Improving Notification of Tuberculosis through Development of a Mandatory Notification Tool and Reporting System

February 2019

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CHALLENGE TB

Acknowledgements

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Acronyms

ACSM	advocacy, communication, and social mobilization
API	application programming interface
BRAC	Bangladesh Rural Advancement Committee
CTB	Challenge TB
DOTS	directly observed treatment, short course
FAQ	frequently asked question
GPS	global positioning system
HIV	human immunodeficiency virus
icddr,b	International Centre for Diarrhoeal Disease Research, Bangladesh
IEC	information, education and communication
MN	mandatory notification
MSH	Management Sciences for Health
NTP	National TB Control Program
PP	private practitioner
SMS	short message service
SOP	standard operating procedure
TB	tuberculosis
USAID	US Agency for International Development

Summary

The estimated incidence of 10.0 million and death of 1.3 million in 2017 keeps tuberculosis (TB) a worldwide concern. A considerable number of cases were missing, including undiagnosed and unreported TB cases, likely because of private health care providers (1, 2). In 2017, 33% of cases were missing cases with an estimated overall incidence of 221 and death of 36 per 100,000 (2). Bangladesh belongs to both groups of 30 high-burden countries for TB and multidrug-resistant TB.

Like many other diseases, the practice of TB notification is not common worldwide. TB notification became mandatory in Bangladesh in 2014. However, the first practical tool for TB notification did not become available until early 2019. Until then, it was a missed opportunity for the private sector to adhere to the standards of TB care and mainstreaming the estimated missing volume of TB cases.

On the basis of a survey in 2016 for operationalizing mandatory notification (MN) and feedback received from key stakeholders, a cross-platform application was developed in 2018 by the International Centre for Diarrhoeal Disease Research, Bangladesh (icddr,b). USAID's Challenge TB (CTB) Project, implemented by Management Sciences for Health, funded the initiative and the National TB Control Program (NTP) endorsed piloting the tool in Dhaka city. The app became available in android, iOS, and web platforms intended for private physicians, their assistants, and directly observed treatment, short course (DOTS) providers. Prior to the launch of the app, health providers conducted a field trial to understand and fine-tune the role of DOTS after TB notification.

For understanding and orientation of key end users, a series of trainings were arranged in early 2019. To ease use of the app, information, education, and communication (IEC) materials (a brochure, leaflet, and sticker) were developed. An operational manual targeting stakeholders, including NTP, and standard operating procedures (SOP) covering all users' perspectives and another system document were drafted to cover technical aspects of development and maintenance of the app.

A total of 334 doctors, 292 doctor's assistants, and 112 DOTS personnel attended the MN application orientation and training program. After two years in development and because of active participation by NTP and other stakeholders, potential users welcomed the arrival of the notification system.

The orientation seminars ended on February 15, 2019, and the project ended on February 28. This left the team with only 13 days to follow up; 42 physicians notified 75 patients within that period. Although one application cannot be expected to capture all the missing cases from the private sector, early observations show that such interventions can start a positive momentum that can increase notification.

Much practical feedback was noted from users and stakeholders to incorporate and fine-tune the system for scaling up in the near future. For example, contact information for DOTS personnel was not available in the NTP annual report and website. This information will be very helpful for tracking DOTS implementation of TB MN. This can also be helpful for doctors and patients for choosing the right location for DOTS for treatment or referral. After overcoming various challenges and limitations of this small-scale piloting, the application is expected to be scaled up gradually to a broader group of users in the near future.

Introduction

TB now ranks alongside HIV as a leading cause of death worldwide. In 2017, an estimated 10.0 million people developed TB, and 1.3 million died from the disease (1, 2). Bangladesh is both a high-burden TB country and a low- and middle-income country, with a population of 165 million. Bangladesh is also one of the 30 high multidrug-resistant TB-burden countries per the World Health Organization's 2018 report. The incidence of TB (all forms) is estimated at 221 per 100,000 population per year, and TB mortality is estimated at 36 per 100,000 population per year (2).

One of the major hurdles in the fight against TB is the sheer number of missing TB cases worldwide. Missing cases constitute both undiagnosed and unreported cases. A significant portion of TB cases is managed in the private sector in many parts of the world (3). The recently published report of the National Tuberculosis Prevalence Survey, Bangladesh 2015-2016, also showed that a significant portion of TB cases sought care from the private sector. Notification from this sector is largely unregulated in Bangladesh. The survey also found that the infection is more prevalent among the urban population– 334 compared to 274 in rural areas, which apparently validates the long-held criticism of the government's urban health programs run by the local government authority (4).

MN of TB started as early as the start of the twentieth century in some parts of the world (5). However, it was not common in this part of the subcontinent, and it started very recently in neighboring countries with a similar TB burden (6). This collaboration of public and private sectors has contributed to better case notification as well as improving TB treatment outcome (6, 7). It has been recommended worldwide that ensuring proper notification of cases being managed in the private sector and collaborating with them to ensure proper management of cases are essential to improving the TB situation (6, 8).

The Government of Bangladesh declared TB as a notifiable disease in January 2014. It became mandatory that all public and private health care providers inform the NTP when someone is diagnosed with TB. Although it has been five years since TB was declared a mandatory notifiable disease, the tools and system for MN have not yet been deployed. We are still unable to notify all TB patients that have been identified by private facilities, as we do not yet have a notification system in place. This MN declaration has provided an opportunity to support the private sector in adhering to standards of TB care, which includes helping patients with the right diagnosis, treatment, follow-up, contact tracing, and linkages to social support systems and monitoring disease trends.

