timeline without skilled workers to help. With shortage of skilled laboratory technicians and others you are expected to give quality results. This is a big thing" — Physician, Bhojpur (Male, MBBS, permanent)*

> *"there should be a meeting with MOIC. we can share our problems in that meeting with MOIC, and MOIC can provide information to the upper-level authorities regarding our problems. Only our senior officers can solve our problems so that we can work freely. There has to be support from our senior officers we cannot do anything" — Physician, Darbhanga (Male, MBBS, contractual)*

Few female respondents in this study felt high workload and commented that their stress was caused by lack of time spent at home along with low pay. They felt that their day's work impinged on their family life.

> *"pressure from the public is there. They have become aware now-a-days but they do not give proper respect to us" — Physician, Begusarai (Female, AYUSH, contractual)*

> *"in the job the pressure I face is that I cannot give enough time to my family and also get a low salary" — Physician, Bhojpur (Female, AYUSH, contractual)*

Although women work full-time in professional jobs, they were often not given due credit.

> *"work load is there, moreover the public here is not so supportive. They often show bad behaviour towards doctors" — Physician, Darbhanga (Female, AYUSH, contractual)*

O. Satisfaction with job/work

In all three studied districts, majority of the physicians were satisfied with their job. The main motivation seemed their belief in the noble nature of their job and the opportunity to help society. The ability to make patients happy also was a strong determinant among many for their job satisfaction.

> *"the profession that I have chosen I am happy with that. There is a bit of pressure but that is part of the job, I manage ignoring thing that will demotivate" — Physician, Darbhanga (Male, MBBS, contractual)*

> *"the patients get cured here and that makes me happy" — Physician, Bhojpur (Male, MBBS, permanent)*

"it is a chance to serve.... this is the reason for the happiness of the work" — Physician, Darbhanga (Male, AYUSH, contractual)

"I am very happy with the job. The work I want to do for the people that I can do through this job"— Physician, Begusarai (Female, AYUSH, contractual)

"yes, definitely I am happy with the job. Our profession is a noble one and I feel we have come for helping mankind, there is no doubt in that. When patients are treated by us and they seems happy with our services, it gives immense satisfaction. I feel very happy with that" — Physician, Darbhanga (Male, AYUSH, contractual)

"yes, I am happy. I mean its ok, like when we can give our best to the patients its satisfying" — Physician, Darbhanga (Female, MBBS, permanent)

Motivation and job satisfaction were also influenced by their professional degree as well as their perception of honesty in doing their job. Better job fulfilment was reported by clinicians when they perceived themselves as offering or facilitating high-quality care.

"I am happy as the duty I have I do with integrity and I get returns. Therefore, I am happy with the job" — Physician, Darbhanga (Male, BDS, contractual)

"I am happy with my job. I work hard and have the confidence that all patients I attend, I do so with full dedication. I feel happy treating the patients as I have come from AIIMS and it is obvious, I have to keep the reputation. so, I am working and am feeling happy working in the rural sector" Physician, Bhojpur (Male, MBBS, contractual)

"I am doing my work with full honesty and integrity therefore I am happy with the work" — Physician, Darbhanga (Male, MBBS, contractual)

Similarly, some reported that even though they are happy with their work, many a times it's difficult to satisfy the general public

"I am very happy with the job but sometimes it is hard to make the public happy" — Physician, Bhojpur (Female, MBBS, permanent)

Impediments in delivering high-quality care was foremost reason of job dissatisfaction. For those who were not pleased with the job, the main reasons being lack of basic infrastructure, security issues and overburdening due to shortage of manpower. Physicians in the study commonly stated challenges were mostly stemming from overload due to patients and small place for work.

"you can be happy in your job when you have all the needed infrastructures which is lacking here. We cannot do anything in this infrastructure and due to this we have problems with the public, even violence happens. There is no security and we feel helpless. Still if any patient is cured, I feel satisfied with the job though it is tough with shortage of staff and the violence against us" — Physician, Begusarai (Female, MBBS, permanent)

TABLE 1: General information of the responding physicians in the three studied districts of Bihar, 2019 (N=253), *Contd...*

		Overall		Begusarai		Darbhanga		Bhojpur	
Indicator Category		**N**	**Mean (95% CI)**	**N**	**Mean (95% CI)**	**N**	**Mean (95% CI)**	**N**	**Mean (95% CI)**
Job duration as Physician in IDSP (in months)		253	60.81(51.03-70.58)	63	56.08(48.92-63.24)	90	53.29(40.25-66.33)	100	70.55(49.08-92.02)
Age of the respondent		253	45.77(44.38-47.16)	63	46.24(43.36-49.12)	90	46.09(43.67-48.51)	100	45.19(43.03-47.35)
Time taken to reach work place (in hour)		253	0.28(0.11-0.45)	63	0.33(0.16-0.51)	90	0.47(0.02-0.92)	100	0.08(0.02-0.14)
Time taken to reach work place (in min)		253	18.32(16.69-19.95)	63	23.48(20.27-26.69)	90	17.72(14.74-20.70)	100	15.61-13.34-17.88)
Indicator	**Category**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**
Type of health facility	Primary Health Centre	156	61.66(55.63-67.69)	42	66.67 (54.70-78.63)	62	68.89 (59.14-78.64)	52	52.00 (42.04-61.96)
	Additional Primary Health Centre	42	16.60(11.98-21.22)	17	26.98 (15.72-38.25)	19	21.11 (12.52-29.71)	6	6.00 (1.26-10.74)
	Community Health Centre	11	4.35(1.82- 6.88)	-	-	1	1.11 (0.00-3.32)	10	10.00 (4.02-15.98)
	Urban Hospital	1	0.40(0.00- 1.17)	1	1.59 (0.00-4.76)	-	-	-	-
	Other	43	17.00(12.34-21.66)	3	4.76 (0.00-10.17)	8	8.89 (2.90-14.88)	32	32.00 (22.70-41.30)
Employment contract	Permanent	114	45.06(38.89-51.23)	18	28.57 (17.10-40.04)	39	43.33 (32.90-53.77)	57	57.00 (47.13-66.87)
	Contractual	139	54.94(48.77-61.11)	45	71.43 (59.96-82.90)	51	56.67 (46.23-67.10)	43	43.00 (33.13-52.87)
Professional degree	AYUSH	73	28.85(23.23-34.47)	27	42.86 (30.29-55.42)	33	36.67 (26.52-46.82)	13	13.00 (6.29-19.71)
	Others	19	7.51(4.24-10.78)	4	6.35 (0.16-12.54)	8	8.89 (2.90-14.88)	7	7.00 (1.91-12.09)
	MBBS	161	63.64(57.67-69.60)	32	50.79 (38.10-63.49)	49	54.44 (43.96-64.93)	80	80.00 (72.02-87.98)
Original residence	Bihar	251	99.21(98.11-100.0)	63	100.0 (100.0-100.0)	90	100.0 (100.0-100.0)	98	98.00 (95.21-100.0)
	Outside Bihar	2	0.79(0.00- 1.89)	-	-	-	-	2	2.00 (0.00-4.79)
Means to travel to work	By foot	57	22.53(17.35-27.71)	4	6.35 (0.16-12.54)	15	16.67 (8.82-24.52)	38	38.00 (28.32-47.68)
	By public transport	38	15.02(10.59-19.45)	12	19.05 (9.08-29.02)	6	6.67 (1.41-11.92)	20	20.00 (12.02-27.98)
	By own vehicle	158	62.45(56.44-68.46)	47	74.60 (63.55-85.65)	69	76.67 (67.76-85.57)	42	42.00 (32.16-51.84)

TABLE 2: Physicians' knowledge of IDSP core surveillance functions in the three studied districts of Bihar, 2019 (n=253)

		Overall		Begusarai		Darbhanga		Bhojpur	
Indicator	**Category**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**
Knowledge regarding disease Surveillance	Incorrect	218	86.17(81.88-90.45)	57	90.48 (83.02-97.93)	80	88.89 (82.27-95.51)	81	81.00 (73.18-88.82)
	Correct	35	13.83(9.55-18.12)	6	9.52 (2.07-16.98)	10	11.11 (4.49-17.73)	19	19.00 (11.18-26.82)
Awareness about IDSP	No	35	13.83(9.55-18.12)			29	32.22 (22.38-42.07)	6	6.00 (1.26-10.74)
	Yes	218	86.17(81.88-90.45)	63	100.0 (100.0-100.0)	61	67.78 (57.93-77.62)	94	94.00 (89.26-98.74)
Knowledge regarding main objective of IDSP	Incorrect	113	51.83(45.15-58.52)	6	9.52 (2.07-16.98)	39	63.93 (51.53-76.33)	68	72.34 (63.13-81.55)
	Correct	105	48.17(41.48-54.85)	57	90.48 (83.02-97.93)	22	36.07 (23.67-48.47)	26	27.66 (18.45-36.87)
Knowledge regarding main area where all crucial level of IDSP activities occur	Incorrect	74	33.94(27.61-40.28)	15	23.81 (13.00-34.62)	37	60.66 (48.04-73.27)	22	23.40 (14.69-32.12)
	Correct	144	66.06(59.72-72.39)	48	76.19 (65.38-87.00)	24	39.34 (26.73-51.96)	72	76.60 (67.88-85.31)
Different ways of diagnosis	Poor	16	6.32(3.30- 9.34)	1	1.59 (0.00-4.76)	4	4.44 (0.10-8.78)	11	11.00 (4.76-17.24)
	Average	168	66.40(60.54-72.26)	53	84.13 (74.85-93.40)	85	94.44 (89.62-99.27)	30	30.00 (20.86-39.14)
	Good	69	27.27(21.75-32.80)	9	14.29 (5.40-23.17)	1	1.11 (0.00-3.32)	59	59.00 (49.19-68.81)

TABLE 3: Physicians' knowledge regarding names of diseases under IDSP in the three studied districts of Bihar, 2019 (n=253)

		Overall		Begusarai		Darbhanga		Bhojpur	
Indicator	**Category**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**
Knowledge regarding name of Acute Diarrheal Disease	No	59	23.32(18.07-28.57)	-	-	53	58.89 (48.53-69.25)	6	6.00 (1.26-10.74)
	Yes	194	76.68(71.43-81.93)	63	100.0 (100.0-100.0)	37	41.11 (30.75-51.47)	94	94.00 (89.26-98.74)
Knowledge regarding name of Bacillary Dysentery	No	152	60.08(54.00-66.15)	8	12.70 (4.25-21.15)	83	92.22 (86.58-97.86)	61	61.00 (51.27-70.73)
	Yes	101	39.92(33.85-46.00)	55	87.30 (78.85-95.75)	7	7.78 (2.14-13.42)	39	39.00 (29.27-48.73)
Knowledge regarding name of Viral Hepatitis	No	114	45.06(38.89-51.23)	17	26.98 (15.72-38.25)	72	80.00 (71.58-88.42)	25	25.00 (16.36-33.64)
	Yes	139	54.94(48.77-61.11)	46	73.02 (61.75-84.28)	18	20.00 (11.58-28.42)	75	75.00 (66.36-83.64)
Knowledge regarding name of Enteric Fever	No	85	33.60(27.74-39.46)	11	17.46 (7.82-27.10)	64	71.11 (61.56-80.66)	10	10.00 (4.02-15.98)
	Yes	168	66.40(60.54-72.26)	52	82.54 (72.90-92.18)	26	28.89 (19.34-38.44)	90	90.00 (84.02-95.98)
Knowledge regarding name of Malaria	No	72	28.46(22.86-34.06)	-	-	69	76.67 (67.76-85.57)	3	3.00 (0.00-6.40)
	Yes	181	71.54(65.94-77.14)	63	100.0 (100.0-100.0)	21	23.33 (14.43-32.24)	97	97.00 (93.60-100.0)
Knowledge regarding name of Dengue	No	102	40.32(34.23-46.40)	11	17.46 (7.82-27.10)	81	90.00 (83.68-96.32)	10	10.00 (4.02-15.98)
	Yes	151	59.68(53.60-65.77)	52	82.54 (72.90-92.18)	9	10.00 (3.68-16.32)	90	90.00 (84.02-95.98)

TABLE 3: Physicians' knowledge regarding names of diseases under IDSP in the three studied districts of Bihar, 2019 (n=253) *Contd...*

		Overall		Begusarai		Darbhanga		Bhojpur	
Indicator	**Category**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**
Knowledge regarding name of Chikungunya	No	131	51.78(45.58-57.98)	24	38.10 (25.77-50.42)	85	94.44 (89.62-99.27)	22	22.00 (13.74-30.26)
	Yes	122	48.22(42.02-54.42)	39	61.90 (49.58-74.23)	5	5.56 (0.73-10.38)	78	78.00 (69.74-86.26)
Knowledge regarding name of Acute Encephalitis Syndrome	No	163	64.43(58.49-70.37)	36	57.14 (44.58-69.71)	86	95.56 (91.22-99.90)	41	41.00 (31.19-50.81)
	Yes	90	35.57(29.63-41.51)	27	42.86 (30.29-55.42)	4	4.44 (0.10-8.78)	59	59.00 (49.19-68.81)
Knowledge regarding name of Meningitis	No	121	47.83(41.63-54.02)	18	28.57 (17.10-40.04)	78	86.67 (79.51-93.83)	25	25.00 (16.36-33.64)
	Yes	132	52.17(45.98-58.37)	45	71.43 (59.96-82.90)	12	13.33 (6.17-20.49)	75	75.00 (66.36-83.64)
Knowledge regarding name of Measles	No	41	16.21(11.63-20.78)	-	-	40	44.44 (33.98-54.91)	1	1.00 (0.00-2.98)
	Yes	212	83.79(79.22-88.37)	63	100.0 (100.0-100.0)	50	55.56 (45.09-66.02)	99	99.00 (97.02-100.0)
Knowledge regarding name of Diphtheria	No	122	48.22(42.02-54.42)	11	17.46 (7.82-27.10)	78	86.67 (79.51-93.83)	33	33.00 (23.62-42.38)
	Yes	131	51.78(45.58-57.98)	52	82.54 (72.90-92.18)	12	13.33 (6.17-20.49)	67	67.00 (57.62-76.38)
Knowledge regarding name of Pertussis	No	108	42.69(36.55-48.82)	9	14.29 (5.40-23.17)	81	90.00 (83.68-96.32)	18	18.00 (10.34-25.66)
	Yes	145	57.31(51.18-63.45)	54	85.71 (76.83-94.60)	9	10.00 (3.68-16.32)	82	82.00 (74.34-89.66)
Knowledge regarding name of Chicken Pox	No	102	40.32(34.23-46.40)	2	3.17 (0.00-7.63)	68	75.56 (66.50-84.61)	32	32.00 (22.70-41.30)
	Yes	151	59.68(53.60-65.77)	61	96.83 (92.37-100.0)	22	24.44 (15.39-33.50)	68	68.00 (58.70-77.30)
Knowledge regarding name of Fever of unknown origin	No	181	71.54(65.94-77.14)	23	36.51 (24.29-48.73)	86	95.56 (91.22-99.90)	72	72.00 (63.05-80.95)
	Yes	72	28.46(22.86-34.06)	40	63.49 (51.27-75.71)	4	4.44 (0.10-8.78)	28	28.00 (19.05-36.95)
Knowledge regarding name of Acute Respiratory Infection	No	166	65.61(59.72-71.51)	16	25.40 (14.35-36.45)	83	92.22 (86.58-97.86)	67	67.00 (57.62-76.38)
	Yes	87	34.39(28.49-40.28)	47	74.60 (63.55-85.65)	7	7.78 (2.14-13.42)	33	33.00 (23.62-42.38)
Knowledge regarding name of Pneumonia	No	105	41.50(35.39-47.61)	4	6.35 (0.16-12.54)	79	87.78 (80.88-94.68)	22	22.00 (13.74-30.26)
	Yes	148	58.50(52.39-64.61)	59	93.65 (87.46-99.84)	11	12.22 (5.32-19.12)	78	78.00 (69.74-86.26)
Knowledge regarding name of Leptospirosis	No	184	72.73(67.20-78.25)	55	87.30 (78.85-95.75)	71	78.89 (70.29-87.48)	58	58.00 (48.16-67.84)
	Yes	69	27.27(21.75-32.80)	8	12.70 (4.25-21.15)	19	21.11 (12.52-29.71)	42	42.00 (32.16-51.84)
Knowledge regarding name of Acute Flaccid Paralysis	No	115	45.45(39.28-51.63)	3	4.76 (0.00-10.17)	70	77.78 (69.02-86.53)	42	42.00 (32.16-51.84)
	Yes	138	54.55(48.37-60.72)	60	95.24 (89.83-100.0)	20	22.22 (13.47-30.98)	58	58.00 (48.16-67.84)
Overall knowledge regarding disease names	Poor	86	33.99(28.12-39.87)	-	-	82	91.11 (85.12-97.10)	4	4.00 (0.09-7.91)
	Average	88	34.78(28.87-40.69)	25	39.68 (27.26-52.10)	8	8.89 (2.90-14.88)	55	55.00 (45.08-64.92)
	Good	79	31.23(25.48-36.97)	38	60.32 (47.90-72.74)	-	-	41	41.00 (31.19-50.81)

TABLE 4: Physicians' knowledge regarding the standard case definition of diseases under IDSP in the three studied districts of Bihar, 2019 (n=253)

		Overall		Begusarai		Darbhanga		Bhojpur	
Indicator	**Category**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**
Knowledge regarding standard case definition of Acute Diarrheal Disease	Incorrect	101	39.92(33.85-46.00)	-	-	72	80.00 (71.58-88.42)	29	29.00 (19.95-38.05)
	Correct	152	60.08(54.00-66.15)	63	100.0 (100.0-100.0)	18	20.00 (11.58-28.42)	71	71.00 (61.95-80.05)
Knowledge regarding standard case definition of Measles	Incorrect	26	10.28(6.51-14.04)	-	-	17	18.89 (10.64-27.13)	9	9.00 (3.29-14.71)
	Correct	227	89.72(85.96-93.49)	63	100.0 (100.0-100.0)	73	81.11 (72.87-89.36)	91	91.00 (85.29-96.71)
Knowledge regarding standard case definition of Enteric Fever or Typhoid	Incorrect	98	38.74(32.69-44.78)	15	23.81 (13.00-34.62)	42	46.67 (36.16-57.17)	41	41.00 (31.19-50.81)
	Correct	155	61.26(55.22-67.31)	48	76.19 (65.38-87.00)	48	53.33 (42.83-63.84)	59	59.00 (49.19-68.81)
Knowledge regarding standard case definition of Dengue	Incorrect	73	28.85(23.23-34.47)	13	20.63 (10.36-30.91)	30	33.33 (23.40-43.26)	30	30.00 (20.86-39.14)
	Correct	180	71.15(65.53-76.77)	50	79.37 (69.09-89.64)	60	66.67 (56.74-76.60)	70	70.00 (60.86-79.14)
Knowledge regarding standard case definition of Acute Encephalitis Syndrome	Incorrect	92	36.36(30.40-42.33)	37	58.73 (46.23-71.23)	33	36.67 (26.52-46.82)	22	22.00 (13.74-30.26)
	Correct	161	63.64(57.67-69.60)	26	41.27 (28.77-53.77)	57	63.33 (53.18-73.48)	78	78.00 (69.74-86.26)
Knowledge regarding standard case definition of Viral Hepatitis	Incorrect	89	35.18(29.25-41.10)	22	34.92 (22.82-47.02)	42	46.67 (36.16-57.17)	25	25.00 (16.36-33.64)
	Correct	164	64.82(58.90-70.75)	41	65.08 (52.98-77.18)	48	53.33 (42.83-63.84)	75	75.00 (66.36-83.64)
Overall knowledge regarding standard case definition based on tertile distribution	Poor	85	33.60(27.74-39.46)	16	25.40 (14.35-36.45)	44	48.89 (38.36-59.42)	25	25.00 (16.36-33.64)
	Average	110	43.48(37.33-49.63)	26	41.27 (28.77-53.77)	40	44.44 (33.98-54.91)	44	44.00 (34.10-53.90)
	Good	58	22.92(17.71-28.14)	21	33.33 (21.37-45.30)	6	6.67 (1.41-11.92)	31	31.00 (21.78-40.22)

TABLE 5: Physicians' knowledge of trigger levels for epidemic prone diseases under IDSP in the three studied districts of Bihar, 2019

		Overall		Begusarai		Darbhanga		Bhojpur	
Indicator	**Category**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**
Knowledge regarding trigger level	Yes	199	78.66(73.57-83.74)	63	100.0 (100.0-100.0)	43	47.78 (37.26-58.30)	93	93.00 (87.91-98.09)
	No	39	15.42(10.94-19.89)	-	-	37	41.11 (30.75-51.47)	2	2.00 (0.00-4.79)
	Don't Know	15	5.93(3.00- 8.86)	-	-	10	11.11 (4.49-17.73)	5	5.00 (0.65-9.35)
Knowledge regarding the trigger level for Acute Diarrheal Disease	Incorrect	184	72.73(67.20-78.25)	40	63.49 (51.27-75.71)	69	76.67 (67.76-85.57)	75	75.00 (66.36-83.64)
	Correct	69	27.27(21.75-32.80)	23	36.51 (24.29-48.73)	21	23.33 (14.43-32.24)	25	25.00 (16.36-33.64)
Knowledge regarding the trigger level for Viral Hepatitis	Incorrect	193	76.28(71.01-81.56)	31	49.21 (36.51-61.90)	87	96.67 (92.89-100.0)	75	75.00 (66.36-83.64)
	Correct	60	23.72(18.44-28.99)	32	50.79 (38.10-63.49)	3	3.33 (0.00-7.11)	25	25.00 (16.36-33.64)
Knowledge regarding the trigger level for Enteric Fever or Typhoid	Incorrect	226	89.33(85.50-93.16)	51	80.95 (70.98-90.92)	88	97.78 (94.67-100.0)	87	87.00 (80.29-93.71)
	Correct	27	10.67(6.84-14.50)	12	19.05 (9.08-29.02)	2	2.22 (0.00-5.33)	13	13.00 (6.29-19.71)
Knowledge regarding the trigger level for Measles	Incorrect	135	53.36(47.17-59.55)	24	38.10 (25.77-50.42)	80	88.89 (82.27-95.51)	31	31.00 (21.78-40.22)
	Correct	118	46.64(40.45-52.83)	39	61.90 (49.58-74.23)	10	11.11 (4.49-17.73)	69	69.00 (59.78-78.22)
Knowledge regarding the trigger level for Dengue	Incorrect	126	49.80(43.60-56.01)	10	15.87 (6.60-25.15)	72	80.00 (71.58-88.42)	44	44.00 (34.10-53.90)
	Correct	127	50.20(43.99-56.40)	53	84.13 (74.85-93.40)	18	20.00 (11.58-28.42)	56	56.00 (46.10-65.90)
Overall knowledge regarding trigger level	Poor	81	32.02(26.23-37.80)	6	9.52 (2.07-16.98)	55	61.11 (50.84-71.38)	20	20.00 (12.02-27.98)
	Average	109	43.08(36.94-49.23)	22	34.92 (22.82-47.02)	32	35.56 (25.47-45.64)	55	55.00 (45.08-64.92)
	Good	63	24.90(19.54-30.27)	35	55.56 (42.94-68.17)	3	3.33 (0.00-7.11)	25	25.00 (16.36-33.64)