Although strategic guidance and operational manuals, including infectious disease notification policies, eHealth standards, interoperability guidelines, and SOPs, are available in the country, reporting of notifiable diseases remains largely voluntary. Without clear operational guidelines for enforcement of mandatory TB case notification, enactment of the MN policy by all health care providers is not possible. These operational guidelines should include a defined time limit for notification, simple notification tools for confidential reporting, and penalties for noncompliance. Therefore, in addition to building easy, digitalized solutions by leveraging the ever-growing mobile phone sector and the nation's progress toward digitalization, additional enablers are needed for mitigating the barriers and making the environment conductive to ensure sustained private sector engagement in MN of TB. In this regard, the national task force will play a pivotal role by providing the strategic guidance to operationalize MN.

In 2016, a survey among private practitioners (PPs) on operationalization of TB MN in Bangladesh was conducted by icddr,b with funding support from CTB Bangladesh . A significant number of private PPs from Dhaka, Sylhet, and Narayangonj were included. About two-thirds of them reported that they were aware of the government declaration on TB MN. However, any defined mechanism for when,

how, or to whom to notify was not available. More than half of them preferred short message service (SMS) or a smart phone application to any other methods for TB notification. More than 90% of the PPs had smart phones , and more than 80% had a cellular or other internet connection. Ultimately, subsequent initiatives led to the current small-scale piloting, resulting in development of a cross-platform smart phone application.

The small-scale piloting was initiated through a CTB fixed price contract (CTB BD-FPC-17-003) to icddr,b. Amendment no. 1 stipulated that activities start in January 2018, including preparation and a field trial before piloting and finalizing the digital application and developing supporting documents. Amendment no. 2 stipulated getting NTP's feedback and endorsement for implementation of the project, i.e., piloting the MN app, including orientation for 500 PPs, their assistants, and DOTS providers.

Small-Scale Piloting in Focus

The first step was development of a cross-platform application that can be accessed or operated through android, web, and iOS platforms. The choice of digital platform was based on a 2016 survey on MN conducted by icddr,b with funding from USAID's CTB Project. Further considerations were made based on rising internet and smart phone use among the population in Bangladesh and how quick and easy it is to notify a TB patient using a smart phone application. Although a smart phone may be perceived as a small digital tool for users, the overall mechanism of notification deserves a systems thinking approach to be inclusive of all stakeholders, partners, and users who will be involved at different levels. This small-scale piloting was just a hint of the potential of the system. Further evolution will come as the system, its digital components, and all stakeholders mature in using it as an effective tool for TB notification. The crucial point for sustainability for the application or system will be the engagement of end users, vis a vis, health providers or their assignees. As a beginning, the enthusiasm and involvement inspired future development and promotion of the system within a broader group of users.

The piloting was carried out only in Dhaka among 500 graduate PPs, including their assistants. They were oriented on the application and trained to start and continue to notify the TB patients they diagnosed; they also communicated with the development team as necessary, e.g., mobile phone call, SMS, or email for any difficulties with or troubleshooting the application.

Many other supportive resources are found in the web application, which is accessible through a computer or mobile using any common browser. Resources include, but are not limited to, frequently asked questions (FAQs) in English and Bengali; a list of DOTs centers in Dhaka, including interactive distribution maps that can direct a user to the kind of services s/he is looking for; and a convenient user panel that enables direct queries through the web application interface.

To develop the system from just a seed to a visible outcome, an engaged and dedicated team at icddr,b worked throughout the project period. To solve many of the challenges, CTB collaborated with icddr,b for a strong advocacy within NTP to make it successful. All other stakeholders and partners were included at the very early stages to achieve better contribution and feedback for establishing a potential and successful TB MN system. NTP, under the Directorate General of Health Services of the Ministry of Health and Family Welfare, initiated the MN system in Bangladesh and acted as steward throughout the project. The NTP engaged different partners with a long history of working with TB programs, including the Bangladesh Rural Advancement Committee (BRAC), Damien Foundation, and other nongovernmental organizations. The overall mechanism was conceptualized by icddr,b, and CTB nurtured it to a successful completion. At CTB's request, icddr,b took on the role of initiating, hosting, developing, and fine-tuning the application, involving all stakeholders to push the MN system into place. Because of the positive response from stakeholders and leadership to the successful pilot, the MN system will be scaled up in all divisions and districts in next or later phases.

Activities during the preparation phase

Development of the Application (Android/Web/iOS)