TABLE 6: Physicians' knowledge of the reporting formats under the IDSP in the three studied districts of Bihar, 2019 (n=253)

		Overall		Begusarai		Darbhanga		Bhojpur	
Indicator	**Category**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**
Knowledge regarding reporting format under IDSP	Incorrect	221	87.35(83.23-91.48)	61	96.83 (92.37-100.0)	80	88.89 (82.27-95.51)	80	80.00 (72.02-87.98)
	Correct	32	12.65(8.52-16.77)	2	3.17 (0.00-7.63)	10	11.11 (4.49-17.73)	20	20.00 (12.02-27.98)
Knowledge regarding the name of the specific disease reporting form	Incorrect	219	86.56(82.33-90.79)	54	85.71 (76.83-94.60)	85	94.44 (89.62-99.27)	80	80.00 (72.02-87.98)
	Correct	34	13.44(9.21-17.67)	9	14.29 (5.40-23.17)	5	5.56 (0.73-10.38)	20	20.00 (12.02-27.98)
Knowledge regarding number of reporting forms generated	Number	66	26.09(20.64-31.53)	24	38.10 (25.77-50.42)	15	16.67 (8.82-24.52)	27	27.00 (18.15-35.85)
	Don't know	187	73.91(68.47-79.36)	39	61.90 (49.58-74.23)	75	83.33 (75.48-91.18)	73	73.00 (64.15-81.85)
Knowledge regarding data collection	Don't know & Immediate basis	162	64.03(58.08-69.99)	7	11.11 (3.13-19.09)	79	87.78 (80.88-94.68)	76	76.00 (67.48-84.52)
	Weekly basis (Monday & Sunday)	86	33.99(28.12-39.87)	54	85.71 (76.83-94.60)	9	10.00 (3.68-16.32)	23	23.00 (14.61-31.39)
	Both weekly and immediate basis	5	1.98(0.25- 3.70)	2	3.17 (0.00-7.63)	2	2.22 (0.00-5.33)	1	1.00 (0.00-2.98)
Knowledge regarding data collation	Paramedical staff (Pharmacists)	16	6.32(3.30- 9.34)	-	-	5	5.56 (0.73-10.38)	11	11.00 (4.76-17.24)
	Block Health Manager	62	24.51(19.17-29.84)	54	85.71 (76.83-94.60)	1	1.11 (0.00-3.32)	7	7.00 (1.91-12.09)
	Data Entry Operator	33	13.04(8.87-17.22)	5	7.94 (1.07-14.80)	23	25.56 (16.37-34.74)	5	5.00 (0.65-9.35)
	Don't know	133	52.57(46.37-58.76)	4	6.35 (0.16-12.54)	58	64.44 (54.36-74.53)	71	71.00 (61.95-80.05)
	Other	9	3.56(1.26- 5.86)	-	-	3	3.33 (0.00-7.11)	6	6.00 (1.26-10.74)
Knowledge regarding data storage	Scanned and stored digitally	8	3.16(0.99- 5.33)	1	1.59 (0.00-4.76)	5	5.56 (0.73-10.38)	2	2.00 (0.00-4.79)
	In a color-coded form	23	9.09(5.52-12.66)	1	1.59 (0.00-4.76)	2	2.22 (0.00-5.33)	20	20.00 (12.02-27.98)
	In a separate register	57	22.53(17.35-27.71)	56	88.89 (80.91-96.87)	1	1.11 (0.00-3.32)	-	-
	No idea	164	64.82(58.90-70.75)	5	7.94 (1.07-14.80)	81	90.00 (83.68-96.32)	78	78.00 (69.74-86.26)
	Other (specify)	1	0.40(0.00- 1.17)	-	-	1	1.11 (0.00-3.32)	-	-
	Yes, sometime	62	24.51(19.17-29.84)	25	39.68 (27.26-52.10)	18	20.00 (11.58-28.42)	19	19.00 (11.18-26.82)
	Yes, regularly	48	18.97(14.11-23.84)	36	57.14 (44.58-69.71)	1	1.11 (0.00-3.32)	11	11.00 (4.76-17.24)

TABLE 7: Physicians' knowledge of outbreak investigation & outbreak detection in the three studied districts of Bihar, 2019

		Overall		Begusarai		Darbhanga		Bhojpur	
Indicator	**Category**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**
Detection of unusual clustering	Clustering of cases from the same locality on a given day or consecutive days	107	42.29(36.16-48.42)	43	68.25 (56.44-80.07)	26	28.89 (19.34-38.44)	38	38.00 (28.32-47.68)
	Media reports	2	0.79(0.00- 1.89)	1	1.59 (0.00-4.76)			1	1.00 (0.00-2.98)
	Information reaching from the affected community	74	29.25(23.61-34.89)	13	20.63 (10.36-30.91)	18	20.00 (11.58-28.42)	43	43.00 (33.13-52.87)
	All of the above	28	11.07(7.18-14.96)	6	9.52 (2.07-16.98)	8	8.89 (2.90-14.88)	14	14.00 (7.08-20.92)
	Other	42	16.60(11.98-21.22)			38	42.22 (31.82-52.62)	4	4.00 (0.09-7.91)
Usual time response to outbreak	Within 24 hours	238	94.07(91.14-97.00)	52	82.54 (72.90-92.18)	87	96.67 (92.89-100.0)	99	99.00 (97.02-100.0)
	Between 24 and 48 hours	10	3.95(1.54- 6.37)	8	12.70 (4.25-21.15)	1	1.11 (0.00-3.32)	1	1.00 (0.00-2.98)
	Beyond 48 hours	3	1.19(0.00- 2.53)	3	4.76 (0.00-10.17)	-	-	-	-
	In most of the times no response	2	0.79(0.00- 1.89)	-	-	2	2.22 (0.00-5.33)	-	-
Transmission of information related to outbreak to the next higher level	Pharmacist/Block health manager immediately report to District Surveillance Officer over phone	159	62.85(56.85-68.84)	11	17.46 (7.82-27.10)	57	63.33 (53.18-73.48)	91	91.00 (85.29-96.71)
	Pharmacist/Block health manager generate a report & submit it to District Surveillance Officer	74	29.25(23.61-34.89)	50	79.37 (69.09-89.64)	19	21.11 (12.52-29.71)	5	5.00 (0.65-9.35)
	Don't Know	10	3.95(1.54- 6.37)	1	1.59 (0.00-4.76)	8	8.89 (2.90-14.88)	1	1.00 (0.00-2.98)
	Other (specify)	10	3.95(1.54- 6.37)	1	1.59 (0.00-4.76)	-	-	3	3.00 (0.00-6.40)

TABLE 8: Physicians' knowledge of outbreak preparedness and response in the three studied districts of Bihar, 2019 (n=253)

		Overall		Begusarai		Darbhanga		Bhojpur	
Indicator	**Category**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**
Knowledge regarding approach to exploring risk factor: Interacting with Index case and family members	Yes, but not always, No	96	37.94(31.92-43.96)	31	49.21 (36.51-61.90)	58	64.44 (54.36-74.53)	7	7.00 (1.91-12.09)
	Yes, always	157	62.06(56.04-68.08)	32	50.79 (38.10-63.49)	32	35.56 (25.47-45.64)	93	93.00 (87.91-98.09)
Knowledge regarding approach to exploring risk factor: Timely survey	Yes, but not always, No	77	30.43(24.73-36.14)	14	22.22 (11.67-32.78)	48	53.33 (42.83-63.84)	15	15.00 (7.88-22.12)
	Yes, always	176	69.57(63.86-75.27)	49	77.78 (67.22-88.33)	42	46.67 (36.16-57.17)	85	85.00 (77.88-92.12)
Knowledge regarding approach to exploring risk factor: Sending water supply	Yes, but not always, No	155	61.26(55.22-67.31)	44	69.84 (58.19-81.49)	77	85.56 (78.15-92.96)	34	34.00 (24.55-43.45)
	Yes, always	98	38.74(32.69-44.78)	19	30.16 (18.51-41.81)	13	14.44 (7.04-21.85)	66	66.00 (56.55-75.45)
Knowledge regarding approach to exploring risk factor: Checking immunization coverage	Yes, but not always, No	152	60.08(54.00-66.15)	10	15.87 (6.60-25.15)	83	92.22 (86.58-97.86)	59	59.00 (49.19-68.81)
	Yes, always	101	39.92(33.85-46.00)	53	84.13 (74.85-93.40)	7	7.78 (2.14-13.42)	41	41.00 (31.19-50.81)
Knowledge regarding approach to exploring risk factor: Checking mode of defecation	Yes, but not always,	109	43.08(36.94-49.23)	6	9.52 (2.07-16.98)	80	88.89 (82.27-95.51)	23	23.00 (14.61-31.39)
	Yes, always	144	56.92(50.77-63.06)	57	90.48 (83.02-97.93)	10	11.11 (4.49-17.73)	77	77.00 (68.61-85.39)
Overall knowledge regarding exploring risk factors	Poor	92	36.36(30.40-42.33)	8	12.70 (4.25-21.15)	73	81.11 (72.87-89.36)	11	11.00 (4.76-17.24)
	Average	85	33.60(27.74-39.46)	27	42.86 (30.29-55.42)	17	18.89 (10.64-27.13)	41	41.00 (31.19-50.81)
	Good	76	30.04(24.35-35.73)	28	44.44 (31.83-57.06)	-	-	48	48.00 (38.04-57.96)

TABLE 8: Physicians' knowledge of outbreak preparedness and response in the three studied districts of Bihar, 2019 (n=253), *Contd...*

		Overall		Begusarai		Darbhanga		Bhojpur	
Indicator	**Category**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**
Knowledge regarding outbreak preparedness & response	Poor	104	41.11(35.00-47.21)	5	7.94 (1.07-14.80)	78	86.67 (79.51-93.83)	21	21.00 (12.88-29.12)
	Average	87	34.39(28.49-40.28)	26	41.27 (28.77-53.77)	12	13.33 (6.17-20.49)	49	49.00 (39.03-58.97)
	Good	62	24.51(19.17-29.84)	32	50.79 (38.10-63.49)	-	-	30	30.00 (20.86-39.14)
Exploration of risk factors during an outbreak	Yes	106	41.90(35.78-48.02)	47	74.60 (63.55-85.65)	17	18.89 (10.64-27.13)	42	42.00 (32.16-51.84)
	No	27	10.67(6.84-14.50)	-	-	10	11.11 (4.49-17.73)	17	17.00 (9.51-24.49)
	Outbreak did not happen during my tenure	120	47.43(41.24-53.63)	16	25.40 (14.35-36.45)	63	70.00 (60.35-79.65)	41	41.00 (31.19-50.81)

TABLE 9: Factors effecting Physicians' knowledge of IDSP in the three studied districts of Bihar, 2019 (n=253)

Description	**Categories**	**Overall Knowledge (Reference=Poor)**				
			Average		**Good**	
			OR (95% CI)	P-Value	OR (95% CI)	P-Value
Doctor's Age	-	UOR*	1.01(0.99-1.04)	0.3791	1.02(0.99-1.05)	0.1495
		AOR*	1.01(0.98-1.03)	0.6335	1.00(0.97-1.04)	0.7688
Doctor's Professional degree (Reference=Ayush)	Others	UOR	1.49(0.51-4.32)	0.462	0.41(0.05-3.59)	0.4204
		AOR	1.83(0.61-5.48)	0.2803	0.65(0.07-5.92)	0.7056
	MBBS	UOR	2.00(1.06-3.80)	0.0329	3.95(1.79-8.70)	0.0007
		AOR	2.20(1.14-4.27)	0.0192	4.96(2.14-11.47)	0.0002
Received formal training on IDSP (Reference=No)	Yes	UOR	1.54(0.74-3.21)	0.2528	2.62(1.23-5.56)	0.0122
		AOR	1.79(0.81-3.98)	0.1499	3.25(1.39-7.65)	0.0068

***UOR= Unadjusted Odds Ratio*

AOR= Adjusted Odds Ratio, adjusted for age and degree of doctors adjusted with all exposures

TABLE 10: Physicians' practice of case detection and using standard case definition of diseases under IDSP in the three studied districts of Bihar, 2019 (n=253)

Indicator	Category	Overall		Begusarai		Darbhanga		Bhojpur	
		Frequency	% (95% CI)	Frequency	% (95% CI)	Frequency	% (95% CI)	Frequency	% (95% CI)
Use of standard case definition while reporting	Not at all	23	9.09(5.52-12.66)	–	–	10	11.11 (4.49-17.73)	13	13.00 (6.29-19.71)
	Yes, sometimes	44	17.39(12.69-22.09)	4	6.35 (0.16-12.54)	8	8.89 (2.90-14.88)	32	32.00 (22.70-41.30)
	Yes, always	186	73.52(68.04-78.99)	59	93.65 (87.46-99.84)	72	80.00 (71.58-88.42)	55	55.00 (45.08-64.92)
Practice of putting provisional diagnosis	No	93	36.76(30.78-42.74)			53	58.89 (48.53-69.25)	40	40.00 (30.23-49.77)
	Yes, sometimes	35	13.83(9.55-18.12)	1	1.59 (0.00-4.76)	10	11.11 (4.49-17.73)	24	24.00 (15.48-32.52)
	Yes, always	125	49.41(43.20-55.61)	62	98.41 (95.24-100.0)	27	30.00 (20.35-39.65)	36	36.00 (26.43-45.57)
Maintenance of out-patient register	No	–	–	–	–	–	–	–	–
	Yes, sometimes	6	2.37(0.48-4.26)	–	–	–	–	6	6.00 (1.26-10.74)
	Yes, always	247	97.63(95.74-99.52)	63	100.0 (100.0-100.0)	90	100.0 (100.0-100.0)	94	94.00 (89.26-98.74)
Maintenance of in-patient register	No	77	30.43(24.73-36.14)	17	26.98 (15.72-38.25)	42	46.67 (36.16-57.17)	18	18.00 (10.34-25.66)
	Yes, sometimes	26	10.28(6.51-14.04)	1	1.59 (0.00-4.76)	13	14.44 (7.04-21.85)	12	12.00 (5.52-18.48)
	Yes, always	150	59.29(53.19-65.38)	45	71.43 (59.96-82.90)	35	38.89 (28.62-49.16)	70	70.00 (60.86-79.14)
Record keeping of patients complaining more than two symptoms	No definite standard followed	61	24.11(18.80-29.42)	4	6.35 (0.16-12.54)	40	44.44 (33.98-54.91)	17	17.00 (9.51-24.49)
	Report those with epidemic potential	44	17.39(12.69-22.09)	8	12.70 (4.25-21.15)	13	14.44 (7.04-21.85)	23	23.00 (14.61-31.39)
	Report all	148	58.50(52.39-64.61)	51	80.95 (70.98-90.92)	37	41.11 (30.75-51.47)	60	60.00 (50.23-69.77)
Second time recording	No definite standard followed & New report are not recorded	12	4.74(2.11- 7.38)	–	–	8	8.89 (2.90-14.88)	4	4.00 (0.09-7.91)
	Discard previous & enter current report as a new entry	10	3.95(1.54- 6.37)	3	4.76 (0.00-10.17)	5	5.56 (0.73-10.38)	2	2.00 (0.00-4.79)
	Add the current report to the previous one	231	91.30(87.81-94.80)	60	95.24 (89.83-100.0)	77	85.56 (78.15-92.96)	94	94.00 (89.26-98.74)
Overall	Poor	117	46.25(40.06-52.43)	8	12.70 (4.25-21.15)	67	74.44 (65.26-83.63)	42	42.00 (32.16-51.84)
	Average	74	29.25(23.61-34.89)	17	26.98 (15.72-38.25)	20	22.22 (13.47-30.98)	37	37.00 (27.37-46.63)
	Good	62	24.51(19.17-29.84)	38	60.32 (47.90-72.74)	3	3.33 (0.00-7.11)	21	21.00 (12.88-29.12)

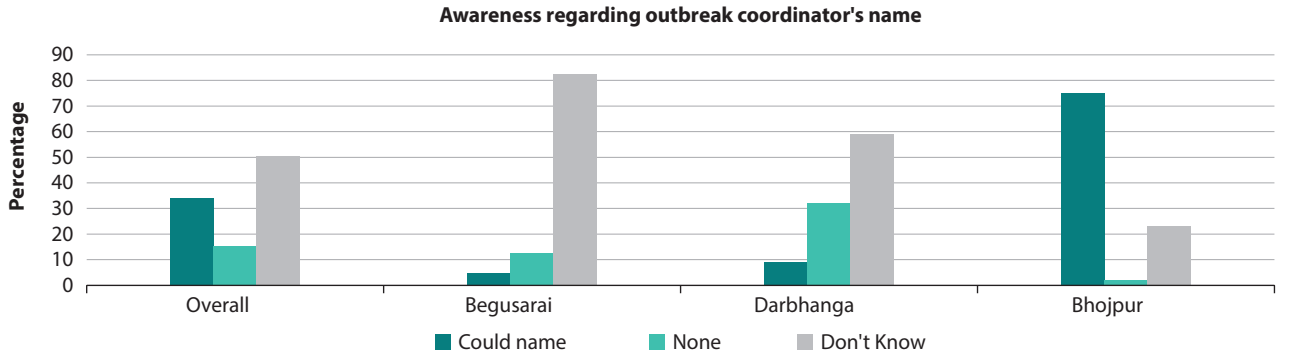
TABLE 11: Physicians' practice related to data analysis and emergency management in the three studied districts of Bihar, 2019 (n=253)

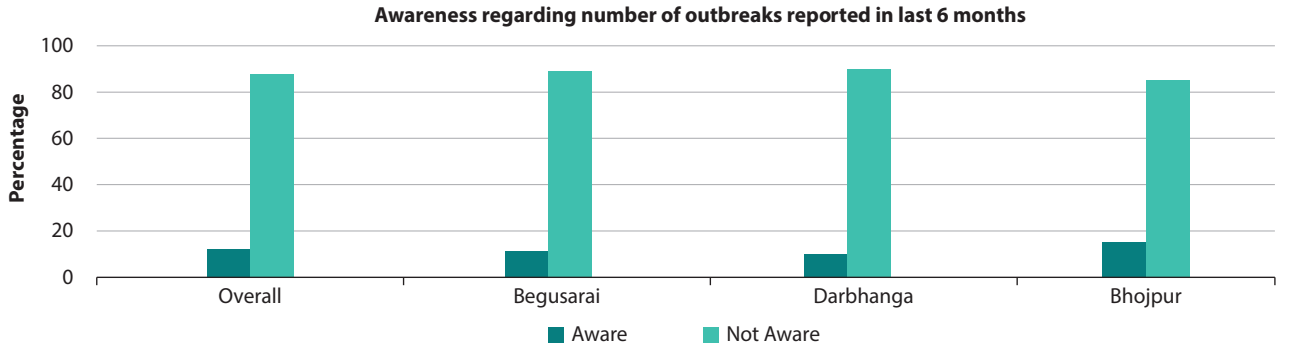
Indicator	Category	Overall		Begusarai		Darbhanga		Bhojpur	
		Frequency	% (95% CI)	Frequency	% (95% CI)	Frequency	% (95% CI)	Frequency	% (95% CI)
Analysis and interpretation of data	Never	143	56.52(50.37-62.67)	2	3.17 (0.00-7.63)	71	78.89 (70.29-87.48)	70	70.00 (60.86-79.14)
	Yes, sometime	62	24.51(19.17-29.84)	25	39.68 (27.26-52.10)	18	20.00 (11.58-28.42)	19	19.00 (11.18-26.82)
	Yes, regularly	48	18.97(14.11-23.84)	36	57.14 (44.58-69.71)	1	1.11 (0.00-3.32)	11	11.00 (4.76-17.24)
Existence of a rapid response team	Yes sometimes	46	23.96(17.87-30.05)	17	28.33 (16.59-40.07)	6	6.67 (1.41-11.92)	11	11.58 (5.03-18.13)
	Yes, always	146	76.04(69.95-82.13)	43	71.67 (59.93-83.41)	19	51.35 (34.46-68.25)	84	88.42 (81.87-94.97)
Presence of a designated surveillance committee at district	No	6	4.23(0.88- 7.57)	2	9.09 (0.00-22.14)	4	13.33 (0.42-26.24)	–	–
	Yes	136	95.77(92.43-99.12)	20	90.91 (77.86-100.0)	26	86.67 (73.76-99.58)	90	100.0 (100.0-100.0)
Presence of verification copies of outbreak	No	131	85.62(80.00-91.24)	56	100.0 (100.0-100.0)	39	82.98 (71.82-94.13)	36	72.00 (59.11-84.89)
	Yes	22	14.38(8.76-20.00)	–	–	8	17.02 (5.87-28.18)	14	28.00 (15.11-40.89)
Availability of appropriate supplies during outbreaks	No	33	13.04(8.87-17.22)	1	1.59 (0.00-4.76)	27	30.00 (20.35-39.65)	5	5.00 (0.65-9.35)
	Yes, sometimes	38	15.02(10.59-19.45)	10	15.87 (6.60-25.15)	25	27.78 (18.34-37.21)	3	3.00 (0.00-6.40)
	Yes, always	182	71.94(66.36-77.51)	52	82.54 (72.90-92.18)	38	42.22 (31.82-52.62)	92	92.00 (86.59-97.41)

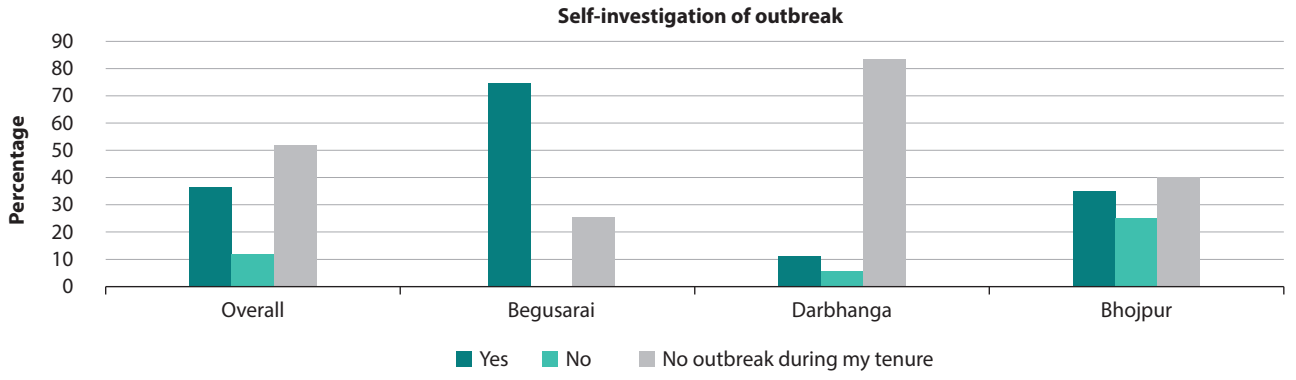
TABLE 11: Physicians' practice related to data analysis and emergency management in the three studied districts of Bihar, 2019 (n=253), *Contd...*

Indicator	Category	Overall		Begusarai		Darbhanga		Bhojpur	
		Frequency	% (95% CI)	Frequency	% (95% CI)	Frequency	% (95% CI)	Frequency	% (95% CI)
Access to emergency stocks	No	12	4.74(2.11- 7.38)	1	1.59 (0.00-4.76)	10	11.11 (4.49-17.73)	1	1.00 (0.00-2.98)
	Yes, sometimes	39	15.42(10.94-19.89)	8	12.70 (4.25-21.15)	26	28.89 (19.34-38.44)	5	5.00 (0.65-9.35)
	Yes, always	202	79.84(74.86-84.82)	54	85.71 (76.83-94.60)	54	60.00 (49.68-70.32)	94	94.00 (89.26-98.74)
Access to emergency funds	No	152	60.08(54.00-66.15)	56	88.89 (80.91-96.87)	64	71.11 (61.56-80.66)	32	32.00 (22.70-41.30)
	Yes, sometimes	15	5.93(3.00- 8.86)	4	6.35 (0.16-12.54)	8	8.89 (2.90-14.88)	3	3.00 (0.00-6.40)
	Yes, always	86	33.99(28.12-39.87)	3	4.76 (0.00-10.17)	18	20.00 (11.58-28.42)	65	65.00 (55.49-74.51)
Allowance for vehicle use	No	49	19.37(14.46-24.27)	5	7.94 (1.07-14.80)	33	36.67 (26.52-46.82)	11	11.00 (4.76-17.24)
	Yes, sometimes	54	21.34(16.26-26.43)	33	52.38 (39.70-65.06)	18	20.00 (11.58-28.42)	3	3.00 (0.00-6.40)
	Yes, always	150	59.29(53.19-65.38)	25	39.68 (27.26-52.10)	39	43.33 (32.90-53.77)	86	86.00 (79.08-92.92)
Overall	Poor	86	33.99(28.12-39.87)	21	33.33 (21.37-45.30)	57	63.33 (53.18-73.48)	8	8.00 (2.59-13.41)
	Average	84	33.20(27.36-39.04)	36	57.14 (44.58-69.71)	18	20.00 (11.58-28.42)	30	30.00 (20.86-39.14)
	Good	83	32.81(26.98-38.63)	6	9.52 (2.07-16.98)	15	16.67 (8.82-24.52)	62	62.00 (52.32-71.68)
Need for lab confirmation for public health response during outbreak	Yes	53	20.95(15.90-26.00)	9	14.29 (5.40-23.17)	29	32.22 (22.38-42.07)	15	15.00 (7.88-22.12)
	No	192	75.89(70.58-81.20)	54	85.71 (76.83-94.60)	53	58.89 (48.53-69.25)	85	85.00 (77.88-92.12)
	Don't know	8	3.16(0.99- 5.33)	–	–	8	8.89 (2.90-14.88)	–	–

FIGURE 8 Physicians' awareness & practice of outbreak response under IDSP in the three studied districts of Bihar







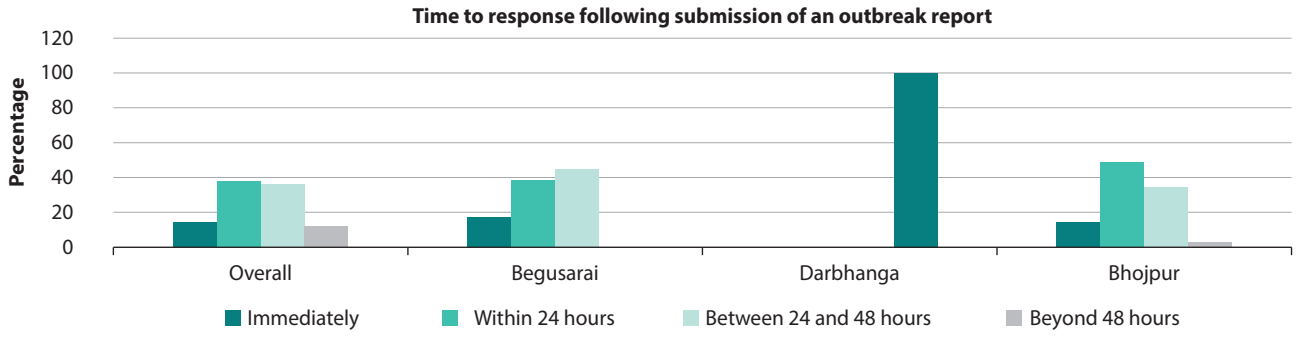


TABLE 12: Physicians' general outbreak preparedness and response under IDSP in the three studied districts of Bihar, 2019 (n=253)

Indicator	Category	Overall		Begusarai		Darbhanga		Bhojpur	
		Frequency	% (95% CI)	Frequency	% (95% CI)	Frequency	% (95% CI)	Frequency	% (95% CI)
Prevention and control measure following submission of the outbreak report	Yes	149	58.89 (52.79-65.00)	46	73.02 (61.75-84.28)	19	21.11 (12.52-29.71)	84	84.00 (76.69-91.31)
	No	11	4.35 (1.82- 6.88)	1	1.59 (0.00-4.76)	9	10.00 (3.68-16.32)	1	1.00 (0.00-2.98)
	No outbreak	93	36.76 (30.78-42.74)	16	25.40 (14.35-36.45)	62	68.89 (59.14-78.64)	15	15.00 (7.88-22.12)
Prevention and control measure following submission of the outbreak report: Water purification	No	16	10.74 (5.71-15.77)	–	–	11	57.89 (33.45-82.34)	5	5.95 (0.79-11.12)
	Yes, but not always	17	11.41 (6.25-16.57)	11	23.91 (11.11-36.72)	–	–	6	7.14 (1.52-12.77)
	Yes, always	116	77.85 (71.11-84.60)	35	76.09 (63.28-88.89)	8	42.11 (17.66-66.55)	73	86.90 (79.54-94.27)
Prevention and control measure following submission of the outbreak report: Container surveys	No	67	44.97 (36.89-53.05)	25	54.35 (39.39-69.30)	16	84.21 (66.15-100.0)	26	30.95 (20.86-41.05)
	Yes, but not always	54	36.24 (28.43-44.05)	10	21.74 (9.35-34.12)	3	15.79 (0.00-33.85)	41	48.81 (37.90-59.72)
	Yes, always	28	18.79 (12.45-25.14)	11	23.91 (11.11-36.72)	–	–	17	20.24 (11.47-29.01)
Prevention and control measure following submission of the outbreak report: Awareness campaigns	No	12	8.05 (3.63-12.47)	–	–	12	63.16 (39.27-87.04)	–	–
	Yes, but not always	6	4.03 (0.83- 7.22)	4	8.70 (0.24-17.16)	1	5.26 (0.00-16.32)	1	1.19 (0.00-3.56)
	Yes, always	131	87.92 (82.63-93.21)	42	91.30 (82.84-99.76)	6	31.58 (8.56-54.60)	83	98.81 (96.44-100.0)
Prevention and control measure following submission of the outbreak report: Stock medication	No	15	10.07(5.18-14.95)	–	–	12	63.16 (39.27-87.04)	3	3.57 (0.00-7.62)
	Yes, but not always	2	1.34(0.00- 3.21)	1	2.17 (0.00-6.55)	–	–	1	1.19 (0.00-3.56)
	Yes, always	132	88.59(83.43-93.75)	45	97.83 (93.45-100.0)	7	36.84 (12.96-60.73)	80	95.24 (90.59-99.89)
Prevention and control measure following submission of the outbreak report: Mass chemoprophylaxis	No	16	10.74(5.71-15.77)	–	–	14	73.68 (51.88-95.49)	2	2.38 (0.00-5.71)
	Yes, but not always	12	8.05(3.63-12.47)	1	2.17 (0.00-6.55)	2	10.53 (0.00-25.72)	9	10.71 (3.96-17.47)
	Yes, always	121	81.21(74.86-87.55)	45	97.83 (93.45-100.0)	3	15.79 (0.00-33.85)	73	86.90 (79.54-94.27)
Overall practice regarding control measure during an outbreak	Poor	84	56.38(48.32-64.43)	31	67.39 (53.32-81.47)	18	94.74 (83.68-100.0)	35	41.67 (30.90-52.43)
	Average	40	26.85(19.65-34.04)	5	10.87 (1.52-20.21)	1	5.26 (0.00-16.32)	34	40.48 (29.76-51.19)
	Good	25	16.78(10.71-22.85)	10	21.74 (9.35-34.12)	–	–	15	17.86 (9.50-26.22)

FIGURE 9 Observational checklist of the health facility in regards to IDSP in the three studied districts of Bihar, 2019 (n=253)

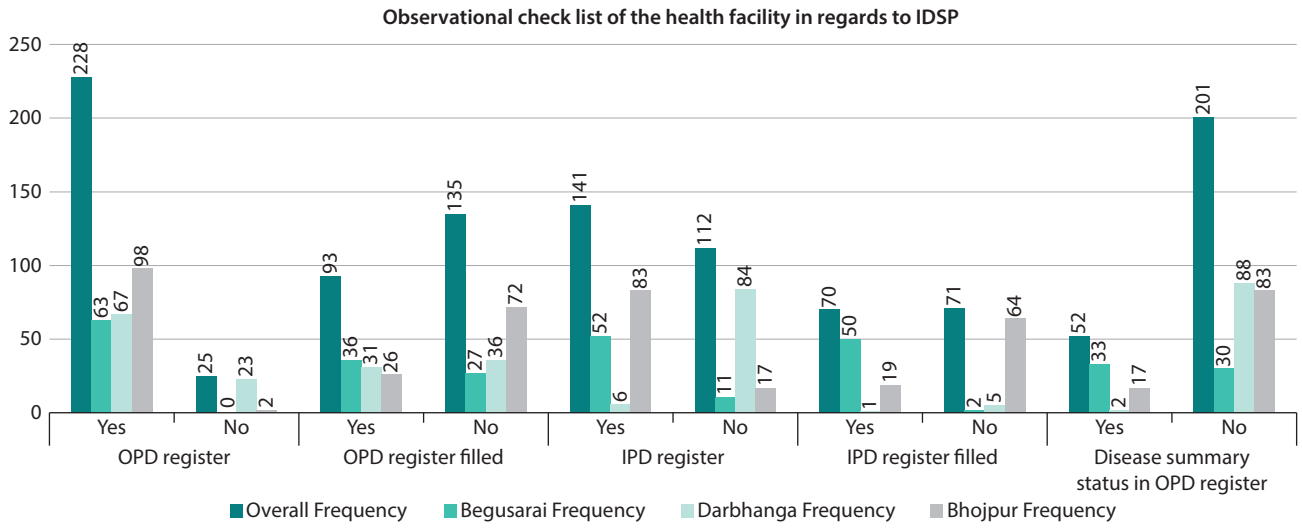


FIGURE 10 Observational checklist of the health facility in regards to IDSP in the three studied districts of Bihar, 2019 (n=92)

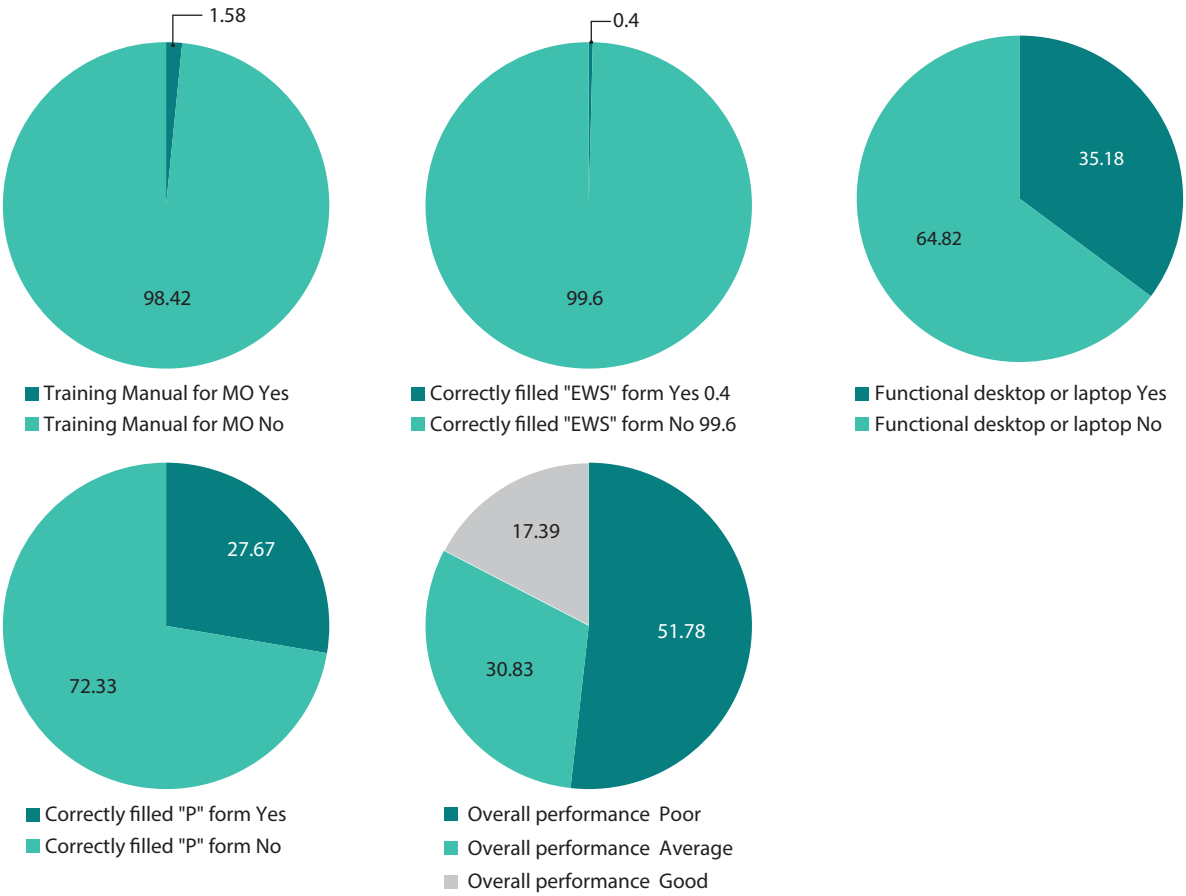


TABLE 13: Training and supervision of the physicians under IDSP in the three studied districts of Bihar, 2019 (n=253)

Indicator	Category	Overall		Begusarai		Darbhanga		Bhojpur	
		Frequency	% (95% CI)	Frequency	% (95% CI)	Frequency	% (95% CI)	Frequency	% (95% CI)
Formal training received	Yes, before joining	7	2.77(0.73- 4.80)	–	–	4	4.44 (0.10-8.78)	3	3.00 (0.00-6.40)
	Yes, immediately after joining	48	18.97(14.11-23.84)	28	44.44 (31.83-57.06)	17	18.89 (10.64-27.13)	3	3.00 (0.00-6.40)
	No	198	78.26(73.14-83.38)	35	55.56 (42.94-68.17)	69	76.67 (67.76-85.57)	94	94.00 (89.26-98.74)
Formal training received	No	198	78.26(73.14-83.38)	35	55.56 (42.94-68.17)	69	76.67 (67.76-85.57)	94	94.00 (89.26-98.74)
	Yes	55	21.74(16.62-26.86)	28	44.44 (31.83-57.06)	21	23.33 (14.43-32.24)	6	6.00 (1.26-10.74)
Number of training received in the past	No Training received	218	86.17(81.88-90.45)	58	92.06 (85.20-98.93)	77	85.56 (78.15-92.96)	83	83.00 (75.51-90.49)
	One training	23	9.09(5.52-12.66)	4	6.35 (0.16-12.54)	10	11.11 (4.49-17.73)	9	9.00 (3.29-14.71)
	Two trainings	9	3.56(1.26- 5.86)	1	1.59 (0.00-4.76)	2	2.22 (0.00-5.33)	6	6.00 (1.26-10.74)
	Three trainings	2	0.79(0.00- 1.89)	–		1	1.11 (0.00-3.32)	1	1.00 (0.00-2.98)
	Four trainings	1	0.40(0.00- 1.17)	–	–	–	–	1	1.00 (0.00-2.98)
Supervision of employee's work	Yes, always	40	15.81(11.28-20.34)	10	15.87 (6.60-25.15)	15	16.67 (8.82-24.52)	15	15.00 (7.88-22.12)
	Yes, sometimes	37	14.62(10.24-19.01)	11	17.46 (7.82-27.10)	10	11.11 (4.49-17.73)	16	16.00 (8.69-23.31)
	No	176	69.57(63.86-75.27)	42	66.67 (54.70-78.63)	65	72.22 (62.79-81.66)	69	69.00 (59.78-78.22)
Supervision by DSO	Yes, always	43	17.00(12.34-21.66)	15	23.81 (13.00-34.62)	6	6.67 (1.41-11.92)	22	22.00 (13.74-30.26)
	Yes, sometimes	90	35.57(29.63-41.51)	43	68.25 (56.44-80.07)	16	17.78 (9.73-25.83)	31	31.00 (21.78-40.22)
	No	120	47.43(41.24-53.63)	5	7.94 (1.07-14.80)	68	75.56 (66.50-84.61)	47	47.00 (37.05-56.95)
Feedback from district	Yes	90	35.57(29.63-41.51)	27	42.86 (30.29-55.42)	15	16.67 (8.82-24.52)	48	48.00 (38.04-57.96)
	No	163	64.43(58.49-70.37)	36	57.14 (44.58-69.71)	75	83.33 (75.48-91.18)	52	52.00 (42.04-61.96)

TABLE 13: Training and supervision of the physicians under IDSP in the three studied districts of Bihar, 2019 (n=253), *Contd...*

Indicator	Category	Overall		Begusarai		Darbhanga		Bhojpur	
		Frequency	% (95% CI)	Frequency	% (95% CI)	Frequency	% (95% CI)	Frequency	% (95% CI)
Interval of feedback from district	Monthly	44	48.89(38.36-59.42)	15	55.56 (35.52-75.59)	7	46.67 (18.07-75.26)	22	45.83 (31.21-60.45)
	Quarterly	27	30.00(20.35-39.65)	5	18.52 (2.86-34.18)	4	26.67 (1.32-52.02)	18	37.50 (23.29-51.71)
	Annually	11	12.22(5.32-19.12)	2	7.41 (0.00-17.96)	1	6.67 (0.00-20.97)	8	16.67 (5.73-27.60)
	Only during an outbreak	8	8.89(2.90-14.88)	5	18.52 (2.86-34.18)	3	20.00 (0.00-42.93)	–	–
Organization of workshop & guideline by district team	Yes, regularly	28	11.07(7.18-14.96)	19	30.16 (18.51-41.81)	5	5.56 (0.73-10.38)	4	4.00 (0.09-7.91)
	Yes, not regularly	56	22.13(16.98-27.28)	31	49.21 (36.51-61.90)	10	11.11 (4.49-17.73)	15	15.00 (7.88-22.12)
	No	169	66.80(60.96-72.64)	13	20.63 (10.36-30.91)	75	83.33 (75.48-91.18)	81	81.00 (73.18-88.82)
Satisfaction with the content of the last workshop	Fully	68	80.95(72.38-89.53)	44	88.00 (78.67-97.33)	7	46.67 (18.07-75.26)	17	89.47 (74.28-100.0)
	Partially	13	15.48(7.58-23.37)	6	12.00 (2.67-21.33)	7	46.67 (18.07-75.26)	–	–
	No	2	2.38(0.00- 5.71)	–	–	1	6.67 (0.00-20.97)	1	5.26 (0.00-16.32)
	Did not participate	1	1.19(0.00- 3.56)	–	–	–	–	1	5.26 (0.00-16.32)