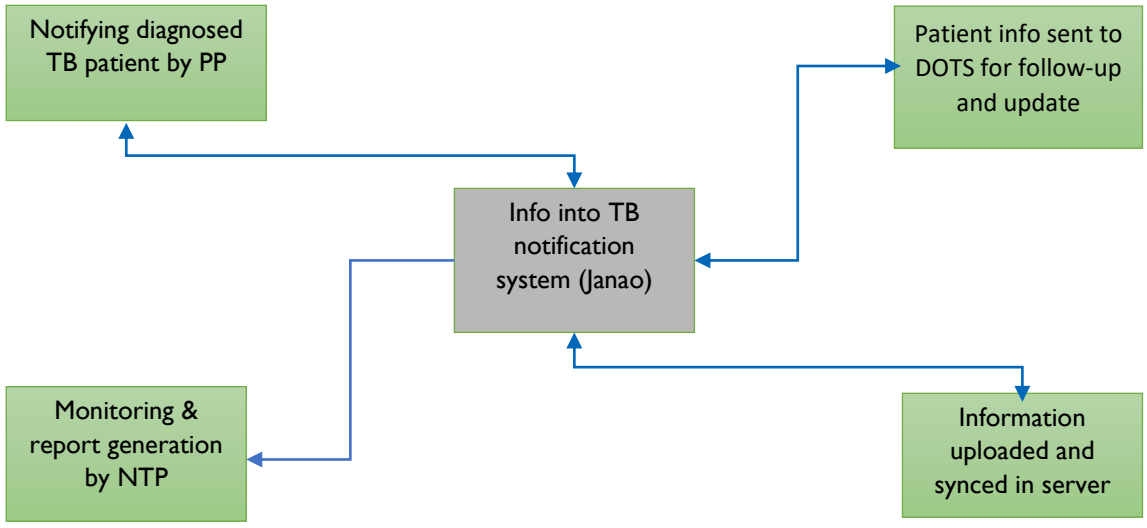
The name proposed for the application (annex 1) was "Janao," meaning "to inform" in English. The alpha and beta versions were reviewed and tested by the software development team, including revisions by the CTB and icddr,b project teams playing different roles with the beta version. All bugs were corrected, and any issues appearing from the users' point of view were settled accordingly. The stable version was uploaded to Google Play Store and Apple App Store. For that purpose, independent accounts were secured with necessary payments to respective stores by project initiative.

Another variation of the application with substantial features was also deployed on the web and hosted through by the icddr,b IT team on a secure server dedicated to MN. All data generated by any platform of the application will be stored on the server. A summary of the current status of notifications by different indicators is accessible as a dashboard in the web version.

SMS-Based Inputs

To be inclusive for all kind of users, the system was designed with maximum flexibility according to the principles of human-centered design. However, to date, many DOTS users and doctors' assistants do not have smart phones in the workplace. An interim way to notify TB patients through SMS was designed. Inputs through structured SMS were fed into the app through the application programming interface (API). However, unlike the app, notification through SMS has limitations; it cannot include all the information that the app usually can. For the tenure of this project, the icddr,b field team mitigated this gap when they followed up notified patients by introducing a technical calibration addressing each specific reported issue.

MN System Flow Chart



Preparation of Necessary Documents

A new system needs good stewardship to begin and convenient tools to engage users. MN of TB through digital tools is a new concept in Bangladesh. As part of nurturing the system for stakeholders and users, necessary documents were produced. The documents drafted were approved by the CTB Bangladesh and are expected to be national documents endorsed by NTP.

Operational Manual

An operational manual was developed as a strategic document to guide NTP to establish the TB MN system in Bangladesh. It covers how to use the system and basic definitions required for TB notification. An outline of the information flow from end users to the central server (and vice versa) to complete the notification pathway was also included. As a whole, this document briefly describes the goals, objectives, potential system features, roles of the different stakeholders, monitoring, and routine reporting.

Standard Operating Procedure

An SOP including a step-by-step quick-access guide (annex 2) was prepared to guide users through all the features of Janao. Based on the feedback from potential users and discussion with all stakeholders, the document was customized and made convenient for all to use. In general, this document focuses on different levels of users with different roles and accessibility and provides them with instructions on how to use the application through the mobile or web version.

Documentation of System Development

A technical document was compiled, including system requirements, data flow diagram, use cases, source codes, and API documentation, to encompass the functional requirements to run the application, compatibility of the application for different platforms, tables on different user roles based on access to different features, hardware, runtime environments, etc. This document also includes security, portability, and other attributes to maintain the application.

Development of IEC Materials

To popularize the MN system and the application, advocacy, communication, and social mobilization (ACSM) activities were included as an integrated part of the orientation and training programs. The field team also visited the target population multiple times to convey information on the developing system and the earlier initiatives to support such a system, i.e., published gazette declaring TB as a MN disease. Several IEC materials (annex 3) were prepared to conduct ACSM activities.

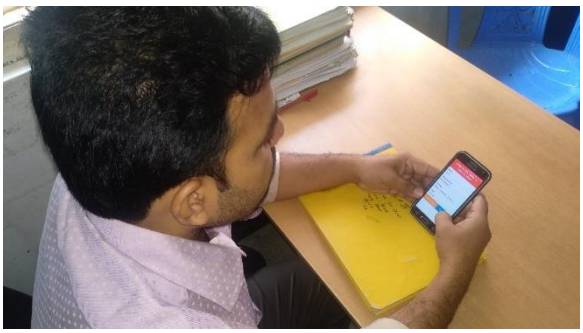
A brochure was developed after multiple revisions by icddr,b and the CTB team. It includes key information on values of TB notification, the role of the doctor in TB notification, a brief intro on the Janao application, and contacts and links to access and use the application. The brochure also serves as key material for the user, including a graphical flow chart that portrays different steps of the mobile app usage from downloading to patient notification.

In addition, a leaflet containing key information on the value of the app in notifying TB and links to download it were developed and distributed among users at different levels. A sticker listing the contacts and links for any kind of assistance in using the app was also developed and provided to intended users.

Activities done during the execution phase

Field Trial of the Application in 10 Selected DOTS Centers

After development of the application, the first step in testing its performance was to enter details of test TB patients through SMS and get feedback from the staff of the 10 selected DOTS centers. A combined team of NTP, CTB, icsddr,b, and BRAC notified test TB patients and recorded responses from the DOTS centers through frequent visits and close interactions. All feedback was noted and addressed accordingly. The latest version of the application thus emerged for piloting among the graduate PPs, their assistants, and all DOTS providers in Dhaka city.