TABLE 14: Factors effecting Physicians' practice of filling the P-Form of IDSP in the three studied districts of Bihar, 2019 (n=253)

Description	Categories	Measures	P form correctly filled or not (Reference=No)	
			Yes	
			OR* (95% CI)	p-Value
Doctor's Age	-	UOR	1.01(0.98- 1.03)	0.4674
		AOR	1.00(0.98- 1.03)	0.7576
Doctor's Professional degree (Reference=Ayush)	Others	UOR	3.37(0.93-12.16)	0.0639
		AOR	3.26(0.85-12.54)	0.0862
	MBBS	UOR	5.31(2.29-12.33)	0.0001
		AOR	4.86(2.02-11.68)	0.0004
Overall Knowledge (Reference=Poor)	Average	UOR	5.43(2.64-11.14)	<.0001
		AOR	4.98(2.37-10.44)	<.0001
	Good	UOR	3.09(1.40- 6.84)	0.0053
		AOR	2.32(1.02- 5.28)	0.0456
Received formal training on IDSP (Reference=No)	Yes	UOR	0.31(0.13- 0.73)	0.0071
		AOR	0.30(0.12- 0.74)	0.0094
System level readiness (Reference=Poor)	Average	UOR	3.04(1.66- 5.55)	0.0003
		AOR	2.73(1.46- 5.12)	0.0017

Age and Degree of doctors adjusted with all exposures

OR= Odds Ratio UOR= Unadjusted Odds Ratio AOR= Adjusted Odds Ratio*

TABLE 15: Factors effecting Physicians' practice of putting provisional diagnosis in IDSP in the three studied districts of Bihar, 2019 (n=253)

Description	Categories	Measures	Practice of putting provisional diagnosis (Reference=No)			
			Yes, sometimes		Yes, always	
			OR* (95% CI)	P-Value	OR (95% CI)	P-Value
Doctor's Age	–	UOR	0.99(0.96- 1.03)	0.6987	1.00(0.98- 1.02)	0.9408
		AOR	0.99(0.96- 1.03)	0.6207	1.00(0.97- 1.02)	0.8999
Doctor's Professional degree (Reference=Ayush)	Others	UOR	0.47(0.05- 4.37)	0.5045	1.60(0.53- 4.80)	0.4018
		AOR	0.43(0.05- 4.05)	0.4596	1.37(0.42- 4.49)	0.6065
	MBBS	UOR	1.14(0.48- 2.70)	0.7678	1.06(0.58- 1.93)	0.855
		AOR	1.06(0.44- 2.54)	0.8996	0.86(0.45- 1.64)	0.6394
System level readiness (Reference=Inappropriate)	Appropriate	UOR	2.16(0.95- 4.87)	0.0646	5.68(3.14-10.30)	<.0001
		AOR	2.15(0.95- 4.90)	0.0674	5.78(3.17-10.54)	<.0001

Age and Degree of doctors adjusted with all exposure

OR= Odds Ratio UOR= Unadjusted Odds Ratio AOR= Adjusted Odds Ratio*

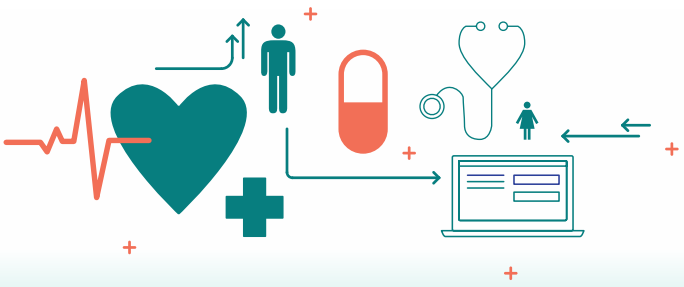
TABLE 16: Factors effecting Physicians' general practice in IDSP in the three studied districts of Bihar, 2019 (n=253)

Description	Categories	Measures	Overall Practice (Reference=Poor)			
			Average		Good	
			OR* (95% CI)	p-value	OR (95% CI)	p-value
Doctor's Age	–	UOR	1.02(0.99- 1.04)	0.1937	1.01(0.99- 1.04)	0.3092
		AOR	1.01(0.98- 1.04)	0.3864	1.01(0.97- 1.04)	0.7311
Doctor's Professional degree (Reference=Ayush)	Others	UOR	0.85(0.24- 3.02)	0.8001	1.17(0.32- 4.32)	0.8085
		AOR	0.85(0.23- 3.18)	0.8076	1.47(0.33- 6.56)	0.615
	MBBS	UOR	1.90(0.98- 3.68)	0.0584	2.27(1.09- 4.71)	0.0275
		AOR	1.44(0.71- 2.91)	0.3104	1.16(0.48- 2.77)	0.742
Overall Knowledge (Reference=Poor)	Average	UOR	3.73(1.91- 7.30)	0.0001	10.30(3.56-29.75)	<.0001
		AOR	3.52(1.78- 6.94)	0.0003	10.06(3.46-29.23)	<.0001
	Good	UOR	5.29(2.11-13.23)	0.0004	54.72(17.42-171.8)	<.0001
		AOR	4.58(1.79-11.69)	0.0015	53.64(16.61-173.2)	<.0001
System level readiness (Reference=Poor)	Average	UOR	3.44(1.75- 6.77)	0.0004	12.72(5.09-31.76)	<.0001
		AOR	3.37(1.69- 6.74)	0.0006	12.00(4.74-30.43)	<.0001
	Good	UOR	8.18(2.46-27.16)	0.0006	78.75(22.05-281.2)	<.0001
		AOR	9.17(2.70-31.17)	0.0004	94.95(25.44-354.3)	<.0001
Received formal training on IDSP (Reference=No)	Yes	UOR	2.18(1.04- 4.58)	0.0394	3.01(1.42- 6.36)	0.004
		AOR	2.36(1.06- 5.24)	0.0358	3.75(1.63- 8.61)	0.0018

Age and Degree of doctors adjusted with all exposure

OR= Odds Ratio UOR= Unadjusted Odds Ratio AOR= Adjusted Odds Ratio*

Chapter 6



A DEEPER DIVE INTO THE LABORATORY COMPONENT OF IDSP

Summary

On an average, the participants were 41 years old and had 4 years of experience in Integrated Disease Surveillance Program (IDSP). The majority were Hindu, a native of Bihar and had completed graduation. About 90% of the respondents were contractual staffs and about 77% reported receiving formal training on IDSP. Quantitative analysis from the majority of the surveyed labs revealed insufficient procedural and documentational readiness, lack of cleanliness and poor condition of equipment, inappropriate bio-safety and bio-medical waste management process, limited availability of basic resources including consumables, culture media, protective gears, microscopes, freezer, autoclave, ELISA reader and supplies for collection of specimens. Moreover, only 40% of the laboratories had any internal quality control. In-depth interviews with the laboratory technicians reinforced these quantitative findings. Furthermore, participants shared the challenges to reach the affected communities during an outbreak in remote areas. Modification of the IDSP reporting format to include more information, clear and simple display of information regarding tests performed and those done free of cost outside the labs, increasing space, strengthening infrastructure for preservation of samples/specimen or reagents and regular training on IDSP, particularly the emerging, re-emerging and newer pathogens were some of the possible solutions suggested by the participants. Results indicated that lack of trained human resources, weak infrastructure, inefficient quality control and poor practice among lab personnel had contributed to sub-optimal provision of diagnostic services under infectious disease surveillance in Bihar.

The concerns and challenges with respect to the functioning of the public health laboratories indicated in this paper reinforced the urgent need to act decisively on integration of basic services under one standardized platform so that early warning mechanism, detection and response capacities could be effectively implemented. It is imperative for the government to invest in personnel and equipment for the state public health laboratories, develop state-based laboratory strategic plans and policies for upgradation of the

existing labs, capacity-building, establish public-private partnerships for increasing accuracy in the diagnostic services, and ensure effective laboratory network and sustainable investing.

Background

Authentic, reliable and valid laboratory information have become a crucial component of disease surveillance and the base upon which treatment, prevention and control programs are prioritized. Public health laboratories under the IDSP in India perform diagnostic testing for routine surveillance of traditional infectious diseases along with emerging and re-emerging diseases.[36] However, investment in enhancing laboratory capacity and maintenance are limited in majority of the developing countries. [47, 48] In India, reporting of laboratory confirmed cases under the IDSP using a prescribed format known as L form are mandated by the Government of India as a part of routine surveillance.[9] During the early years of surveillance, upgradation of laboratory set-up from the peripheral to the national level and ensuring quality assurance became mandatory for improving diagnostic accuracy across the country. However, due to limited human resources and fund restraints, upgradation of existing laboratories was done in a phased manner throughout India. As a part of laboratory strengthening, the upgraded laboratories were provided with trained work force and funds for procuring essential equipment, reagents and consumables so that laboratories can run efficiently. A network of referral laboratories was established and they were linked with medical colleges in each state to carry out selective diagnosing testing, an essential step in effective control of infectious disease outbreak.[49]

Despite playing a critical role in disease surveillance, the laboratory component has not received due attention in resource-poor countries including India.[50] Evidence indicated several challenges associated with having a functional laboratory which included insufficient laboratory supplies, lack of essential equipment, limited trained staff, poor quality control, ineffective logistical support, weak laboratory network, lack of laboratory policies and strategies, inadequate monitoring and absence of specific indicators to measure efficiency of laboratory surveillance. [51-53]

Published literature showed limited studies on detailed assessment of laboratory surveillance under the IDSP in the country, especially in less developed states where reporting of suspected cases of infectious diseases appeared to be high. Thus, a comprehensive evaluation of the laboratory component of the ongoing IDSP in Bihar would help to develop insights regarding the gaps in identifying burden of endemic and epidemic-prone diseases, outbreak investigation process, changes in disease etiology, emergence and re-emergence of new diseases, dissemination of surveillance data and integration with other public health labs at the national level. The current study was conducted to explore functionality and infrastructure of public health laboratories under IDSP in Bihar, one of the backward states in the country. In addition, qualitative interviews were conducted with laboratory technicians to have a better understanding of the specific role and responsibility of lab technicians during routine surveillance activities, outbreak investigation process, motivation, job-related stress and suggestions to improve the current IDSP and laboratory capacity.

Findings

In the three selected districts, all 62 designated public health laboratories for IDSP and one

consenting on-duty technician involved in reporting to IDSP were included (Begusarai=23, Bhojpur=17 & Darbhanga=22) for quantitative data. Qualitative data was obtained by personal interview of 45 consenting on-duty laboratory technicians working under IDSP (15 from each district) in all the three study districts. Any lab technician not willing to participate or not involved with IDSP reporting and testing was excluded.

Quantitative Data

Socio-demographic characteristics & job-related factors

All together information was obtained from 62 laboratory personnel engaged public health laboratory at block-level in the three selected districts. The mean age of the respondents was 41 years. Majority of the respondents were Hindus (81%) and had completed graduation (61%), with Bhojpur having the highest proportion (82%) of graduates. About 90% of the technicians were hired contractually, mostly from Bihar (97%) and had spent on average about 9 years and 10 months (118.13 months) in the current job. In general, the respondents had been involved with the IDSP for little over four years (mean= 51.19 months). Using own vehicle seemed to be the preferred mode for transport to work in Begusarai (61%) and Darbhanga (59%), while majority (65%) travelled by foot in Bhojpur. Approximately 71% of the technicians had not received any special training related to IDSP. (Table 1)

Presence of key documents

Overall, only 14 of 62 labs received a copy of Standard Operating Procedure (SOP) from the state. None of the laboratories in Bhojpur had a copy of SOP, guideline for budget allocation, reagent kit registers and national vaccination policy for lab workers. Even in districts where special training was given, the presence of standard operating procedure (SOP) (8 of 23 in Begusarai and 6 of 22 in Darbhanga), guideline for budget allocation (1 of 23 in Begusarai and none in Darbhanga) and national vaccination policy for lab workers (2 of 23 in Begusarai and none of the 22 in Darbhanga) were missing. Only 7 of 40 in the other two districts had an annual maintenance contract (AMC) for instruments and none in Darbhanga. Similarly, only 15 of the 40 laboratories in Begusarai and Bhojpur and none in Darbhanga had any record of consumables and reagents purchased.

Though majority of the laboratories visited in the three districts had stock registers (53 of 62), presence of external quality assessment scheme was missing in 83.87% (52/62) of them. In all, 21 of 62 labs had certification and accreditation documents including calibration & validation certificates. Logbooks were absent in 45% and 71% of the labs in Darbhanga and Bhojpur, respectively. Overall, only 40% (25/62) had a training module for lab workers and 34% (21/62) could document the presence of any policy for waste management and disposal.

National guidelines for specimens packaging was absent in 58 of the 62 labs, while only 19 (of which 12 were in Bhojpur) had the national guideline for the transport of infectious materials. Also, there was no standardized request form for tests in majority (40/62) of the laboratories. Results of internal quality control reports were also unavailable in 40 labs. Only 12 of the 62 units had a list of hazards associated with proposed lab work, while 35 did not have a list of the notifiable diseases the laboratory must report on to the IDSP. Only 18 labs could show inventory log book. Overall, the laboratories in all the three districts were very poor regarding procedural preparation and documentation (42%). (Table 2)

Assessment of the laboratory structure

General cleanliness and organization were found to be poor in 10 of the 22 laboratories in Darbhanga. Incubators were not clean in 77% (48/62) of all surveyed labs in the three studied districts. Near about 21% (13/62) of the labs had microscopes in a poor condition. Furthermore, the maintenance of autoclave and Eliza reader was also poor in 57 of the 62 units. Only 3 of the 17 labs in Bhojpur had a clean and functional refrigerator, while 27 of 45 labs in the other two districts showed functional refrigerator. Of the 30 working refrigerators in the three districts, only 7 had internal thermometers and temperature chart was maintained for only 4 of them.

Blood culture bottles were not available in 38 of the 39 laboratories of Darbhanga and Bhojpur districts and petri dishes were not organized in 60 of the 61 labs in the three districts. In 41% of the labs in Darbhanga, the samples collected were not adequately labelled. Availability of personal protection equipment appeared inadequate such as presence of lab coats in 24/62, gloves in 48/62, glasses in 9/62 and masks in 31/62. Provision for disinfection of benches at the end of the work, separate waste (lid-covered) containers for non-contaminated and contaminated wastes and regular clearance of waste were not available in 24, 28 and 13 of the 62 labs in the three studied districts. Findings indicated that overall consumables for culture and ELISA were present in 6/62 and 7/62 labs, respectively. In total, 32/62 labs did not have the new L forms.

Even though the inability to confirm malaria and tuberculosis was moderately low in the labs due to the presence of strong vertical programs, inability to confirm Typhoid, Cholera, Shigellosis, Leptospirosis, Meningococcal Meningitis, Japanese Encephalitis, Diphtheria, Hepatitis, Measles, Dengue and Chikungunya was alarmingly high. (Table 3)

Assessment of lab functionality & reporting

Logbooks/lab register were correctly filled for all listed diseases under IDSP in 42 of the 50 laboratories. Line list registers for all laboratory-confirmed positive cases were present in only 36 of the 62 labs, but all filled correctly. Approximately 61% (38/62)) laboratories uploaded weekly report of L-forms at IDSP portal. Only 40% (25/62) of surveyed labs practiced some degree of internal quality control mechanism and about 16% (10/62) labs could document bio-safety and bio-medical waste management practices. Approximately 34% (21/62) lab technicians admitted transport of specimen to the referral lab for confirmation.

Perhaps the most concerning fact was that less than 2% lab staff received the recommended vaccination. List of referral labs was documented only in 31% labs (19/62). Training on IDSP by district officials was imparted to lab technicians in 49 out of total 62 labs. The majority reported that such training was provided at least once in preceding 6-12 months. Interestingly, a trained lab technician was present in all the units of the three districts (Table 3 & 4).

Logistic regression analysis was conducted to determine the factors associated with the practice of correctly filling "L" forms. In both unadjusted and adjusted models, no significant associations were found between demographic factors (age, education), receiving formal training on IDSP, overall condition of the lab and correctness in filling up the forms. This finding could be attributable to the small sample size and lack of statistical power. (Table 5)

Qualitative data

Altogether 45 In-Depth Interviews were conducted among laboratory technicians involved with IDSP in the three studied districts (15 from each district). All qualitative data from the interviews were coded with emerging concepts and according to a-priori after which key themes and sub-themes were identified. (Table 6)

A. Routine investigation

Collection of biological samples: Almost all of the laboratory technicians responded that they collected biological samples from anyone suspected to be suffering from infectious diseases at their facility without any bias. Most of them also mentioned that samples were collected from those who were advised to undertake laboratory test in the out-patient department (OPD) of the same facility only.

> *"of course, we do sir, from the patients. When the doctor recommends test, they come to us and based on the test, we give them labelled and marked containers to collect samples. I put the names in the registers and after they provide the required samples, we test it" - Lab tech #, Begusarai*

> *"yes, we collect samples for common infectious diseases including tuberculosis and HIV" - Lab tech #, Darbhanga*

> *"yes, we collect samples from presumptive cases" - Lab tech #, Begusarai*

There were few who pointed out that due to limited number of facilities, they often preferred not to collect enough samples.

> *"there is no facility for doing laboratory tests, what will we do collecting samples" - Lab tech #, Darbhanga*

Proportion of suspected cases sent to lab per day: As reported by the respondents, the proportion of patients who were sent for laboratory confirmation ranged from 8-20 percent of the OPD attendance and varied with seasonality.

> *"for testing in the laboratory about 8-10% of the OPD patients are prescribed testing" - Lab tech #, Begusarai*

> *"more or less in about 100 patients, 10-15 cases come for testing or even more sometime depending on seasons when more patients come" - Lab tech #, Begusarai*

> *"daily about 10-12% of the patients are sent for testing" - Lab tech #, Darbhanga*

Record keeping of investigation: Majority of the respondents said that they maintained detailed records of the investigations in lab registers and the collected samples were appropriately processed. The different vertical disease programs and the IDSP, all had different registers with different reporting formats, which necessitate the laboratory technicians to maintain them separately, often leading to duplication of records and this created additional burden on the personnel.

> *"test results are reported on the OPD form and also in a register where we register the patients name, investigation, report and OPD form no." - Lab tech #, Begusarai*

> *"for all the tests that takes place here, there are different registers. There is one for malaria, one for kala-azar, one for TB and one for general*

laboratory tests. After testing we write in the registers according to format and also give reports to the patients by writing on the slips and adding the official seal" - Lab tech #, Bhojpur

Sero-types or antibiotic resistance patterns tests: Most participants had no idea about the sero-typing and the antibiotic sensitivity tests. A few did report undertaking antibiotic sensitivity tests for detecting antibiotic susceptibility of Tuberculosis mycobacterium from sputum samples for a vertical control program, Revised National Tuberculosis Control Program (RNTCP).

"no, I don't know anything about these sero-typing and antibiotic sensitivity tests" - Lab tech #, Darbhanga

"yes, we do antibiotic susceptibility test in the RNTCP program for TB patients" - Lab tech #, Bhojpur

An interesting point that came to notice was that respondents working in laboratories of district or sub-divisional hospitals were more aware about the risk factors for emergence of antibiotic resistance and had opinions on dealing with them.

"the target especially set by Govt. of India to eliminate TB is 2022. Other than TB, elimination is also targeted for malaria, kala-azar etc. and the medicines that are provided we understand that it should not be stopped midway and if you have started taking antibiotics then finish it. We should target the eldest of the family or the head of the family to make them understand and create awareness that the medicines should not be stopped and if the patient is on the verge of stopping medicines or forget, then they must be reminded periodically and the patient should get the full dose of the medicines." - Lab tech #, Begusarai

Reliable results in a timely manner: There was a consensus among the participants that there was currently no problem in providing reliable and timely test report from their facility.

"*No there are no such problems. We work hard to give reliable and accurate results to the patients and if there are some discrepancies in the report, we undertake retesting. So, there is no problem as we use reagents sourced from different company for retesting." - Lab tech #, Begusarai*

Many of those who reported that there were currently no problems in providing reliable and timely report stated that the situation was different before and had improved now.

"there were some problems before but not now. Previously there was no room and now a new building has been provided and all the facilities are present. Now the lab is functioning properly" - Lab tech #, Begusarai

A few did report that there were some problems with reliability and timeliness but that was minuscule compared to the alternate opinion.

Communication of results to appropriate authority: This was a major problem that emerged from the qualitative interviews. There was no set protocol for reporting the test results to the higher authorities other than filling up the L-Form on the IDSP portal and putting in the laboratory register. Many of the technicians on a personal basis informed the medical officers about the test results but that too was far and few. At present, the patients form the key link of reporting test result from the laboratory to the medical officers.

"from the records in the register they come to know" - Lab tech #, Begusarai

"I myself accompany the patients along with the report to the doctor and he gives medicine accordingly" - Lab tech #, Begusarai

"I inform my superiors and then only they give medicines" - Lab tech #, Bhojpur

Supply of media, equipment and other related materials: The respondents shared different views, many were of the opinion that though sometimes requisition was a time-taking affair there were no problems with the availability of reagents in general.

"no there is no such problems and if it happens it is very rare. We inform the in-charge of the central store over telephone and the materials is sent over. If it is not available in the central store, then we give applications and it is sent, there is no problem" - Lab tech #, Begusarai

Others, however, identified that there was a lack of resources to undertake tests and that hindered the delivery of test reports in a timely manner.

"many at times it has happened that materials are not available and there is pressure of patients for testing" - Lab tech #, Bhojpur

"sometimes it happens that reagents are finished then testing is stopped" - Lab tech #, Darbhanga

B. Outbreak Investigation

Detecting and confirming outbreak: Many of the lab technicians were of the opinion that they would be able to detect outbreaks by looking at clustering of the laboratory-confirmed cases.