DOTS staff field-testing the app

Challenges Faced/Addressed/Perceived from the Field Trial of 10 Selected DOTS in November 2018

Operational Perspectives Handled During the Trial

Sl.	Challenges	How they were addressed
1	Delay in DOTS (other than BRAC DOTS) receiving official information about this trial	They later received the information. All participating DOTS cooperated during training and they responded to the received TB case information by SMS or app.
2	DOTS personnel enrolled two notified TB cases by mistake, before communicating with the patients	The system was oriented to DOTS personnel again, after which the intended response was obtained.
3	Cost of SMS sent by the MN application and cost of SMS/data for DOTS personnel to respond	Currently the cost of the MN application is managed by the project and the cost at DOTS was managed by monthly allocation for internet at DOTS centers.
4	In two cases, DOTS personnel did not return phone calls after the patient asked them to call back later	Staff need to become familiar with a new system and practice with it after training. Overall response by the DOTS personnel was excellent.
5	Tracking multiple notified TB cases after a while as the list of cases grows	A color responsive tracking for different disposals of the notified cases would facilitate the process.
6	Define response time for DOTS personnel to contact the notified TB case for counselling and inviting them to enroll or giving them a referral to another DOTS; that is to be agreed over phone with the patient	Needs further discussion among stakeholder
7	Some DOTS personnel not interested in sharing information of any DOTS run by other partner organizations that may be more convenient to patients	

Technical Perspectives Handled During the Trial

Sl.	Challenges	How they were addressed
1	TB cases were notified to go to a distant DOTS rather than to one near the patient.	More accurate linking to DOTS was worked out technically. In addition, an option is being added so that the doctor can suggest a DOTS location when the patient is notified. GPS coordinates will be used to track all the DOTS.
2	Multiple SMS were sent to the DOTS for the same TB case notified.	Technical calibration done to address the issue.
3	Lack of visibility of some button for a specific android handset model.	
4	In a few cases, an error message appeared when the sync/send button was tapped after entering TB case information.	This was a technical error that was rectified in the subsequent version of Janao.
5	Observation by the admin: a filtering option to get a list of TB cases notified by date.	A filtering option in the application can be applied for the purpose of using excel. Further custom filtering options are being worked out.

More Broader Perspectives to Address in the Long Run

Sl.	Challenges	How they were addressed
1	Lack of android device for daily office use at DOTS	Staff were very cooperative in using the application on their personal android mobile. Some of them collaborated with their colleagues who have a personal android mobile. We are working on a mechanism so DOTS personnel can respond through SMS.
2	Lack of fixed mobile no. for daily office use at DOTS	A policy-level initiative is needed to facilitate implementation of MN in Bangladesh.
3	Lack of unique identifier for all DOTS	
4	Lack of DOTS/DOTS personnel contact information in the list in the NTP annual report	This will be very helpful to track DOTS for implementation of TB MN. This can be helpful for doctors and patients to choose the right DOTS location when treatment or referral is needed.
5	Lack of easily available DOTS information from NTP website	

Orientation and Training of End Users

After consultation and discussion with NTP, a series of orientation and training programs were arranged in different locations and venues for health care providers. Eighteen events were organized starting from the end of January to the third week of February 2019. Doctors were engaged through ten sessions and another five were organized for assistants. An additional three sessions were held at NTP to train DOTS personnel. The following tables summarize participation in orientation and training programs.

Table 1 Number of doctors attending MN orientation and training

Serial	Date (2019)	Number of doctors invited	Number of doctors that attended the event		Spot registration on the app
			Male (83%)	Female (17%)	
1	Sat, Feb 2	64	24	4	21
2	Sun, Feb 3	73	45	4	31
3	Mon, Feb 4	52	29	6	29
4	Tue, Feb 5	44	26	3	26
5	Wed, Feb 6	35	5	4	9
6	Sat, Feb 9	47	17	4	24
7	Sun, Feb 10	119	57	10	52
8	Mon, Feb 11	81	32	7	32
9	Tue, Feb 12	72	33	8	28
10	Thu, Feb 14	44	10	6	13
	Total	631		Total = 334	265

Table 2 Number of assistants attending MN orientation and training

Serial	Date (2019)	Number of assistants invited	Number of assistants that attended the event		Spot registration on the app
			Male (69%)	Female (31%)	
1	Fri, Feb 1	80	62	15	25
2	Fri, Feb 8	65	39	23	13
3	Fri, Feb 8	51	21	20	15
4	Fri, Feb 15	69	43	12	17
5	Fri, Feb 15	68	37	20	19
	Total	333	Total = 292		89

Assistants at MN training

Table 3 Number of DOTS personnel attending MN orientation and training

Serial	Date (2019)	Number of DOTS representatives invited	Number of DOTS personnel that attended		Spot registration on the app
			Male (62%)	Female (38%)	
1	Tue, Jan 29	37	19	13	21
2	Wed, Jan 30	34	30	12	29
3	Thu, Jan 31	31	21	17	22
	Total	102	Total = 112		72

DOTS personnel attend training in Dhaka

Key Findings from Piloting MN System

The orientation seminars ended on February 15 and the project period ended February 28, 2019. This left us with only 13 days of follow-up; 42 physicians notified 75 patients within that 13 days. Although it cannot be expected that one application will capture all the missing cases from private sector, early observations show that such interventions can start a positive momentum toward increasing notification from the private sector.