"If a patient come to me and is tested positive and few other patients comes from the same area and are also tested positive then I suspect an outbreak"- Lab tech #, Bhojpur

There were few who could not clearly state how to detect outbreaks and identified the ASHA, ANM and medical officers as those responsible for detecting and responding to such health events.

"I send my reports to my superior. They identify if there is an outbreak" - Lab tech #, Bhojpur

Also, on the other end, some laboratory personnel could not shed any light on the process of detection and confirmation of any outbreak or their role in them.

"don't know" - Lab tech #, Darbhanga.

Action following confirmation of an outbreak: Almost all of the responding technicians in Begusarai and Darbhanga correctly identified the Rapid Response Team (RRT) as the primary outbreak response team in the block. They also mentioned that along with the experts in the RRT, they also played a vital role in it.

"there is a team of doctors and ANM is also there who go to the spot and I also go. I collect samples and then treatment is given there or the patients are sent to the hospital" – Lab tech #, Darbhanga

"after detection of an outbreak, our medical officer goes there, a team is constituted and visits the affected area…there proper treatment facilities are provided and counselling is provided to prevent further outbreaks" - Lab tech #, Begusarai

Most of the lab technicians were of the opinion that biological samples were obtained regularly for laboratory testing during outbreaks but the main challenges for sample collection and processing were superstitious views of the population, large gatherings during visit, unavailability of facilities in the field, transporting the collected samples to referral labs and maintaining cold chain for transporting samples for testing.

"see the challenges we face is that we have to reach the outbreak area and undertake a camp strategy. Now to reach the camp we face problems with transport. Also, there are several teams facilitated by different agencies like NGOs, hospitals and there is communication gap at times" - Lab tech #, Darbhanga

"yes, during outbreaks we receive samples like sometimes if there is a presumptive AFP case and we receive information of it, we immediately send a vehicle to collect sample"- Lab tech #, Bhojpur

"as far as biological samples are concerned sometimes we receive them and sometimes we don't during an outbreak.

Now think if there is a sample, suppose stool sample and for that we need transport and also maintain a cold and we have to travel by own means, then we face difficulties but still we collect sample and do test" - Lab tech #, Begusarai

"here few people who are uneducated and superstitious, create problems but we make them understand and work accordingly" – Lab tech #, Darbhanga

"here in the lab everything is organized but in field during an outbreak, people from the affected area come at the same time and demand to be looked at first, other than that there are problems with transportation and organization, there is no chair, no table and we have to work somehow" - Lab tech #, Bhojpur

Intersectoral co-ordination: Majority responded that they did not get support from other departments including the State Public Work Department (PWD) or the Animal Husbandry and livestock department during an outbreak investigation and doing it alone was the norm.

"no, we work on our own, don't get any help from others" Lab tech #, Bhojpur

"no" Lab tech #, Darbhanga

There were very few places though where the respondents informed that they received inter-sectoral co-ordination when required.

"there is the animal hospital besides us. We get help if needed. No problem as such" -Lab Tech #, Darbhanga

"yes, we receive help" - Lab tech #, Bhojpur

C. Job responsibilities

Awareness about IDSP and knowledge about job responsibility: Most of the respondents were aware about the IDSP and identified it with filling up of the L-Form.

"yes, I have heard of IDSP" - Lab tech #, Bhojpur

"In IDSP I have to weekly fill in the reports in L-Form" - Lab tech #, Darbhanga

"data operator shows me the L-Form and asks to weekly fill it so I have to report" - Lab tech #, Darbhanga

Analysis of data: Many felt the need of analyzing the reported notifiable diseases, but all of them said they never did such analysis. There were others too who had not thought of analysis of the laboratory data and were unaware of its benefits.

"yes, I have felt the need of analysis" - Lab tech #, Bhojpur

"yes, I have felt the need as every week or every 15 days we have to report. If we do not report weekly then immediately superiors call and asks why

reporting has not been done. We are aware and after testing we take the address of the patient and report to my supervisor" – Lab tech #, Begusarai

"I have never done any analysis" - Lab tech #, Begusarai

D. Motivation and happiness

Enjoy doing this job: Barring a few, nearly all the respondents enjoyed doing their job and felt very happy with their work.

"yes, I am happy doing my work, I am helping patients" -Lab Tech #, Darbhanga

Motivation of work: The fact that they were an essential part of medical diagnosis and that their diagnosis helped patients get appropriate treatment was the major motivator that emerged from this study. Surprisingly, financial motivation was one of the least mentioned sub-themes in the analysis.

"I was motivated to work as a lab tech as my father was once hospitalized and then I had to run pillar and post to get laboratory test done. From that day I decided to become a lab tech and help the patients" -Lab Tech #, Darbhanga

"I feel motivated because my work is helping the patients get good treatment and that is very satisfactory to see patients are cured due to the right diagnosis and proper treatment" - Lab tech #, Bhojpur

"I am motivated for my job" -Lab Tech #, Darbhanga

E. Stress management

Work pressure: Work pressure appeared to be felt by all participants. The majority also admitted that in spite of excess patient load, they were able to effectively tackle the problem of overburdening.

"yes, there happens that I am the only technician and at times there are a lot of patients and I don't get any time, patients also ask for reports fast. I make them understand that I am only person here and I have to fill different registers for different tests like malaria, Tuberculosis and also give report on time. So that time there is lots of pressure" -Lab Tech #, Begusarai

"I know that I alone have to do the work as there is no one else, so I do it part by part and try to finish the work on time" – Lab Tech #, Darbhanga

Economic insecurity was another point that came up during the interviews among few respondents in Bhojpur which led to some stress in the job.

"this job is challenging and salary is less leading to pressure in the family"- Lab tech #, Bhojpur

F. Suggestions

Improve the existing efficiency of lab: There were several suggestions provided for improving the functionality of the public health laboratory. These included provision of more space, quality equipment, availability of basic reagents and kits, updating knowledge through regular training. The other factors which the respondents found crucial to improving the laboratory efficiency included more manpower and regular servicing of existing equipment.

"this should be an independent laboratory with various new instruments. If any machine or instrument does not work properly, there should be a center/cell at district level to procure and repair these instruments. With this people can trust on our laboratory in generating correct report"- Lab tech #, Darbhanga

"there should be a proper infrastructure to reach excellence at laboratory and there should be a

timely updating of all the technology" Lab tech #, Begusarai

"as per the need, there should be a designated medical officer and the duty of every medical officer should be fixed because the doctors are not available every day in hospital daily as per their schedule, which creates problem. The doctors are always involved in their own private clinic. In laboratory, there are some inner link between doctors, health workers and private lab to earn commission or illegal money on the name of test for which they send the patients to private hospital/laboratories in place of public hospital/laboratories. Therefore, the public does not believe us and devalue us" - Lab tech #, Darbhanga

Improving IDSP: For improving IDSP, many suggestions were offered which included increasing the frequency of reporting from a weekly format to daily format, increasing the number of diseases reported under the IDSP, increasing the space provided in the IDSP reporting format to add more relevant information and rigorous monitoring.

"we are working as much as possible but if the superior engages in regular monitoring and from time to time provide feedback, then we can work better in full coordination and can communicate the shortcomings so that corrective actions can be taken accordingly"– Lab Tech #, Begusarai

"add more diseases which are not included in the current IDSP notifiable diseases. there should be place for writing other diseases in the register and a column should be added if necessary; Also, a display of tests conducted at free of cost outside the lab will attract more patients " - Lab tech #, Bhojpur

"from the superior level there should be monitoring" - Lab tech #, Darbhanga

Improving skill in the laboratory: The major opinions that emerged for improving laboratory skills were regular training and improved learning through practices.

"*studying every day and learning new things" - Lab tech #, Darbhanga*

"*from training***" -** *Lab tech #, Bhojpur*

"read good books, collect new information on current methods or guidelines and study. This will ensure there is no mistake and if there is training anywhere then one should participate and participate with seriousness" - Lab tech #, Darbhanga

"there are some new instruments which are installed to improve the performance of lab. For new laboratory test and also old ones, there is a need to provide training There should be workshops so we can always get new information related to work. There are some problems regarding new instruments (connected with computer application) because engineers come only once to teach us especially at the time of installation period and we can't learn all the application at that time as we are not expert in computer-based application and also did not get any information about computer in our education system. Therefore, engineers should be available all the time to teach us and we should have easy to access the engineers. In training period, our training manual was in hardcopy but now there are online or computer-based systems. Therefore, we are taking time to earn each and every step to conduct all the laboratory test" - Lab tech #, Darbhanga.

TABLE 1: Distribution of socio-demographic characteristics and job-related factors of lab technicians, Bihar, 2019 (n=62)

Description		Overall		Begusarai		Darbhanga		Bhojpur	
		N	Mean (95% CI)	N	Mean (95% CI)	N	Mean (95% CI)	N	Mean (95% CI)
Age of the respondent (years) -		62	40.77 (39.33-42.22)	23	41.52(39.03-44.01)	22	41.36(38.67-44.05)	17	39.00(36.44-41.56)
Duration in current job (months)		62	118.13 (104.23-132.02)	23	112.78(91.65-133.91)	22	124.73(91.78-157.67)	17	116.82(102.44-131.21)
Duration in IDSP (months)		62	51.19 (42.80-59.59)	23	53.70(43.07-64.33)	22	43.68(26.15-61.21)	17	57.53(40.04-75.02)
		Frequency	% (95% CI)	Frequency	% (95% CI)	Frequency	% (95% CI)	Frequency	% (95% CI)
Employment contact	Permanent	6	9.68(2.11-17.25)	2	8.70 (0.00-21.15)	4	18.18 (0.68-35.68)	-	-
	Contractual	56	90.32(82.75-97.89)	21	91.30 (78.85-100.0)	18	81.82 (64.32-99.32)	17	100.0 (100.0-100.0)
Religion	Hindu	50	80.65(70.53-90.76)	17	73.91 (54.50-93.33)	19	86.36 (70.79-100.0)	14	82.35 (62.15-100.0)
	Muslim	12	19.35(9.24-29.47)	6	26.09 (6.67-45.50)	3	13.64 (0.00-29.21)	3	17.65 (0.00-37.85)
Education	Beyond 8th standard & below graduate	24	38.71(26.24-51.18)	11	47.83 (25.74-69.91)	10	45.45 (22.86-68.05)	3	17.65 (0.00-37.85)
	Graduate and above	38	61.29(48.82-73.76)	12	52.17 (30.09-74.26)	12	54.55 (31.95-77.14)	14	82.35 (62.15-100.0)
Special training	Yes	48	77.42(66.71-88.12)	22	95.65 (86.64-100.0)	21	95.45 (86.00-100.0)	5	29.41 (5.26-53.56)
	No	14	22.58(11.88-33.29)	1	4.35 (0.00-13.36)	1	4.55 (0.00-14.00)	12	70.59 (46.44-94.74)
Residence	Bihar	60	96.77(92.25-100.0)	22	95.65 (86.64-100.0)	22	100.0 (100.0-100.0)	16	94.12 (81.65-100.0)
	Outside Bihar	2	3.23(0.00- 7.75)	1	4.35 (0.00-13.36)	-	-	1	5.88 (0.00-18.35)
Mode of transport to work place	By foot	22	35.48(23.23-47.73)	2	8.70 (0.00-21.15)	9	40.91 (18.60-63.22)	11	64.71 (39.38-90.03)
	By public transport	10	16.13(6.71-25.55)	7	30.43 (10.09-50.78)	-	-	3	17.65 (0.00-37.85)
	By own vehicle	30	48.39(35.59-61.18)	14	60.87 (39.29-82.45)	13	59.09 (36.78-81.40)	3	17.65 (0.00-37.85)

TABLE 2: Distribution of key documents in the public health laboratories under IDSP, Bihar, 2019

		Overall		Begusarai		Darbhanga		Bhojpur	
Description	**Category**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**
Presence of Standard Operating Procedure (SOP)	No	48	77.42(66.71-88.12)	15	65.22 (44.16-86.28)	16	72.73 (52.52-92.94)	17	100.0 (100.0-100.0)
	Yes	14	22.58(11.88-33.29)	8	34.78 (13.72-55.84)	6	27.27 (7.06-47.48)	-	-
Presence of Guideline for budget allocation	No	61	98.39(95.16-100.0)	22	95.65 (86.64-100.0)	22	100.0 (100.0-100.0)	17	100.0 (100.0-100.0)
	Yes	1	1.61(0.00- 4.84)	1	4.35 (0.00-13.36)	-	-	-	-
Presence of Reagent Kit Register	No	25	40.32(27.76-52.88)	1	4.35 (0.00-13.36)	13	59.09 (36.78-81.40)	17	100.0 (100.0-100.0)
	Yes	37	59.68(47.12-72.24)	22	95.65 (86.64-100.0)	9	40.91 (18.60-63.22)	0	0 (0.00-0.00)
Presence of Stock Register	No	9	14.52(5.50-23.53)	-	-	6	27.27 (7.06-47.48)	3	17.65 (0.00-37.85)
	Yes	53	85.48(76.47-94.50)	23	100.0 (100.0-100.0)	16	72.73 (52.52-92.94)	14	82.35 (62.15-100.0)
Presence of External Quality Assessment Scheme	No	52	83.87(74.45-93.29)	20	86.96 (72.07-100.0)	17	77.27 (58.25-96.29)	15	88.24 (71.16-100.0)
	Yes	10	16.13(6.71-25.55)	3	13.04 (0.00-27.93)	5	22.73 (3.71-41.75)	2	11.76 (0.00-28.84)
Presence of Certification and accreditation documents including calibration & validation certificates	No	41	66.13(54.01-78.25)	12	52.17 (30.09-74.26)	15	68.18 (47.04-89.32)	14	82.35 (62.15-100.0)
	Yes	21	33.87(21.75-45.99)	11	47.83 (25.74-69.91)	7	31.82 (10.68-52.96)	3	17.65 (0.00-37.85)
Presence of Operation and maintenance of instrument	No	20	32.26(20.29-44.23)	-	-	16	72.73 (52.52-92.94)	4	23.53 (1.05-46.01)
	Yes	42	67.74(55.77-79.71)	23	100.0 (100.0-100.0)	6	27.27 (7.06-47.48)	13	76.47 (53.99-98.95)
Presence of Logbooks or Lab Information System Records	No	25	40.32(27.76-52.88)	3	13.04 (0.00-27.93)	10	45.45 (22.86-68.05)	12	70.59 (46.44-94.74)
	Yes	37	59.68(47.12-72.24)	20	86.96 (72.07-100.0)	12	54.55 (31.95-77.14)	5	29.41 (5.26-53.56)
Presence of Lab worker training module	No	37	59.68(47.12-72.24)	11	47.83 (25.74-69.91)	14	63.64 (41.81-85.47)	12	70.59 (46.44-94.74)
	Yes	25	40.32(27.76-52.88)	12	52.17 (30.09-74.26)	8	36.36 (14.53-58.19)	5	29.41 (5.26-53.56)
Presence of Policy or regulation for waste management and disposal	No	41	66.13(54.01-78.25)	19	82.61 (65.85-99.37)	15	68.18 (47.04-89.32)	7	41.18 (15.09-67.26)
	Yes	21	33.87(21.75-45.99)	4	17.39 (0.63-34.15)	7	31.82 (10.68-52.96)	10	58.82 (32.74-84.91)
Presence of National document for specimens packing	No	58	93.55(87.26-99.84)	22	95.65 (86.64-100.0)	20	90.91 (77.86-100.0)	16	94.12 (81.65-100.0)
	Yes	4	6.45(0.16-12.74)	1	4.35 (0.00-13.36)	2	9.09 (0.00-22.14)	1	5.88 (0.00-18.35)

TABLE 2: Distribution of key documents in the public health laboratories under IDSP, Bihar, 2019 *(Contd...)*

		Overall		Begusarai		Darbhanga		Bhojpur	
Description	**Category**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**
Presence of National regulations for the transport of infectious materials	No	43	69.35(57.55-81.16)	22	95.65 (86.64-100.0)	16	72.73 (52.52-92.94)	5	29.41 (5.26-53.56)
	Yes	19	30.65(18.84-42.45)	1	4.35 (0.00-13.36)	6	27.27 (7.06-47.48)	12	70.59 (46.44-94.74)
Presence of National vaccination policy for lab workers	No	60	96.77(92.25-100.0)	21	91.30 (78.85-100.0)	22	100.0 (100.0-100.0)	17	100.0 (100.0-100.0)
	Yes	2	3.23(0.00- 7.75)	2	8.70 (0.00-21.15)	-	-	-	-
Presence of National guidelines in use (Standard Operating Procedure or SOP)	No	50	80.65(70.53-90.76)	15	65.22 (44.16-86.28)	18	81.82 (64.32-99.32)	17	100.0 (100.0-100.0)
	Yes	12	19.35(9.24-29.47)	8	34.78 (13.72-55.84)	4	18.18 (0.68-35.68)	-	-
Presence of Lab own operating documents (Instructions, SOP)	No	45	72.58(61.16-84.00)	13	56.52 (34.60-78.44)	17	77.27 (58.25-96.29)	17	100.0 (100.0-100.0)
	Yes	17	27.42(16.00-38.84)	10	43.48 (21.56-65.40)	5	22.73 (3.71-41.75)	0	0.00 (0.00-0.00)
Information on costs and turnabout time for the test results available to patients	No	48	77.42(66.71-88.12)	18	78.26 (60.02-96.50)	18	81.82 (64.32-99.32)	12	70.59 (46.44-94.74)
	Yes	14	22.58(11.88-33.29)	5	21.74 (3.50-39.98)	4	18.18 (0.68-35.68)	5	29.41 (5.26-53.56)
Copies of any reports for review	No	24	38.71(26.24-51.18)	4	17.39 (0.63-34.15)	12	54.55 (31.95-77.14)	8	47.06 (20.61-73.51)
	Yes	38	61.29(48.82-73.76)	19	82.61 (65.85-99.37)	10	45.45 (22.86-68.05)	9	52.94 (26.49-79.39)
Standardized request form for tests prescribers	No	40	64.52(52.27-76.77)	17	73.91 (54.50-93.33)	16	72.73 (52.52-92.94)	7	41.18 (15.09-67.26)
	Yes	22	35.48(23.23-47.73)	6	26.09 (6.67-45.50)	6	27.27 (7.06-47.48)	10	58.82 (32.74-84.91)
Standardized form for results reporting	No	23	37.10(24.73-49.46)	7	30.43 (10.09-50.78)	12	54.55 (31.95-77.14)	4	23.53 (1.05-46.01)
	Yes	39	62.90(50.54-75.27)	16	69.57 (49.22-89.91)	10	45.45 (22.86-68.05)	13	76.47 (53.99-98.95)
Results of Internal Quality Control	No	40	64.52(52.27-76.77)	17	73.91 (54.50-93.33)	15	68.18 (47.04-89.32)	8	47.06 (20.61-73.51)
	Yes	22	35.48(23.23-47.73)	6	26.09 (6.67-45.50)	7	31.82 (10.68-52.96)	9	52.94 (26.49-79.39)
Record of consumables and reagents purchase	No	47	75.81(64.84-86.77)	12	52.17 (30.09-74.26)	22	100.0 (100.0-100.0)	13	76.47 (53.99-98.95)
	Yes	15	24.19(13.23-35.16)	11	47.83 (25.74-69.91)	-	-	4	23.53 (1.05-46.01)
Record of staff qualifications, training and experience	No	32	51.61(38.82-64.41)	3	13.04 (0.00-27.93)	20	90.91 (77.86-100.0)	9	52.94 (26.49-79.39)
	Yes	30	48.39(35.59-61.18)	20	86.96 (72.07-100.0)	2	9.09 (0.00-22.14)	8	47.06 (20.61-73.51)

TABLE 2: Distribution of key documents in the public health laboratories under IDSP, Bihar, 2019 *(Contd...)*

		Overall		Begusarai		Darbhanga		Bhojpur	
Description	**Category**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**
List of hazards associated with proposed lab work	No	50	80.65(70.53-90.76)	15	65.22 (44.16-86.28)	21	95.45 (86.00-100.0)	14	82.35 (62.15-100.0)
	Yes	12	19.35(9.24-29.47)	8	34.78 (13.72-55.84)	1	4.55 (0.00-14.00)	3	17.65 (0.00-37.85)
List of the notifiable diseases the lab must report	No	35	56.45(43.76-69.15)	9	39.13 (17.55-60.71)	19	86.36 (70.79-100.0)	7	41.18 (15.09-67.26)
	Yes	27	43.55(30.85-56.24)	14	60.87 (39.29-82.45)	3	13.64 (0.00-29.21)	10	58.82 (32.74-84.91)
Standardized form/ document to report notifiable diseases or event	No	29	46.77(34.00-59.55)	10	43.48 (21.56-65.40)	15	68.18 (47.04-89.32)	4	23.53 (1.05-46.01)
	Yes	33	53.23(40.45-66.00)	13	56.52 (34.60-78.44)	7	31.82 (10.68-52.96)	13	76.47 (53.99-98.95)
Inventory Log Book	No	44	70.97(59.35-82.59)	21	91.30 (78.85-100.0)	14	63.64 (41.81-85.47)	9	52.94 (26.49-79.39)
	Yes	18	29.03(17.41-40.65)	2	8.70 (0.00-21.15)	8	36.36 (14.53-58.19)	8	47.06 (20.61-73.51)
Log work sheet for a particular disease	No	26	41.94(29.30-54.57)	14	60.87 (39.29-82.45)	9	40.91 (18.60-63.22)	3	17.65 (0.00-37.85)
	Yes	36	58.06(45.43-70.70)	9	39.13 (17.55-60.71)	13	59.09 (36.78-81.40)	14	82.35 (62.15-100.0)
Annual Maintenance Contract (AMC) for instruments	No	55	88.71(80.61-96.81)	19	82.61 (65.85-99.37)	22	100.0 (100.0-100.0)	14	82.35 (62.15-100.0)
	Yes	7	11.29(3.19-19.39)	4	17.39 (0.63-34.15)	-	-	3	17.65 (0.00-37.85)
Overall procedural preparedness & documentation	Poor	26	41.94(29.30-54.57)	4	17.39 (0.63-34.15)	13	59.09 (36.78-81.40)	9	52.94 (26.49-79.39)
	Average	21	33.87(21.75-45.99)	11	47.83 (25.74-69.91)	5	22.73 (3.71-41.75)	5	29.41 (5.26-53.56)
	Good	15	24.19(13.23-35.16)	8	34.78 (13.72-55.84)	4	18.18 (0.68-35.68)	3	17.65 (0.00-37.85)

TABLE 3: Distribution of general characteristics and overall conditions of the public health laboratories under IDSP, Bihar, 2019

		Overall		Begusarai		Darbhanga		Bhojpur	
Description	**Category**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**
General cleanliness	Poor	10	16.13(6.71-25.55)	-	-	10	45.45 (22.86-68.05)	-	-
	Fair	34	54.84(42.10-67.58)	9	39.13 (17.55-60.71)	11	50.00 (27.31-72.69)	14	82.35 (62.15-100.0)
	Good	18	29.03(17.41-40.65)	14	60.87 (39.29-82.45)	1	4.55 (0.00-14.00)	3	17.65 (0.00-37.85)
General organization	Poor	10	16.13(6.71-25.55)	-	-	10	45.45 (22.86-68.05)	-	-
	Fair	39	62.90(50.54-75.27)	11	47.83 (25.74-69.91)	11	50.00 (27.31-72.69)	17	100.0 (100.0-100.0)
	Good	13	20.97(10.55-31.39)	12	52.17 (30.09-74.26)	1	4.55 (0.00-14.00)	-	-
Overall cleanliness of the incubator	Poor	48	77.42(66.71-88.12)	15	65.22 (44.16-86.28)	21	95.45 (86.00-100.0)	12	70.59 (46.44-94.74)
	Fair	6	9.68(2.11-17.25)	-	-	1	4.55 (0.00-14.00)	5	29.41 (5.26-53.56)
	Good	8	12.90(4.32-21.49)	8	34.78 (13.72-55.84)	-	-	-	-
Overall condition of the freezers	Poor	40	64.52(52.27-76.77)	7	30.43 (10.09-50.78)	18	81.82 (64.32-99.32)	15	88.24 (71.16-100.0)
	Fair	11	17.74(7.96-27.52)	7	30.43 (10.09-50.78)	2	9.09 (0.00-22.14)	2	11.76 (0.00-28.84)
	Good	11	17.74(7.96-27.52)	9	39.13 (17.55-60.71)	2	9.09 (0.00-22.14)		
Overall condition of microscopes	Poor	13	20.97(10.55-31.39)	1	4.35 (0.00-13.36)	8	36.36 (14.53-58.19)	4	23.53 (1.05-46.01)
	Fair	30	48.39(35.59-61.18)	8	34.78 (13.72-55.84)	12	54.55 (31.95-77.14)	10	58.82 (32.74-84.91)
	Good	19	30.65(18.84-42.45)	14	60.87 (39.29-82.45)	2	9.09 (0.00-22.14)	3	17.65 (0.00-37.85)
Overall condition of autoclave	Poor	57	91.94(84.96-98.91)	18	78.26 (60.02-96.50)	22	100.0 (100.0-100.0)	17	100.0 (100.0-100.0)
	Fair	1	1.61(0.00- 4.84)	1	4.35 (0.00-13.36)	-	-	-	-
	Good	4	6.45(0.16-12.74)	4	17.39 (0.63-34.15)	-	-	-	-
Overall condition of ELISA reader	Poor	57	91.94(84.96-98.91)	19	82.61 (65.85-99.37)	21	95.45 (86.00-100.0)	17	100.0 (100.0-100.0)
	Fair	2	3.23(0.00- 7.75)	1	4.35 (0.00-13.36)	1	4.55 (0.00-14.00)	-	
	Good	3	4.84(0.00-10.33)	3	13.04 (0.00-27.93)	-	-	-	-
Overall condition and organization of stock shelves, expiration dates of reagents on the shelves	Poor	7	11.29(3.19-19.39)	1	4.35 (0.00-13.36)	5	22.73 (3.71-41.75)	1	5.88 (0.00-18.35)
	Fair	26	41.94(29.30-54.57)	3	13.04 (0.00-27.93)	16	72.73 (52.52-92.94)	7	41.18 (15.09-67.26)
	Good	29	46.77(34.00-59.55)	19	82.61 (65.85-99.37)	1	4.55 (0.00-14.00)	9	52.94 (26.49-79.39)

TABLE 3: Distribution of general characteristics and overall conditions of the public health laboratories under IDSP, Bihar, 2019 *(Contd...)*

		Overall		Begusarai		Darbhanga		Bhojpur	
Description	**Category**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**
Overall cleanliness & organization	Poor	24	38.71(26.24-51.18)	1	4.35 (0.00-13.36)	18	81.82 (64.32-99.32)	5	29.41 (5.26-53.56)
	Average	19	30.65(18.84-42.45)	5	21.74 (3.50-39.98)	4	18.18 (0.68-35.68)	10	58.82 (32.74-84.91)
	Good	19	30.65(18.84-42.45)	17	73.91 (54.50-93.33)	-	-	2	11.76 (0.00-28.84)
Presence of trained lab technician	No	-	-	-	-	-	-	-	-
	Yes	62	100.0(100.0-100.0)	23	100.0 (100.0-100.0)	22	100.0 (100.0-100.0)	17	100.0 (100.0-100.0)
Presence of refrigerator	No	32	51.61(38.82-64.41)	7	30.43 (10.09-50.78)	11	50.00 (27.31-72.69)	14	82.35 (62.15-100.0)
	Yes	30	48.39(35.59-61.18)	16	69.57 (49.22-89.91)	11	50.00 (27.31-72.69)	3	17.65 (0.00-37.85)
Presence of clean refrigerator	No	33	53.23(40.45-66.00)	8	34.78 (13.72-55.84)	11	50.00 (27.31-72.69)	14	82.35 (62.15-100.0)
	Yes	29	46.77(34.00-59.55)	15	65.22 (44.16-86.28)	11	50.00 (27.31-72.69)	3	17.65 (0.00-37.85)
Presence of presence of internal thermometer	No	55	88.71(80.61-96.81)	18	78.26 (60.02-96.50)	21	95.45 (86.00-100.0)	16	94.12 (81.65-100.0)
	Yes	7	11.29(3.19-19.39)	5	21.74 (3.50-39.98)	1	4.55 (0.00-14.00)	1	5.88 (0.00-18.35)
Presence of presence of temperature chart	No	58	93.55(87.26-99.84)	19	82.61 (65.85-99.37)	22	100.0 (100.0-100.0)	17	100.0 (100.0-100.0)
	Yes	4	6.45(0.16-12.74)	4	17.39 (0.63-34.15)	-	-	-	-
Presence of blood culture bottles	No	48	77.42(66.71-88.12)	10	43.48 (21.56-65.40)	22	100.0 (100.0-100.0)	16	94.12 (81.65-100.0)
	Yes	14	22.58(11.88-33.29)	13	56.52 (34.60-78.44)			1	5.88 (0.00-18.35)
Organization of the Petri dishes	No	61	98.39(95.16-100.0)	22	95.65 (86.64-100.0)	22	100.0 (100.0-100.0)	17	100.0 (100.0-100.0)
	Yes	1	1.61(0.00- 4.84)	1	4.35 (0.00-13.36)	-	-	-	-
Samples labelled adequately	No	13	20.97(10.55-31.39)	-	-	9	40.91 (18.60-63.22)	4	23.53 (1.05-46.01)
	Yes	49	79.03(68.61-89.45)	23	100.0 (100.0-100.0)	13	59.09 (36.78-81.40)	13	76.47 (53.99-98.95)
Re-agents labelled adequately	No	6	9.68(2.11-17.25)	-	-	4	18.18 (0.68-35.68)	2	11.76 (0.00-28.84)
	Yes	56	90.32(82.75-97.89)	23	100.0 (100.0-100.0)	18	81.82 (64.32-99.32)	15	88.24 (71.16-100.0)
Personal Protection Equipment available: Lab coats	No	38	61.29(48.82-73.76)	2	8.70 (0.00-21.15)	22	100.0 (100.0-100.0)	14	82.35 (62.15-100.0)
	Yes	24	38.71(26.24-51.18)	21	91.30 (78.85-100.0)	-	-	3	17.65 (0.00-37.85)

TABLE 3: Distribution of general characteristics and overall conditions of the public health laboratories under IDSP, Bihar, 2019 *(Contd...)*

		Overall		Begusarai		Darbhanga		Bhojpur	
Description	**Category**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**
Personal Protection Equipment available: Gloves	No	14	22.58(11.88-33.29)	-	-	13	59.09 (36.78-81.40)	1	5.88 (0.00-18.35)
	Yes	48	77.42(66.71-88.12)	23	100.0 (100.0-100.0)	9	40.91 (18.60-63.22)	16	94.12 (81.65-100.0)
Personal Protection Equipment available: Glasses	No	53	85.48(76.47-94.50)	19	82.61 (65.85-99.37)	21	95.45 (86.00-100.0)	13	76.47 (53.99-98.95)
	Yes	9	14.52(5.50-23.53)	4	17.39 (0.63-34.15)	1	4.55 (0.00-14.00)	4	23.53 (1.05-46.01)
Personal Protection Equipment available: Masks	No	31	50.00(37.20-62.80)	6	26.09 (6.67-45.50)	16	72.73 (52.52-92.94)	9	52.94 (26.49-79.39)
	Yes	31	50.00(37.20-62.80)	17	73.91 (54.50-93.33)	6	27.27 (7.06-47.48)	8	47.06 (20.61-73.51)
Personal Protection Equipment available: Any special footwear	No	62	100.00(100.00-100.00)	23	100.0 (100.0-100.0)	22	100.0 (100.0-100.0)	17	100.0 (100.0-100.0)
	Yes	-	-	-	-	-	-	-	-
Disinfection of benches at the end of the work	No	24	38.71(26.24-51.18)	2	8.70 (0.00-21.15)	19	86.36 (70.79-100.0)	3	17.65 (0.00-37.85)
	Yes	38	61.29(48.82-73.76)	21	91.30 (78.85-100.0)	3	13.64 (0.00-29.21)	14	82.35 (62.15-100.0)
SOP or any recommended good practice strictly followed	No	41	66.13(54.01-78.25)	12	52.17 (30.09-74.26)	18	81.82 (64.32-99.32)	11	64.71 (39.38-90.03)
	Yes	21	33.87(21.75-45.99)	11	47.83 (25.74-69.91)	4	18.18 (0.68-35.68)	6	35.29 (9.97-60.62)
Regular clearance of waste	No	13	20.97(10.55-31.39)	-	-	9	40.91 (18.60-63.22)	4	23.53 (1.05-46.01)
	Yes	49	79.03(68.61-89.45)	23	100.0 (100.0-100.0)	13	59.09 (36.78-81.40)	13	76.47 (53.99-98.95)
Separate waste (lid-covered) containers for non-contaminated and contaminated wastes	No	28	45.16(32.42-57.90)	5	21.74 (3.50-39.98)	15	68.18 (47.04-89.32)	8	47.06 (20.61-73.51)
	Yes	34	54.84(42.10-67.58)	18	78.26 (60.02-96.50)	7	31.82 (10.68-52.96)	9	52.94 (26.49-79.39)
Special solvent container (any for acids)	No	29	46.77(34.00-59.55)	10	43.48 (21.56-65.40)	15	68.18 (47.04-89.32)	4	23.53 (1.05-46.01)
	Yes	33	53.23(40.45-66.00)	13	56.52 (34.60-78.44)	7	31.82 (10.68-52.96)	13	76.47 (53.99-98.95)
Logbooks/lab register present	No	12	19.35(9.24-29.47)	-	-	7	31.82 (10.68-52.96)	5	29.41 (5.26-53.56)
	Yes	50	80.65(70.53-90.76)	23	100.0 (100.0-100.0)	15	68.18 (47.04-89.32)	12	70.59 (46.44-94.74)

TABLE 3: Distribution of general characteristics and overall conditions of the public health laboratories under IDSP, Bihar, 2019 *(Contd...)*

		Overall		Begusarai		Darbhanga		Bhojpur	
Description	**Category**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**
Logbooks/lab register correctly filled for all diseases	No	8	16.00(5.48-26.52)	-	-	2	13.33 (0.00-32.82)	6	50.00 (16.82-83.18)
	Yes	42	84.00(73.48-94.52)	23	100.0 (100.0-100.0)	13	86.67 (67.18-100.0)	6	50.00 (16.82-83.18)
Line list register present for all laboratory confirmed positive cases	No	26	41.94(29.30-54.57)	6	26.09 (6.67-45.50)	6	27.27 (7.06-47.48)	14	82.35 (62.15-100.0)
	Yes	36	58.06(45.43-70.70)	17	73.91 (54.50-93.33)	16	72.73 (52.52-92.94)	3	17.65 (0.00-37.85)
Logbooks or line list register are filled correctly	No	-	-	-	-	-	-	-	-
	Yes	36	100.00(100.00-100.00)	17	100.0 (100.0-100.0)	16	100.0 (100.0-100.0)	3	100.0 (100.0-100.0)
Summary of the logbooks or lab register done	No	27	43.55(30.85-56.24)	4	17.39 (0.63-34.15)	7	31.82 (10.68-52.96)	16	94.12 (81.65-100.0)
	Yes	35	56.45(43.76-69.15)	19	82.61 (65.85-99.37)	15	68.18 (47.04-89.32)	1	5.88 (0.00-18.35)
Availability of new L forms at lab	No	30	48.39(35.59-61.18)	12	52.17 (30.09-74.26)	16	72.73 (52.52-92.94)	2	11.76 (0.00-28.84)
	Yes	32	51.61(38.82-64.41)	11	47.83 (25.74-69.91)	6	27.27 (7.06-47.48)	15	88.24 (71.16-100.0)
L forms filled correctly	No	34	54.84(42.10-67.58)	12	52.17 (30.09-74.26)	19	86.36 (70.79-100.0)	3	17.65 (0.00-37.85)
	Yes	28	45.16(32.42-57.90)	11	47.83 (25.74-69.91)	3	13.64 (0.00-29.21)	14	82.35 (62.15-100.0)
Availability of consumables for culture	No	56	90.32(82.75-97.89)	20	86.96 (72.07-100.0)	21	95.45 (86.00-100.0)	15	88.24 (71.16-100.0)
	Yes	6	9.68(2.11-17.25)	3	13.04 (0.00-27.93)	1	4.55 (0.00-14.00)	2	11.76 (0.00-28.84)
Availability of consumables for Typhi-dot test	No	59	95.16(89.67-100.0)	22	95.65 (86.64-100.0)	20	90.91 (77.86-100.0)	17	100.0 (100.0-100.0)
	Yes	3	4.84(0.00-10.33)	1	4.35 (0.00-13.36)	2	9.09 (0.00-22.14)	-	-
Availability of consumables for ELISA test	No	55	88.71(80.61-96.81)	20	86.96 (72.07-100.0)	18	81.82 (64.32-99.32)	17	100.0 (100.0-100.0)
	Yes	7	11.29(3.19-19.39)	3	13.04 (0.00-27.93)	4	18.18 (0.68-35.68)	-	-
Ability to confirm Malaria	No	16	25.81(14.60-37.01)	7	30.43 (10.09-50.78)	7	31.82 (10.68-52.96)	2	11.76 (0.00-28.84)
	Yes	46	74.19(62.99-85.40)	16	69.57 (49.22-89.91)	15	68.18 (47.04-89.32)	15	88.24 (71.16-100.0)
Ability to confirm Typhoid	No	45	72.58(61.16-84.00)	17	73.91 (54.50-93.33)	17	77.27 (58.25-96.29)	11	64.71 (39.38-90.03)
	Yes	17	27.42(16.00-38.84)	6	26.09 (6.67-45.50)	5	22.73 (3.71-41.75)	6	35.29 (9.97-60.62)

TABLE 3: Distribution of general characteristics and overall conditions of the public health laboratories under IDSP, Bihar, 2019 *(Contd...)*

		Overall		Begusarai		Darbhanga		Bhojpur	
Description	**Category**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**
Ability to confirm Tuberculosis	No	7	11.29(3.19-19.39)	1	4.35 (0.00-13.36)	2	9.09 (0.00-22.14)	4	23.53 (1.05-46.01)
	Yes	55	88.71(80.61-96.81)	22	95.65 (86.64-100.0)	20	90.91 (77.86-100.0)	13	76.47 (53.99-98.95)
Ability to confirm Cholera	No	61	98.39(95.16-100.0)	23	100.0 (100.0-100.0)	22	100.0 (100.0-100.0)	16	94.12 (81.65-100.0)
	Yes	1	1.61(0.00- 4.84)	-	-	-	-	1	5.88 (0.00-18.35)
Ability to confirm Shigellosis	No	61	98.39(95.16-100.0)	23	100.0 (100.0-100.0)	21	95.45 (86.00-100.0)	17	100.0 (100.0-100.0)
	Yes	1	1.61(0.00- 4.84)	-	-	1	4.55 (0.00-14.00)	-	-
Ability to confirm Leptospirosis	No	61	98.39(95.16-100.0)	23	100.0 (100.0-100.0)	22	100.0 (100.0-100.0)	16	94.12 (81.65-100.0)
	Yes	1	1.61(0.00- 4.84)	-	-	-	-	1	5.88 (0.00-18.35)
Ability to confirm Meningococcal Meningitis	No	62	100.00(100.00-100.00)	23	100.0 (100.0-100.0)	22	100.0 (100.0-100.0)	17	100.0 (100.0-100.0)
	Yes	-	-	-	-	-	-	-	-
Ability to confirm Japanese Encephalitis	No	62	100.00(100.00-100.00)	23	100.0 (100.0-100.0)	22	100.0 (100.0-100.0)	17	100.0 (100.0-100.0)
	Yes	-	-	-	-	-	-	-	-
Ability to confirm Diphtheria	No	62	100.00(100.00-100.00)	23	100.0 (100.0-100.0)	22	100.0 (100.0-100.0)	17	100.0 (100.0-100.0)
	Yes	-	-	-	-	-	-	-	-
Ability to confirm Hepatitis	No	35	56.45(43.76-69.15)	13	56.52 (34.60-78.44)	14	63.64 (41.81-85.47)	8	47.06 (20.61-73.51)
	Yes	27	43.55(30.85-56.24)	10	43.48 (21.56-65.40)	8	36.36 (14.53-58.19)	9	52.94 (26.49-79.39)
Ability to confirm Measles	No	62	100.00(100.00-100.00)	23	100.0 (100.0-100.0)	22	100.0 (100.0-100.0)	17	100.0 (100.0-100.0)
	Yes	-	-	-	-	-	-	-	-
Ability to confirm Dengue	No	57	91.94(84.96-98.91)	20	86.96 (72.07-100.0)	22	100.0 (100.0-100.0)	15	88.24 (71.16-100.0)
	Yes	5	8.06(1.09-15.04)	3	13.04 (0.00-27.93)	-	-	2	11.76 (0.00-28.84)
Ability to confirm Chikungunya	No	59	95.16(89.67-100.0)	21	91.30 (78.85-100.0)	22	100.0 (100.0-100.0)	16	94.12 (81.65-100.0)
	Yes	3	4.84(0.00-10.33)	2	8.70 (0.00-21.15)	-	-	1	5.88 (0.00-18.35)

TABLE 4: Distribution of overall functionality of the public health laboratories under IDSP, Bihar, 2019

		Overall		Begusarai		Darbhanga		Bhojpur	
Description	**Category**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**
Uploading weekly report of L forms at IDSP portal	No	24	38.71(26.24-51.18)	8	34.78 (13.72-55.84)	13	59.09 (36.78-81.40)	3	17.65 (0.00-37.85)
	Yes	38	61.29(48.82-73.76)	15	65.22 (44.16-86.28)	9	40.91 (18.60-63.22)	14	82.35 (62.15-100.0)
Presence of any internal quality control for this lab	No	37	59.68(47.12-72.24)	14	60.87 (39.29-82.45)	15	68.18 (47.04-89.32)	8	47.06 (20.61-73.51)
	Yes	25	40.32(27.76-52.88)	9	39.13 (17.55-60.71)	7	31.82 (10.68-52.96)	9	52.94 (26.49-79.39)
Availability of any bio-safety and bio-medical waste management policy	No	52	83.87(74.45-93.29)	23	100.0 (100.0-100.0)	17	77.27 (58.25-96.29)	12	70.59 (46.44-94.74)
	Yes	10	16.13(6.71-25.55)	-	-	5	22.73 (3.71-41.75)	5	29.41 (5.26-53.56)
Transport specimen to the referral lab for confirmation	No	41	66.13(54.01-78.25)	16	69.57 (49.22-89.91)	12	54.55 (31.95-77.14)	13	76.47 (53.99-98.95)
	Yes	21	33.87(21.75-45.99)	7	30.43 (10.09-50.78)	10	45.45 (22.86-68.05)	4	23.53 (1.05-46.01)
Any vaccinations given to the staff	No	61	98.39(95.16-100.0)	22	95.65 (86.64-100.0)	22	100.0 (100.0-100.0)	17	100.0 (100.0-100.0)
	Yes	1	1.61(0.00- 4.84)	1	4.35 (0.00-13.36)	-	-	-	-
Availability of appropriate supplies or set aside for collecting specimens during an urgent situation	No	39	62.90(50.54-75.27)	15	65.22 (44.16-86.28)	18	81.82 (64.32-99.32)	6	35.29 (9.97-60.62)
	Yes	23	37.10(24.73-49.46)	8	34.78 (13.72-55.84)	4	18.18 (0.68-35.68)	11	64.71 (39.38-90.03)
Documented list of referral labs	No	43	69.35(57.55-81.16)	15	65.22 (44.16-86.28)	15	68.18 (47.04-89.32)	13	76.47 (53.99-98.95)
	Yes	19	30.65(18.84-42.45)	8	34.78 (13.72-55.84)	7	31.82 (10.68-52.96)	4	23.53 (1.05-46.01)
Training on IDSP	No	13	20.97(10.55-31.39)	1	4.35 (0.00-13.36)	7	31.82 (10.68-52.96)	5	29.41 (5.26-53.56)
	Yes	49	79.03(68.61-89.45)	22	95.65 (86.64-100.0)	15	68.18 (47.04-89.32)	12	70.59 (46.44-94.74)