From the orientations and exchanges among the stakeholders, icddr,b came up with the following list of recommendations to improve the app:

- Incorporating the Bangladesh Medical and Dental Council's registration number for doctors' enrollment
- Including the national identification number at the DOTS end, which is now available at the doctors' end
- Customizing the dashboard to the needs of different users/roles
- Customizing program/technical/help admin roles; follow-up and modifications within the software are intended for different admin roles
- Creating a systematic approach for managing duplicate patients including a trash/bin and using flag/mark for notifications
- Updating patient ID structure with the same number of digits
- Re-ensuring that the android/web/apple versions have matched terminologies and structural orientation, if not indicated otherwise
- Debugging the problems faced during orientations, e.g., delay/fail in loading the app database at first use, delay in getting a PIN, app does not scroll when attempting notification, app fails in versions of iOS/android, etc.
- Adding the name of a notified patient's father or mother , which will be helpful for managing duplication (this suggestion came from a doctor)
- Providing a hard copy form for doctors and assistants to ease notification through the app (also suggested by doctors)

This is to note that the project contract ended within two weeks of completion of the orientations and there was not enough time to incorporate these findings into Janao. However, following the transition plan of the MN system, these will be valuable to incorporate in the later iteration of the MN system for scaling up among larger populations and in more locations.

Key challenges

One of the key challenges was dealing with delays in conducting activities due to unavoidable challenges. This was fueled by changes in leadership at NTP and the general election in Bangladesh within the project period. The short amount of time to arrange orientations and trainings was the most problematic—doctors were invited with a very short notice, often much less than a week. The same limitation caused the team to conduct activities without a formal task force/dissemination meeting and led to several amendments of the project period. Leveraging the limitations ultimately became fruitful and all deliverables were achieved as per the contract's third amendment.

Limitation using the application

The application is now fully functional with all planned features. However, only a limited number of doctors and assistants from a limited number of locations in Dhaka city were engaged. The current version includes only DOTS within Dhaka, and hence any patients from outside Dhaka who prefer to get treatment in their vicinity cannot be referred to any DOTS outside Dhaka. This will be overcome by integrating all DOTS in the app over time.

Transition plan for the near future

Considering the completion of this small-scale pilot and the enthusiasm exhibited among users and stakeholders, a potential plan is to scale up the MN system and include more users in Dhaka and other divisional headquarters. This needs another project to evolve, new plans, new donors, new/larger team, and new people to be involved. The developed application and the experiences gained initiating the MN system and conducting the field trial and pilot among the health providers are the remaining capital until new funds are allocated for initiating a scale-up project. The icddr,b team is in regular communication with potential donors for this scale-up project. The NTP hierarchy is also highly interested and is engaged in discussions on scaling up this application. The developed system and knowledge is safe within the hands of the implementation team right now, and the icddr,b is committed to handing over the entire system to NTP when they are ready to maintain it and have secured sufficient resources for doing so.

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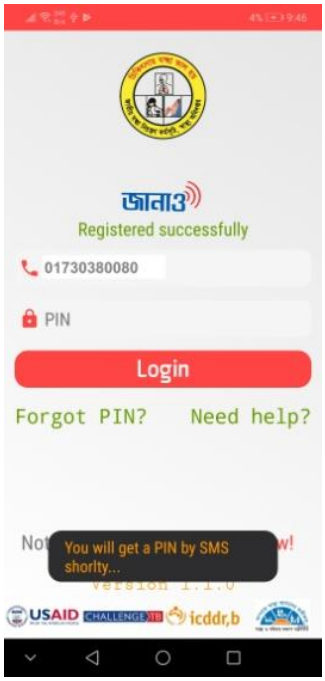
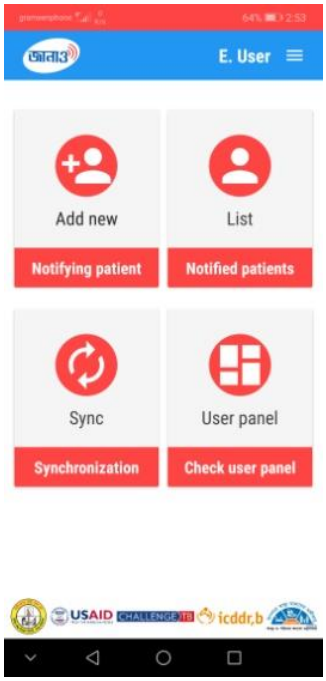
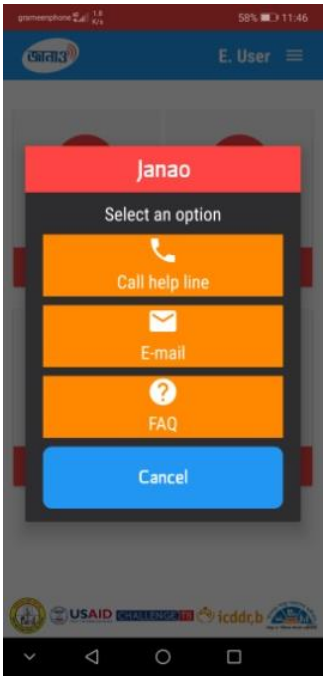
Annex 1. Introductory application screens

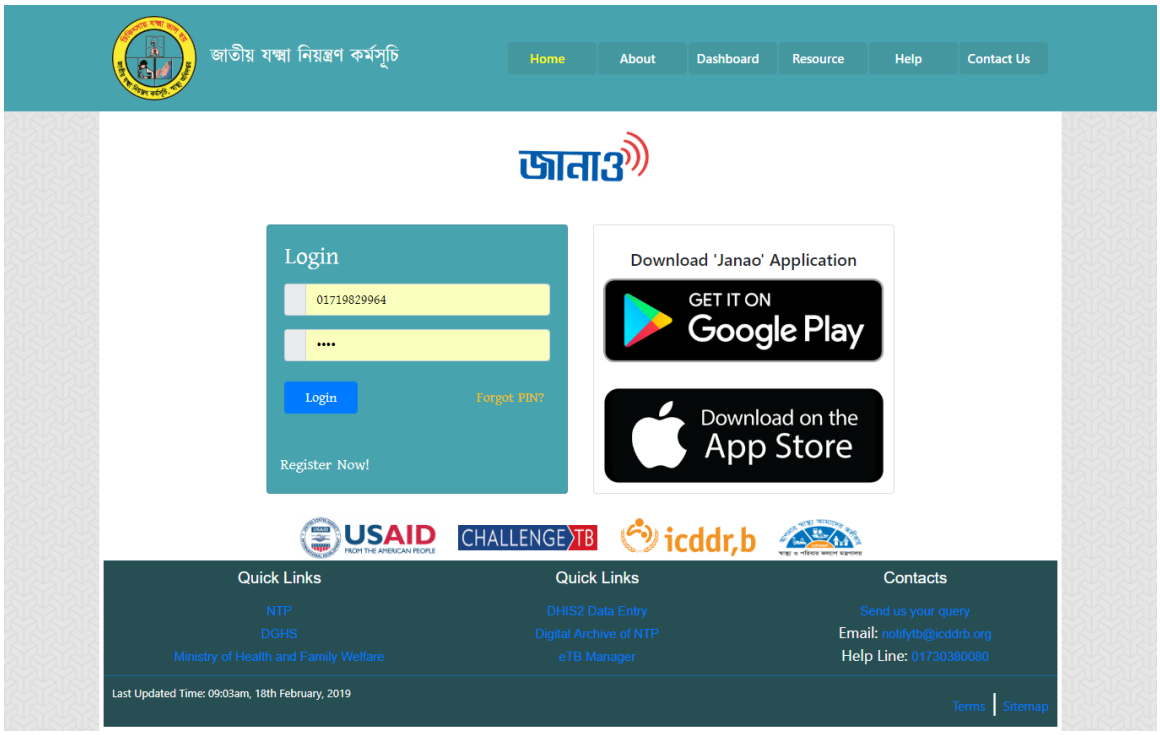
For mobile





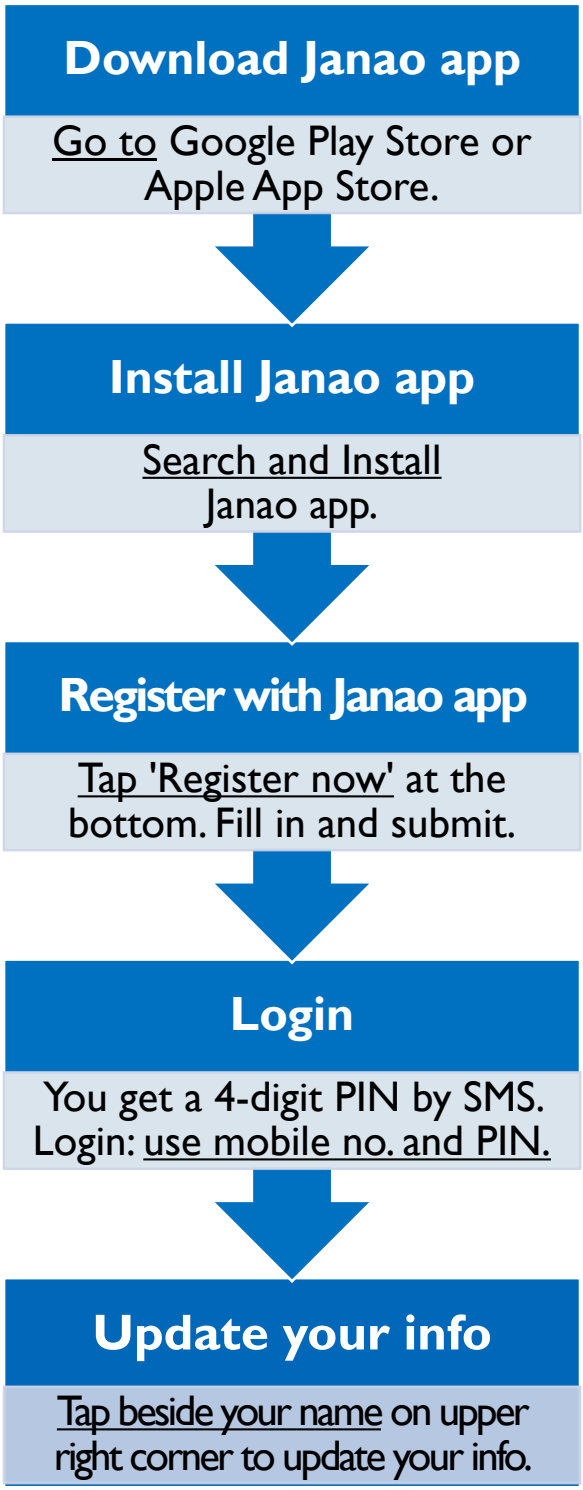


For web

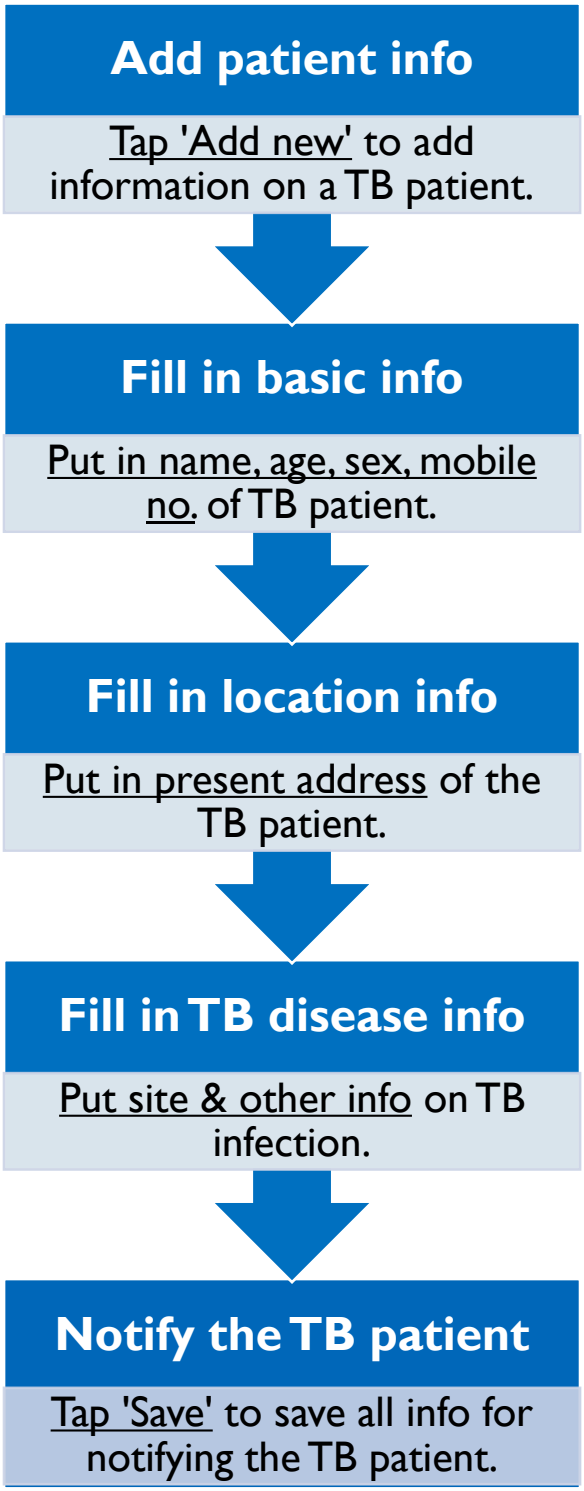


Annex 2. Janao App Quick Access Guide

Registering with the app



Notifying TB patients



Getting your feedback

See list of notified patients

- Tap 'List' to see notified patient list. Tap any patient to see details.