TABLE 4: Distribution of overall functionality of the public health laboratories under IDSP, Bihar, 2019 *(Contd...)*

		Overall		Begusarai		Darbhanga		Bhojpur	
Description	**Category**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**	**Frequency**	**% (95% CI)**
Frequency of training	At least once during preceding 6 months	8	16.33(5.60-27.05)	2	9.09 (0.00-22.14)	5	33.33 (6.31-60.36)	1	8.33 (0.00-26.67)
	At least once during preceding 6-12 months	34	69.39(56.01-82.76)	18	81.82 (64.32-99.32)	7	46.67 (18.07-75.26)	9	75.00 (46.26-100.0)
	None during preceding 12 months	5	10.20(1.42-18.99)	2	9.09 (0.00-22.14)	3	20.00 (0.00-42.93)	-	-
	Other (Specify)	2	4.08(0.00- 9.82)	-	-	-	-	2	16.67 (0.00-41.40)
Presence of a functional waste management system	No	18	29.03(17.41-40.65)	5	21.74 (3.50-39.98)	5	22.73 (3.71-41.75)	8	47.06 (20.61-73.51)
	Yes	44	70.97(59.35-82.59)	18	78.26 (60.02-96.50)	17	77.27 (58.25-96.29)	9	52.94 (26.49-79.39)

TABLE 5: Association between age, education, training, presence of key documents, overall condition of the laboratory and correctly filling the L-Form

Description	Categories	Type of OR*	L form correctly filled or not (Reference=No)	
			Yes	
			OR (95% CI)	P-Value
Lab Technician's age	-	UOR	0.93(0.85-1.03)	0.1461
		AOR	0.93(0.85-1.03)	0.1483
Education of the Lab Technician (Reference=Beyond 8th standard but below graduation)	Graduate/Post-graduation	UOR	1.83(0.62-5.33)	0.2717
		AOR	1.99(0.65-6.10)	0.2271
Received formal training on IDSP (Reference=No)	Yes	UOR	1.42(0.41-4.94)	0.5860
		AOR	1.50(0.39-5.82)	0.5592
Presence of key documents (Reference=Poor) *	Average	UOR	0.88(0.28-2.79)	0.8212
		AOR	0.94(0.28-3.10)	0.9133
	Good	UOR	1.02(0.29-3.65)	0.9747
		AOR	0.88(0.24-3.28)	0.8453
Overall condition of the lab (Reference=Poor) *	Average	UOR	3.34(0.94-11.85)	0.0621
		AOR	3.04(0.83-11.08)	0.0927
	Good	UOR	2.69(0.77-9.51)	0.1223
		AOR	2.91(0.79-10.73)	0.1096

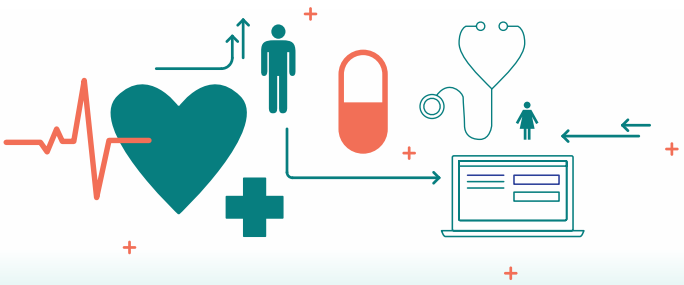
**UOR=Unadjusted Odds Ratio*

AOR=Adjusted Odds Ratio after adjusting for age and education

TABLE 6: Key themes and subthemes that emerged from the qualitative analysis: Lab Surveillance

Key themes	Sub-themes	Verbatim
Routine Investigation	Collection of biological samples	"we collect samples from anyone who comes to the hospital without any prejudice." - Lab tech # Begusarai District
	Proportion of suspected cases sent to lab per day	"in general, 10 to 15 patents come for testing every day." –Lab tech # Darbhanga District
	Record keeping of investigation	"for all tests being conducted in the lab there are different registers, after testing we record in the register." –Lab tech # Bhojpur District
	Sero-types or anti-biotic resistance patterns tests	"this I don't have any information about" –Lab tech # Darbhanga District
	Reliable results in a timely manner	"no there is no issues with reliability of this lab. See it is important to maintain the reagents and instruments properly and that will give you correct result and that is why I have not faced any problem with reliability." –Lab tech # Begusarai District
	Communication of results to appropriate authority	"the patient takes the report to the doctor and sometimes I go with them if they are worried" –Lab tech # Darbhanga District
	Supply of media, equipment and other related materials	"if there is a shortage of materials we give an indent and if available in the store we get it but if it is not available in the store then we send applications endorsed by the in-charge to the management and it takes a bit of time then but is made available." -- Lab tech # Begusarai District
Outbreak Investigation	Detecting and confirming outbreak	"when a patient comes to me and he is tested positive and other patients from the same area also come and are found positive, it indicates an outbreak." –Lab tech # Bhojpur district
	Action following confirmation of an outbreak	"from the information from the ASHA worker or from what I have, a visit to the field is made. A team is constituted where the doctor is there, lab tech is also present. The team does a survey to identify where and when the disease is spreading and treatment is started on field or transported by ambulance to hospital" –Lab tech # Begusarai district
	Challenges during specimen collection and transport	"the most difficult part is facing the public and convincing them to give sample for testing. Another issue is then the transportation of the sample to the referral laboratory."–Lab tech # Begusarai district
	Intersectoral co-ordination	"no, we do not get the support of other agencies such as the PWD or the Animal Husbandry" –Lab tech # Darbhanga district
Job responsibilities	Awareness about IDSP	"yes, I am aware about the IDSP" –Lab tech # Begusarai district
	Knowledge about job responsibility of IDSP	"the main work for IDSP is to fill in the L-Form" –Lab tech # Darbhanga district
	Analysis of data	"felt the need for analysis but have not done it myself" –Lab tech # Bhojpur district
Motivation and happiness	Enjoy doing this job	"I feel very happy working" - Lab tech # Darbhanga district
	Motivation of work	"I feel that I am helping the patient and from my test report he will get the correct treatment" - Lab tech # Begusarai district
Stress management	Work pressure	"there is pressure when 30-40 patients come at the same time and I am the only laboratory technician working. Moreover, every disease has a different register and I have to fill them also beside providing the test results" -Lab tech # Begusarai district
Suggestions	Improve the existing efficiency of lab	"need more space for laboratory and separate spaces for collection and testing" -Lab tech # Darbhanga district
	Improving IDSP	"daily reporting needs to be undertaken and more diseases should be added to the list" -Lab tech # Darbhanga district
	Improving skills	"what I want is regular information about the tests and special training should be available to improve ourselves" -Lab tech # Bhojpur district

Chapter 7



STAKEHOLDERS' PERSPECTIVES & SUGGESTIONS FOR IMPROVING IDSP PERFORMANCE IN BIHAR

Summary

Findings summarized the key stakeholders' views on two major areas: indicator-based (routine) surveillance and event-based (outbreak) surveillance. In addition, the current study also identified threats and opportunities to sustainability of IDSP in Bihar. Although most of the stakeholders were aware of IDSP, they had inadequate knowledge regarding the operational details of IDSP, outbreak investigation process, data management and analysis. The majority of the respondents felt that formal training on IDSP for all key functionaries was required to improve the program performance in an effective way. Some of the implementation barriers identified were shortage of manpower, lack of basic facilities including inadequate space, slow computer operating system, poor network connectivity, shortage of electricity, inadequate compensation package, insufficient leave approval and ineffective coordination with other health personnel.

The current study identified several implementation barriers which adversely affected IDSP performance in Bihar. Findings suggested that additional support and training were required to address some of these challenges, and the existing program could be strengthened only if the state government focused on strategies for securing new resources tailored to meet the local needs. In addition, in-depth and systematic understanding of the key barriers as narrated by the stakeholders in the current study and addressing some of them is likely to improve IDSP implementation in the state. Rethinking for strategic management for epidemic preparedness is needed by policy makers if the state is to achieve IDSP goals on infectious disease control and outbreak response.

Background

Recently published WHO report emphasized that for the effective implementation of public health programs, the most crucial responsibility lies with the stakeholders, who are an integral component of complex health care system.[54] Several prior studies showed that stakeholders were a trusted voice in the public health sector, and also the first

decision-makers at the community level [55-57]. Furthermore, they could effectively address the concerns regarding the conduct and progress of the ongoing activities [57-61]. However, the performance of stakeholders, directly or indirectly involved in the programs, were shaped by a complex interplay of several factors. The major contributing factors, as revealed in prior studies, included acute shortage of manpower, poor infrastructure, several parallel vertical programs with overlapping goals and objectives, lack of clarity in responsibilities, unpredictable funding and limited coordination within the department [57, 60, 62-65].

Research in India also revealed numerous contextual factors that hindered the stakeholder's performance including limited human resources, inadequate supervision, lack of motivation, improper leave policy, poor coordination with other health personnel, low incentive scheme, and absence of basic infrastructure [66-70]. Previous studies in Uttar Pradesh highlighted critical perceived barriers to effective implementation of maternal, new-born and child health programs. [66, 67]. Prior study conducted in Bihar on barriers and facilitators to the provision of optimal obstetric and neonatal emergency care identified several interrelated contextual factors that adversely affected the care provision in the state [68]. Findings from Jharkhand indicated that addressing some of the implementation barriers might improve the utilization of maternal services under the Mukhya Mantri Janani Shishu Swasthya Abhiyan (MMJSSA) Scheme in Jharkhand [70].

Although earlier results from different studies indicated numerous implementation barriers of maternal and child care but very few focused on infectious diseases. A qualitative study among people living with HIV/AIDS in Bihar showed how stigma and discrimination among health care providers impacted the patient access to health care [69]. Also, the majority of the research work was focused on the maternal-child health care program, with more objective rather than subjective evaluation of stakeholder performance. Besides, there were research gaps regarding stakeholder perception under the Integrated Disease Surveillance Program (IDSP) in Bihar. The current qualitative study aimed to identify the potential barriers to performance of stakeholders engaged in IDSP in Bihar, which, if adequately addressed, might help in strengthening surveillance activities and also in future epidemic preparedness in Bihar.

Findings

Approximately 15 semi-structured in-depth interviews were conducted with the different key informants, including civil surgeon, additional chief medical officer, district epidemiologist, district data manager, data entry operator and district program manager across three studied districts and the state representatives of IDSP cell.

The findings of the current study were summarized under two categories: (1) Role and responsibilities of stakeholders and (2) Factors influencing stakeholder performance. Several factors including satisfaction, motivation level, incentives, transport facilities, training opportunities, supportive supervision, coordination between health workers that greatly impacted the performance of stakeholders, and also their opinions on how to improve existing IDSP implementation are presented under key themes emerging from the analysis. Illustrative quotes depicted key experiences and themes implied by multiple stakeholders are also presented (Table 1).

Core functions of stakeholder under IDSP in Bihar

The current study showed that how different stakeholders (district epidemiologist, data manager, data operator, acting chief medical officer, civil surgeon, district health managers, doctor of physical medicine, and doctor of dental medicine) could together ensure the quality of disease surveillance under IDSP in Bihar. The role of the stakeholders appeared to be predominantly focused on being a data compiler, operator, administrator, reviewer of health program and also create a link between state and community for accessing public health services, and also continued to disseminate health-related information among the community.

> *"We (stakeholders) create a link between the state government and community. We compile all the surveillance data and send to state government for further analysis" (Interviewee 1, Bhojpur).*

> *"I do review, supervision and monitoring of all the health-related programs and also perform administrative work" (Interviewee 8, Darbhanga).*

Analysis indicated that participants were much aware of IDSP in general. The majority of the respondents said that they used to compile, synchronize and upload the surveillance data on the state government site (PLS Form: P for the physician, L for a lab technician and S for ANM) submitted during the Tuesday meeting from all health sub-centers, primary health centers, additional primary health centers, district hospitals, and laboratories, although, most of the respondents expressed the need for human resource for proper implementation of IDSP. Some of them also narrated that they did not get correct report of disease surveillance on time.

> *"I compile a weekly report and submit it through email on a weekly basis on the state government online portal. The weekly surveillance data are sent late and sometimes wrong information is sent. There should provide correct information to us and also on time so that we can compile all the data at one time and put the data on the public domain" (Interviewee 3, Darbhanga).*

Findings revealed that stakeholders were also responsible for the outbreak detection, response and also pandemic preparedness for being a part of rapid response and district alert team at block and district level.

> *"When I heard any occurrence of an outbreak in my area, we provide immediate information to the state for the preparedness. We have rapid response and district alert teams at block and district levels to do an on-spot check and take immediate action" (Interviewee 2, Darbhanga).*

Factors influencing stakeholder performance (Box 4)

Shortage of workforce

Most of the stakeholders reported a problem of managing workload against the available trained manpower due to vacancies in the sanctioned posts, for instance, one of the districts in Bihar had one staff posted against the sanctioned number of three. In general, the positions for data operators and epidemiologists were lying vacant in the state. This lack in human resource largely affected the overall performance of the program.

> *"Sir, there should be three staffs at the district level included data operator, data manager, and district*

epidemiologist, although, I am working alone since last 10 years so that it is not possible for me to go for field visit. Shortage in manpower is a big challenge for us and also leading a negative effect on stakeholders' work performance and overall program" (Interviewee 2, Darbhanga).

Training

The finding showed that formal training on IDSP was inadequate. They expressed a wish for additional training and thought that this would significantly improve their knowledge and performance so that IDSP could be implemented systematically.

"I feel that the training on IDSP is taken very lightly and is not a priority. I would like to participate in extensive training related to basic disease surveillance. We need to be trained on how to prepare a report, improve data quality so that the objectives of IDSP can be achieved" (Interviewee 9, Darbhanga).

Institutional Infrastructure

Interaction with key functionaries revealed that there was a lack of basic necessities including electricity, printer, internet, server, etc.

"There is problem of electricity, printer, internet server at center. Last time online portal of state government was not working. sometimes it becomes a reason for stress and pressure" (Interviewee 1, Bhojpur).

Supervision

The majority of the participants narrated that supervisory visits were not being done regularly. It is usually only during disease outbreaks and in event of any unusual death. One of the main reasons cited was the lack of manpower for such activities.

"Supervisory activities are not done due to shortage of manpower" (Interviewee 10, Bhojpur).

Motivation

Several stakeholders mentioned that the passion to work in the health sector was the main source of motivation for them. They also highlighted that to achieve or to maintain the good rank of the district in terms performance also encouraged them.

"Last year my district got 4th rank in Kayakalap program with 50000 rupees prize money. This motivates me to work hard and to maintain the existing status of my district" (Interviewee 7, Begusarai).

Monetary incentives

Most of the stakeholders in general felt that the monthly salary was insufficient against the work assigned to them to fulfill program's objectives. The findings highlighted that monetary compensation was an important factor that influenced the performance of stakeholders.

"Sir, I don't feel I am being paid a fair amount because there is a lot of work that I do. Insufficient salary creates a frustrating situation because we have many family responsibilities" (Interviewee 6, Begusarai).

Communication and coordination

Poor communication among key officials and in absence of timely feedback seemed to be other issues affecting the program

"Nobody is ready to listen and areas of importance and priority are missed" (Interviewee 6, Begusarai).

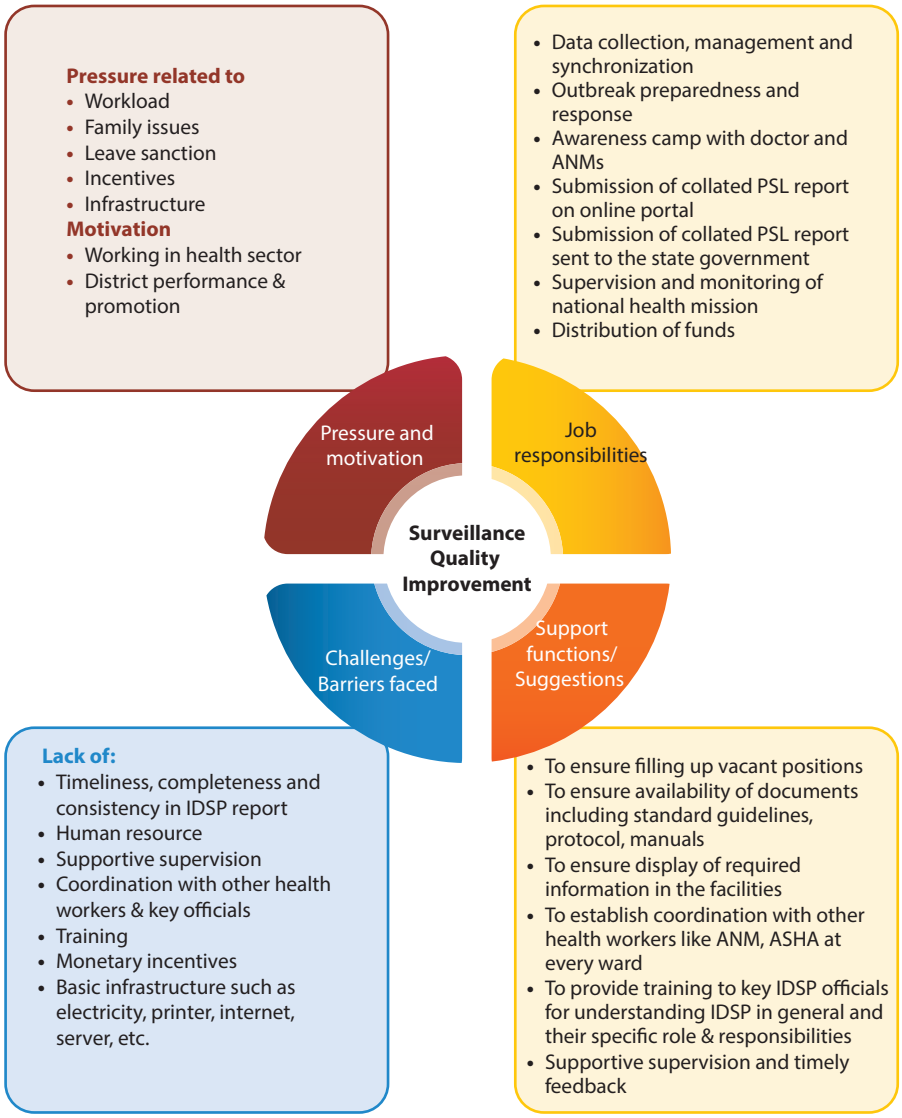
TABLE 1: Illustration of the themes, sub-themes with verbatim of respondents (stakeholders) of the current study, Bihar, 2019

S. N	Theme	Sub-theme	Verbatim
1	Indicator-based surveillance	Overall IDSP in-charge	*# Yes, Sir, DSO/ACMO-Interviewee 1, Bhojpur*
		Capture and documentation regarding patient-related information	*# Yes, Sir, I receive patients' reports from PHC on a weekly basis. After that, I enter all the details in the excel and then upload it on the portal and finally send it to the state- Interviewee 9, Darbhanga*
		Idea about Timeliness and Completeness	*# Yes, Sir, I know- Interviewee 8, Darbhanga*
		Improvement of weekly reporting	*# No, Sir, I do not get patients to report on a regular basis and on time. Some PHCs send the report on Monday, while some other send on Tuesday. Therefore, I can't compile all the data at once and there is always a delay in online upload - Interviewee 9, Darbhanga*
		Contributing factors for Improvement	*# Yes, Sir, there is lack of human resource- Interviewee 2, Darbhanga* *# Yes, Sir, there should be cooperation and coordination between ANM, ASHA at block level- Interviewee 7, Begusarai* *# Yes, Sir, there should be supportive supervision- Interviewee 10, Bhojpur*
		Data management	*# Yes, Sir, I do a compilation of all data that come from PHCs and finally upload them on the portal of IDSP- Interviewee 2, Darbhanga*
		Current condition of the IDSP	*# No, Sir, IDSP is not working properly in my area- Interviewee 3, Darbhanga*
		Barriers related to IDSP implementation	*# Yes, Sir, there is lack of human resource including operator, epidemiologist. There must be three staffs at the district level, while I am working alone for the last 10 years. It is not possible for me to go for field visit- Interviewee 2, Darbhanga*
		Improving IDSP performance	*# Yes, Sir, IDSP can be improved if provided with adequate human resource in every block and through traing- Interviewee 4, Darbhanga*
2	Event-based surveillance	Outbreak investigation procedure improvement	*# Yes, Sir, there are some improvement- Interviewee 6, Begusarai*
		Ways to achievement	*# Yes, Sir, there should be an epidemiologist in every district- Interviewee 6, Begusarai*
		Single opinion to improve the outbreak investigation procedure	*# Yes, Sir, there should be sufficient number of human resource- Interviewee 5, Bhojpur* *# Yes, Sir, there should be household survey by ASHA, ANM- Interviewee 8, Darbhanga* *# Yes, Sir, there should be resource promotion in routine budget- Interviewee 4, Darbhanga*
3	Any special case	Surveillance regarding emerging and re-emerging outbreak	*# Yes, Sir, there is need of awareness camp with doctor and ANMs-Interviewee 7, Begusarai*
4	Resources	Adequate funding	*# Yes, Sir, I don't know if HR will be available, then we can calculate the funding amount- Interviewee 6, Begusarai*
		Trained staffs	*# Yes, Sir, all medical officers and data operators got training- Interviewee 10, Bhojpur*

TABLE 1: Illustration of the themes, sub-themes with verbatim of respondents (stakeholders) of the current study, Bihar, 2019 *(Contd...)*

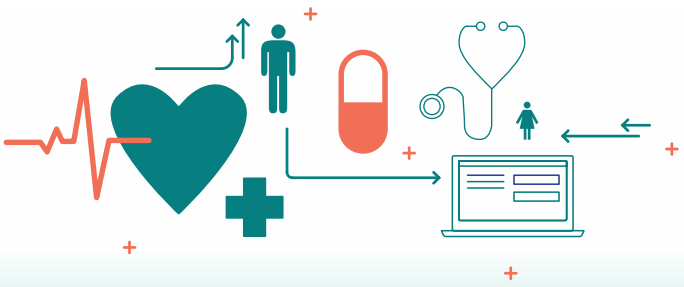
S. N	Theme	Sub-theme	Verbatim
5	Job responsibilities, stress, motivation, expectations, challenges	Feeling about the current job	*# Yes, Sir, I feel very good, sir- Interviewee 9, Darbhanga*
		Routine activities	*# Yes, Sir, I do review and monitor the National Health Mission program- Interviewee 8, Darbhanga* *# Yes, Sir, I do allocation and supervision of fund- Interviewee 10, Bhojpur*
		Perceived job pressure	*# Yes, Sir, we have much workload due to lack of manpower and basic infrastructure including electricity, internet, etc.- Interviewee 1, Bhojpur*
		Current job satisfaction	*# Yes, Sir, I am satisfied with my current job- Interviewee 5, Bhojpur*
		Satisfaction regarding current holidays/leaves	*# No, Sir, I am working even on Sundays- Interviewee 4, Bhojpur* *# No, Sir, there is no leave and I am working 24x7- Interviewee 8, Darbhanga* *# No, Sir, I did not take any leave. My leave lapses always, sir- Interviewee 7, Begusarai*
		Remuneration/ Compensation	*# No, Sir, the current salary is not sufficient for us, and also the salary is not coming on time- Interviewee 2, Darbhanga*
		Job related challenges	*# Yes, Sir, there are so many difficulties, including huge workload, inadequate training and poor incentive and also lack of travel allowance- Interviewee 9, Darbhanga* *# Yes, Sir, there is lack of human resource, and delay in PLS-form submission- Interviewee 10, Bhojpur* *# Yes, Sir, I am getting inadequate incentive, therefore, I have problems in running my family- Interviewee 6, Begusarai*

BOX 3: Showing the snapshot of experiences and opinions shared by stakeholders



MOIC: Medical Officer In-Charge, BHM: Block Health Manager, MO: Medical Officer, DM: District Magistrate. CS: Civil Surgeon

Chapter 8



CONCLUSIONS & RECOMMENDATIONS

The performance of ISDP in Bihar can be improved by developing a state-wide structured robust prospective surveillance system with the following objectives for collecting epidemiological information for each suspected or probable case detected or reported in the community and by increasing state preparedness for ongoing management of infectious disease outbreak.