DOTS enrollment feedback

- For each TB patient enrolled in DOTS, you will get an update by SMS.

Seeking Help

- Tap upper right menu & 'Help': call/SMS, email, or use FAQs.

Check user panel

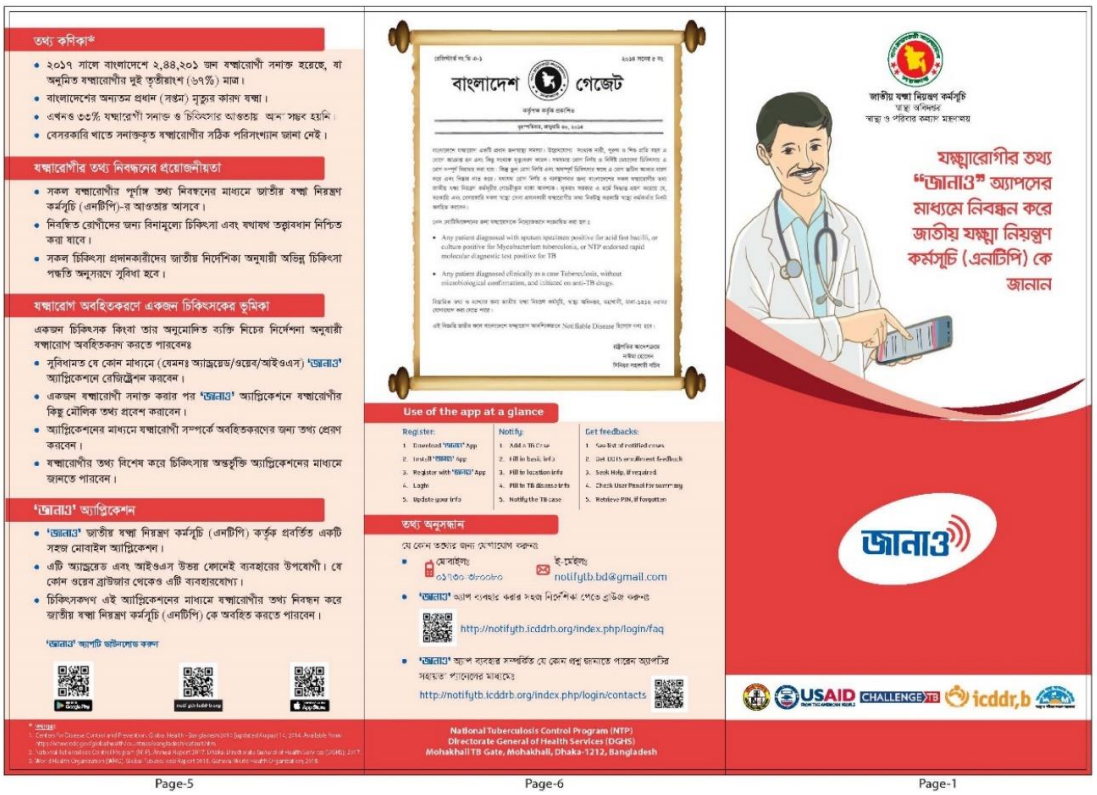
- See summaries on notified TB patients according to time & type.