Objectives

1. To enhance epidemic preparedness in the state by designing a prospective robust infectious disease surveillance system for
    a. Accurate identification and diagnosis of suspected cases in the community
    b. Timely referral of symptom-positive cases from the community to point of confirmatory diagnosis and care (referral laboratories and facilities)
    c. Initiation of appropriate treatment at the facility and regular follow-up
    d. Ensuring correct, complete, timely and mandatory reporting
2. To develop appropriate policy recommendations for the Government of Bihar for scale-up across the state based on cumulative learning

Proposed strategies

A. Institutionalization

- Establishing a State Surveillance Committee for monitoring routine surveillance involving all related departments under the chairmanship of Principal Secretary Health
- Constitution of Emergency Operating Center and Technical Advisory Committee under the Health Department for outbreak investigation, preparedness and control
- Ensuring system-level preparedness including basic infrastructure, essential medicines, adequate trained personnel, ambulance,

computer, internet and lab facility (reagent/ specimen collection, storage, transfer)

- Conducting monthly review meeting of IDSP under the chairmanship of the Principal Secretary Health involving faculty members of all related departments attached to both Government & Private Medical Colleges, representative from Indian Medical Association, Animal Husbandry, Veterinary Hospital, State Public Health Laboratory, State Food Safety Department and Department of Environment

B. Application of Information and communication technology (IT)

- Developing web-enabled real-time electronic system along with mobile application for capturing real-time data
- Generating awareness among community health workers regarding common symptoms of communicable disease through user-friendly digital applications and social media
- Alerting caregivers through an audio-based mobile app before any seasonal outbreak
- Use of IT platform for linking all community-health-workers, public/private physicians, lab technicians and important key players up to district-and-state-level
- Designing of a web-based application with geocoding and GIS integration for tracking & follow-up care management and contact tracing in the community
- Developing user friendly real-time dashboard with inbuilt alert system for monitoring disease trend, impending outbreaks at the state, district and block level
- Developing an open-source web-based electronic medical records to support clinical management & treatment of critical cases

C. Enforcement of mandatory case-reporting & monitoring by local physicians

- Real-time data capture using web-based & mobile application by all key players engaged in IDSP including community health worker, physicians & lab technicians
- Mandatory case-reporting from private facilities and laboratories
- Aadhaar-enabled out-patient-department case registration
- Strategy to ensure accountability through regular data-driven review mechanism and appropriate feedback with performance appraisal

D. Capacity building

- Developing/Modifications/Updating operational guidelines, training manuals, protocols, Terms of Reference and Standard Operating Procedure for all engaged in IDSP
- Orientation & interactive training sessions including small video clippings to all medical officers, community health workers and lab technicians

E. Big data analytics and data-base management

- Creating infectious disease Bihar research team
- Creating data base from each potential case as captured at facility-community levels &

exploring opportunity for linking with other data-resources like private clinics, pharmacy, insurance (where applicable), custom (airport authority), border control, major railways junctions (railway authority), tourist spots

- Data analysis
- Timely dissemination for action

Proposed Actions

A. At the block-level

Establishing a community-based active prospective surveillance system through

- Generating awareness regarding common symptoms of infectious diseases endemic to Bihar and referral system among community-health-workers (CHWs) engaging key health personnel as well through user-friendly digital applications & social media
- Generating awareness among care-givers by CHWs during routine home-visits & through mobile message in local dialect, particularly before any seasonal outbreak
- Ensuring family preparedness in terms of identification of near-by hospital, transport arrangement, emergency money & accompanying person
- Generating awareness among school children regarding the common symptoms related to infectious diseases & things to be done
- Creating a pool of community-volunteers in each village for handling emergencies, family counseling & updating the scenario
- Using social media to connect all CHWs (auxiliary nurse midwife, ASHA, Jevika, etc.), block health managers and block community mobilizers and linking them with key officials at district-and-state level
- Involving informal care providers in real-time reporting of any suspected case in the community to the concerned district health authorities

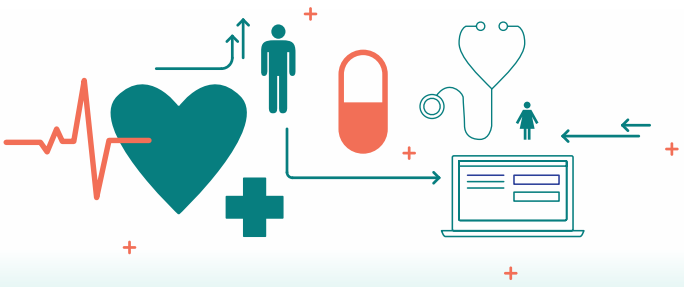
B. At the district-level

- Ensuring facility and laboratory based both active & passive surveillance system in each block involving both public and private health care facilities
- Proper documentation of a probable case using a unique identifier
- Monitoring disease trend, supervision and timely feedback using real-time dashboard with an in-built alert system by all treating physicians, key stakeholders & lab technicians
- Creating a performance indicator to check what proportion of probable cases from the community are being reported and diagnosed
- Updating treatment protocol & case-specific management to all treating physicians, paramedic staffs etc.
- Updating SOP, protocol and guideline to all lab-technicians
- Weekly field visits to blocks for proper monitoring & supervision
- Establishing regular data-driven review mechanism and feedback linked with performance appraisal of each block on a weekly basis

- Organizing meeting with the district surveillance committee for horizontal integration with other related departments

C. At the state-level

- Ensuring system-level preparedness including basic infrastructure, essential medicine, adequate trained personnel, ambulance, computer, internet and lab facility (reagent/specimen collection, storage, transfer)
- Organizing interactive training sessions for all key players engaged in IDSP (Physicians, Lab technicians and community health workers) at the state-and-district level on a monthly basis
- Conducting data-driven review of IDSP in each district & timely feedback fortnightly
- Establishing a State Surveillance Committee for routine surveillance involving all related departments under the chairmanship of Principal Secretary Health
- Constitution of Emergency Operating Center and Technical Advisory Committee under the Health Department for outbreak investigation, preparedness and control
- Monthly visit to district team for supervision, monitoring and feedback
- Planning for field investigation to confirm outbreak and regular follow-up
- Initiate scientific research for identifying causative agent, routes of transmission & risk factors related to communicable diseases endemic to Bihar and also diseases with epidemic potential
- Timely dissemination of investigation findings by the Government to key officials for timely action
- Appropriate risk communication to public in due time
- Situation monitoring using real-time data visualization dashboard
- Intensify ongoing surveillance activities
- Plan for and intensify control/preventive measures
- Evaluation impact of ongoing control measures



REFERENCES

1. McMichael, A.J., *Globalization, climate change, and human health.* N Engl J Med, 2013. **369**(1): p. 96.
2. Fauci, A.S., *Emerging and reemerging infectious diseases: the perpetual challenge.* Acad Med, 2005. **80**(12): p. 1079-85.
3. Morens, D.M. and A.S. Fauci, *Emerging infectious diseases: threats to human health and global stability.* PLoS Pathog, 2013. **9**(7): p. e1003467.
4. Edemekong, P.F. and B. Huang, *Epidemiology, Prevention Communicable Diseases*, in *StatPearls [Internet]*. 2018, StatPearls Publishing.
5. Mohan, P., et al., *Communicable or noncommunicable diseases? Building strong primary health care systems to address double burden of disease in India.* 2019. **8**(2): p. 326.
6. Dikid, T., et al., *Emerging & re-emerging infections in India: An overview.* 2013. **138**(1): p. 19.
7. Bui, C., P. Narasimhan, and R. MacIntyre, *Infectious Disease Outbreaks in India-Challenges and opportunities.*
8. Mourya, D.T., et al., *Emerging/re-emerging viral diseases & new viruses on the Indian horizon.* The Indian journal of medical research, 2019. **149**(4): p. 447.
9. Nkonwa, I.H., et al., *Evaluation of the Disease Surveillance System in Adjumani District Refugee Settlements, Uganda, April 2017.* 2018.
10. *Global, regional, and national incidence, prevalence, and years lived with disability for 328 diseases and injuries for 195 countries, 1990-2016: a systematic analysis for the Global Burden of Disease Study 2016.* Lancet, 2017. **390**(10100): p. 1211-1259.
11. Hotez, P.J., et al., *Rescuing the bottom billion through control of neglected tropical diseases.* 2009. **373**(9674): p. 1570-1575.
12. Dandona, L., et al., *Nations within a nation: variations in epidemiological transition across the states of India, 1990–2016 in the Global Burden of Disease Study.* 2017. **390**(10111): p. 2437-2460.
13. Eddy, D.M., *Clinical decision making: From theory to practice: A collection of essays from the Journal of the American Medical Association.* 1996.

14. Rao, K.D., et al., *When do vertical programmes strengthen health systems? A comparative assessment of disease-specific interventions in India.* 2013. **29**(4): p. 495-505.

15. John, T.J., et al., *Continuing challenge of infectious diseases in India.* Lancet, 2011. **377**(9761): p. 252-69.

16. Debnath, F. and M. Ponnaiah, *Improved timeliness for reporting of acute diarrhoeal disease under surveillance overtime: Evaluation of integrated disease surveillance programme in North 24 Parganas, West Bengal, India, 2015.* Clinical Epidemiology and Global Health, 2018. **6**(4): p. 163-167.

17. Smith, J.L., P.M.J.F.P. Fratamico, and Disease, *Emerging and re-emerging foodborne pathogens.* 2018. **15**(12): p. 737-757.

18. Miller-Petrie, M., S. Pant, and R. Laxminarayan, *Drug-Resistant Infections*, in *Major Infectious Diseases*, rd, et al., Editors. 2017, 2017 International Bank for Reconstruction and Development/The World Bank.: Washington DC.

19. Birhan, G., et al., *A Review on Emerging and re Emerging Viral Zoonotic Diseases.* 2015.

20. Curson, P.J.G., *The Ebola crisis and the failure of governance.* 2015. **28**(3): p. 2.

21. Organization, W.H., *Integrated disease surveillance in the African region: a regional strategy for communicable diseases 1999-2003*, in *Integrated disease surveillance in the African Region: a regional strategy for communicable diseases 1999-2003*. 1999. p. 24-24.

22. Gregg, M.B., *Field epidemiology*. 2008: Oxford University Press, USA.

23. Teutsch, S.M. and R.E. Churchill, *Principles and practice of public health surveillance*. 2000: Oxford University Press, USA.

24. WHO. *Role of the laboratory in surveillance*. [cited 2019 23-12-2019]; Available from: https://www.who.int/ihr/lyon/surveillance/lab_surveillance/en/.

25. Lehmann, U., D.J.T.s.o.t.e.o.p. Sanders, activities, costs, and i.o.h.o.o.u.c.h.w.G.W.H. Organization, *Community health workers: what do we know about them.* 2007: p. 1-42.

26. Agrawal, P.K., et al., *Effect of knowledge of community health workers on essential newborn health care: a study from rural India.* 2011. **27**(2): p. 115-126.

27. Lewin, S., et al., *& Scheel, IB (2010). Lay health workers in primary and community health care for maternal and child health and the management of infectious diseases.* **3**.

28. Saprii, L., et al., *Community health workers in rural India: analysing the opportunities and challenges Accredited Social Health Activists (ASHAs) face in realising their multiple roles.* 2015. **13**(1): p. 95.

29. Baqui, A.H., et al., *Newborn care in rural Uttar Pradesh.* Indian J Pediatr, 2007. **74**(3): p. 241-7.

30. Boyce, M.R. and R. Katz, *Community Health Workers and Pandemic Preparedness: Current and Prospective Roles.* Front Public Health, 2019. **7**: p. 62.

31. Muia, D., A. Kamau, and L.J.A.J.o.S.R. Kibe, *Community Health Workers Volunteerism and Task-Shifting: Lessons from Malaria Control and Prevention Implementation Research in Malindi, Kenya.* 2019. **9**(1): p. 1-8.

32. John, T.J., et al., *Disease surveillance at district level: a model for developing countries.* 1998. **352**(9121): p. 58-61.

33. Gauci, C., et al., *General practitioners role in the notification of communicable diseases-study in Malta.* 2007. **12**(11): p. E5-6.

34. Trottier, H., H. Carabin, and P.J.R.d.e.e.d.s.p. Philippe, *Measles, pertussis, rubella and mumps completeness of reporting. Literature review of estimates for industrialized countries.* 2006. **54**(1): p. 27-39.

35. Abdulrahim, N., et al., *Knowledge, Awareness, and Compliance of Disease Surveillance and Notification Among Jordanian Physicians in Residency Programs.* Inquiry, 2019. **56**: p. 46958019856508.

36. *Integrated Disease Surveillance Program, State Health Society Bihar, 2019; Available at:* http://statehealthsocietybihar.org/idsp.html.

37. *Bihar State Profile. Government of Bihar.* http://gov.bih.nic.in/Profile/default.htm.

38. Phalkey, R.K., et al., *Assessment of the core and support functions of the Integrated Disease Surveillance system in Maharashtra, India.* BMC Public Health, 2013. **13**(1): p. 575.

39. *Community Health Workers. What we know about them?. World Health Organization. January 2007.* https://www.who.int/hrh/documents/community_health_workers.pdf.

40. Bhombe, I., et al., *Time-motion study of auxiliary nurse midwives of a primary health center from Wardha District of Maharashtra.* International Journal of Advanced Medical and Health Research, 2019. **6**(1): p. 18.

41. Organization, W.H., *Community case management during an influenza outbreak: a training package for community health workers.* 2011.

42. Organization, W.H., *Infection-control measures for health care of patients with acute respiratory diseases in community settings: trainer's guide*. 2009, Geneva: World Health Organization.

43. Miller, N.P., et al., *Community health workers during the Ebola outbreak in Guinea, Liberia, and Sierra Leone.* J Glob Health, 2018. **8**(2): p. 020601.

44. Ruckstuhl, L., et al., *Malaria case management by community health workers in the Central African Republic from 2009-2014: overcoming challenges of access and instability due to conflict.* Malar J, 2017. **16**(1): p. 388.

45. Topp, S.M., et al., *Motivations for entering and remaining in volunteer service: findings from a mixed-method survey among HIV caregivers in Zambia.* Hum Resour Health, 2015. **13**: p. 72.

46. Malaviya, P., et al., *Village health workers in Bihar, India: an untapped resource in the struggle against kala-azar.* Trop Med Int Health, 2013. **18**(2): p. 188-93.

47. Kay, A., *THe role of the laboratory in disease surveillance.* 1996.

48. Masanza, M.M., et al., *Laboratory capacity building for the International Health Regulations (IHR[2005]) in resource-poor countries: the experience of the African Field Epidemiology Network (AFENET).* BMC public health, 2010. **10 Suppl 1**(Suppl 1): p. S8-S8.

49. NCDC. *LABORATORY STRENGTHENING*. Available from: https://idsp.nic.in/index1.php?lang=1&level=1&sublinkid=5788&lid=3721.

50. Nkengasong, J.N., et al., *Laboratory systems and services are critical in global health: time to end the neglect?* Am J Clin Pathol, 2010. **134**(3): p. 368-73.

51. Allen, A., S. Allen, and N.J.H.O.C. Olivieri, *Improving laboratory and clinical hematology services in resource limited settings.* 2016. **30**(2): p. 497-512.

52. Wilson, M.L., et al., *Access to pathology and laboratory medicine services: a crucial gap.* 2018. **391**(10133): p. 1927-1938.

53. Iyer, V., et al., *Laboratory Capacity for Surveillance of Infectious Diseases in Gujarat: Quantity, Quality, Effects and Way Forward.* 2019. **11**(07): p. 998.

54. *The WHO India Country Cooperation Strategy 2019–2023: a time of transition. World Health Organization. 2019. Available at:* https://www.who.int/india/country-cooperation-strategy-2019-2023

55. Huotari, P. and Z.J.I.j.o.h.c.q.a. Havrdová, *Stakeholders' roles and responsibilities regarding quality of care.* 2016.

56. Brugha, R., Z.J.H.p. Varvasovszky, and planning, *Stakeholder analysis: a review.* 2000. **15**(3): p. 239-246.

57. Kaur, P., et al., *Perceptions of State Government stakeholders & researchers regarding public health research priorities in India: An exploratory survey.* 2014. **139**(2): p. 231.

58. Gilliam, A., et al., *The value of engaging stakeholders in planning and implementing evaluations.* 2002. **14**(3 Supplement): p. 5-17.

59. Wheelock, A., et al., *Views of policymakers, healthcare workers and NGOs on HIV pre-exposure prophylaxis (PrEP): a multinational qualitative study.* 2012. **2**(4): p. e001234.

60. Waweru, E., et al., *Stakeholder perceptions on patient-centered care at primary health care level in rural eastern Uganda: A qualitative inquiry.* 2019. **14**(8).

61. Tarkkanen, K., P. Reijonen, and V.J.T.R.o.O.i.t.C.o.C.S. Harkke, *Roles and Identification of Stakeholders in Health Care IS Development.* p. 361.

62. Dansky, K.H., L.S.J.J.o.h.o. Gamm, and management, *Accountability framework for managing stakeholders of health programs.* 2004.

63. Olander, S., A.J.C.m. Landin, and economics, *A comparative study of factors affecting the external stakeholder management process.* 2008. **26**(6): p. 553-561.

64. Akhlaq, A., et al., *Barriers and facilitators to health information exchange in low-and middle-income country settings: a systematic review.* 2016. **31**(9): p. 1310-1325.

65. Aluttis, C., T. Bishaw, and M.W.J.G.h.a. Frank, *The workforce for health in a globalized context–global shortages and international migration.* 2014. **7**(1): p. 23611.

66. Bhattacharyya, S., et al., *"Neither we are satisfied nor they" - users and provider's perspective: a qualitative study of maternity care in secondary level public health facilities, Uttar Pradesh, India.* 2015. **15**(1): p. 421.

67. Gautham, M., et al., *District decision-making for health in low-income settings: a qualitative study in Uttar Pradesh, India, on engaging the private health sector in sharing health-related data.* 2016. **31**(suppl_2): p. ii35-ii46.

68. Morgan, M.C., et al., *Barriers and facilitators to the provision of optimal obstetric and neonatal emergency care and to the implementation of simulation-enhanced mentorship in primary care facilities in Bihar, India: a qualitative study.* 2018. **18**(1): p. 1-14.

69. Nair, M., et al., *Refused and referred-persistent stigma and discrimination against people living with HIV/AIDS in Bihar: a qualitative study from India.* 2019. **9**(11).

70. Rai, S.K., et al., *Determinants of utilization of services under MMJSSA scheme in Jharkhand' Client Perspective': a qualitative study in a low performing state of India.* 2011. **55**(4): p. 252.

The Centre for Health Policy
Asian Development Research Institute
BSIDC Colony, Off Boring-Patliputra Road, Patna-800013, India
Phone: +91-612-2575649 | Fax: +91-612-2577102
Email: chp@adriindia.org | Web: www.adriindia.org