Retrieve PIN

- If you forgot PIN, tap 'Forgot PIN' on left to get PIN by SMS.

Annex 3. IEC materials

Brochure



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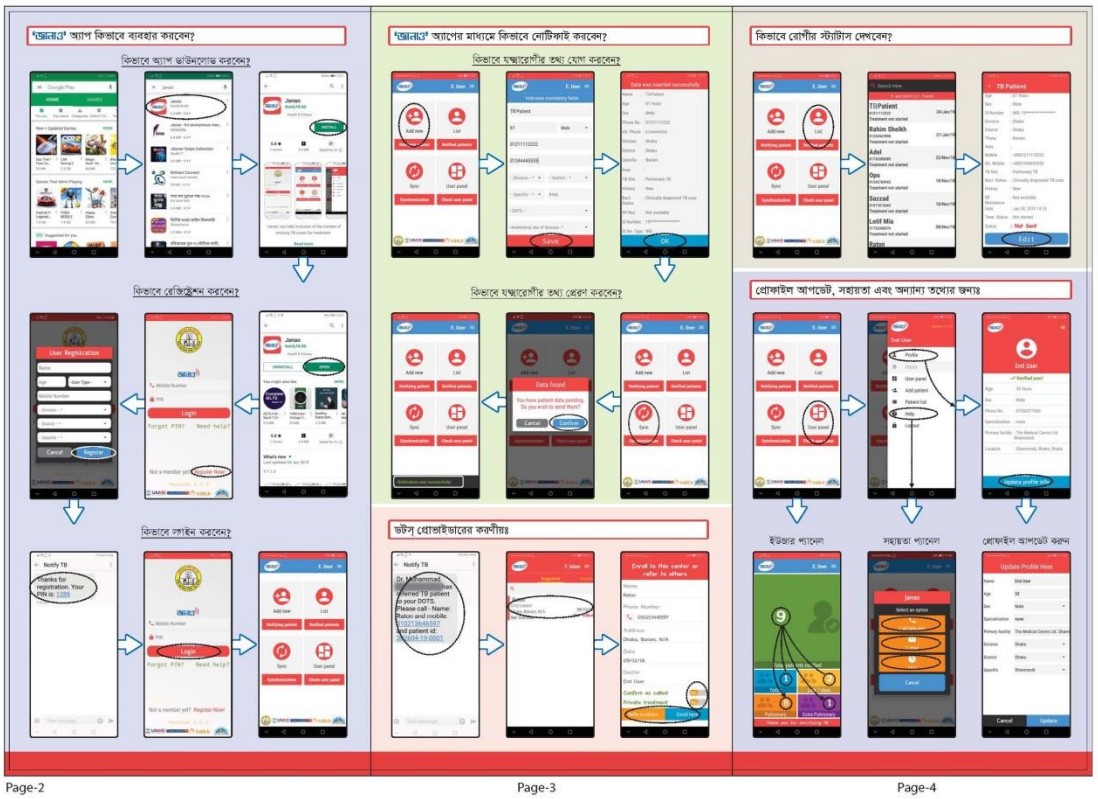

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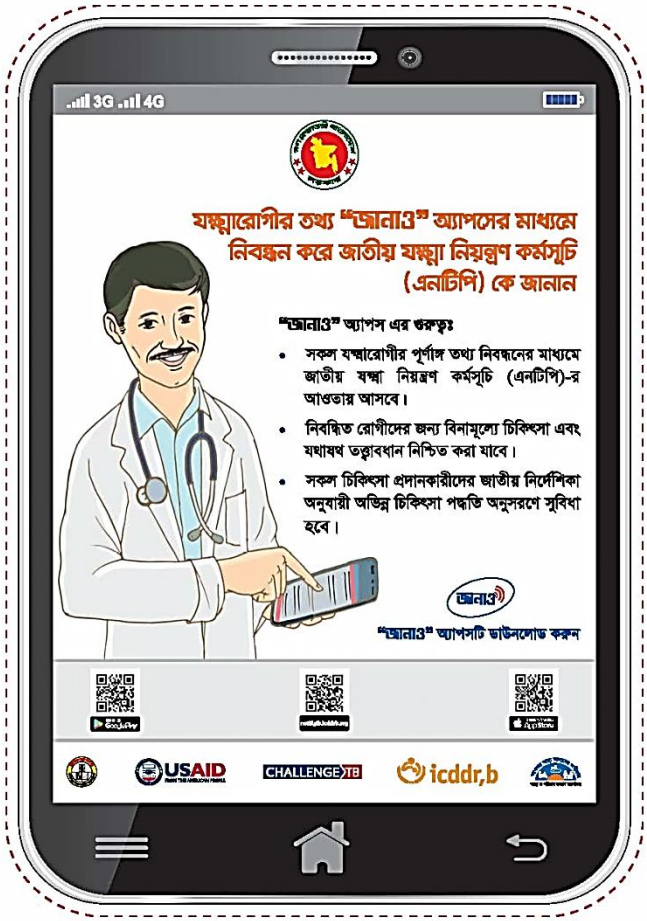
Leaflet and sticker