STUDY REPORT

ON

Introducing Standardized Register for Strengthening the Inpatient Management of Newborn and Sick Children: Implementation Research in Selected Health Facilities of Bangladesh

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Acronyms

PNC	Postnatal Care
OT	Operation Theatre
SUS	System Usability Scale
TAM	Technology Acceptance Model
NICU	Neonatal Intensive Care Unit
ANOVA	Analysis of Variance
KPI	Key Performance Indicator
DGHS	Directorate General of Health Services
IMCI	Integrated Management of Childhood Illness
SDG	Sustainable Development Goal
DHIS2	District Health Information Software 2
NNHP	National Newborn Health and IMCI Programme
icddr,b	International Centre for Diarrhoeal Disease Research, Bangladesh

Introduction

According to the Bangladesh Demographic and Health Survey, Bangladesh has made significant strides in reducing its under-five mortality rate from 48 deaths per thousand live births to 31 deaths per thousand live births between 2011 and 2022. Despite this progress, around 80,000 children under the age of five still die each year in Bangladesh. The majority of these deaths are preventable and occur due to causes such as pneumonia, serious infections, prematurity and low birth-weight, and intrapartum related complications. Nearly two-thirds of these deaths occur within the first 28 days of life

To address this issue, the Government of Bangladesh has implemented the World Health Organization's recommended "Integrated Management of Childhood Illness (IMCI)" approach for outpatient management of childhood illnesses and the "WHO Pocket Book for Hospital Care of Children" to enhance inpatient management. Additionally, Bangladesh has scaled up highly effective evidence-based interventions targeting major causes of under-five deaths. These interventions include immediate newborn care and helping babies breathe for birth asphyxia, administration of antenatal corticosteroid for suspected preterm labor, Kangaroo Mother Care for preterm and low birth-weight babies, administration of injectable antibiotics for serious infections, and establishment of Special Care Newborn Units (SCANUs) for critically ill newborns. Despite these efforts, accelerated action is required from the government to achieve the highly ambitious Sustainable Development Goal (SDG) target of reducing the under-five mortality rate to below 25 deaths per thousand live births and newborn mortality rate to below 12 deaths per thousand live births by 2030.

Improved documentation practices can play a significant role in monitoring disease, exploring healthcare delivery patterns, and generating practical evidence of medical care and service delivery models' impact on children. Strengthening the patient record system and documentation flow can improve the quality of care in a health facility. A combined health systems approach and timely provision of quality inpatient care, identifying those at high risk, and recording and reporting clinical data can save many lives and prevent morbidity.

The Government of Bangladesh has introduced service registers in corners related to newborn and child care, such as postnatal care (PNC) corner, Integrated Management of Childhood Illness (IMCI) corner, labour ward and operation theatre (OT), Special Care Newborn Units (SCANUs), and Kangaroo Mother Care (KMC). Monthly reports are generated from these service registers and are submitted to DHIS2. However, there is no dedicated service register or monthly reporting form in the pediatric inpatient department. Acknowledging this, the National Newborn Health and IMCI programme (NNHP & IMCI programme) of the Directorate General of Health Services (DGHS) took the initiative to introduce a standardized register for managing newborns and sick children during inpatient care. This report describes the experience and learning of implementing the inpatient register in Bangladesh.

Objectives

The study assessed the inpatient register's primary outcomes, including usability, acceptability, adoption, fidelity, and utility. Usability was measured using the System Usability Scale (SUS), and acceptability was measured using the Technology Acceptance Model (TAM). Adoption was measured by the proportion of admitted newborns and children documented in the inpatient register. Fidelity was assessed in terms of completeness, and utility was examined in the context of quality of care. Specific Objectives are and detailed Primary research questions for

successful demonstration based on WHO implementation research framework and implementation outcome variables guided by technical committee provided in (Annex 1)

1. Assess the usability of the inpatient register among healthcare providers
2. Assess the acceptability of the inpatient register among healthcare providers (direct caregivers, supervisors, and managers)
3. Evaluate the level of adoption of the inpatient register
4. Explore the fidelity (data completeness) of the inpatient register
5. Assess the utility (quality of care) of introducing an inpatient register

Methods

Study design

An implementation research was conducted to develop and implement a standardized register for managing newborns and sick children during inpatient care. The National Newborn Health and IMCI Programme, under DGHS, led the design and development of this register.

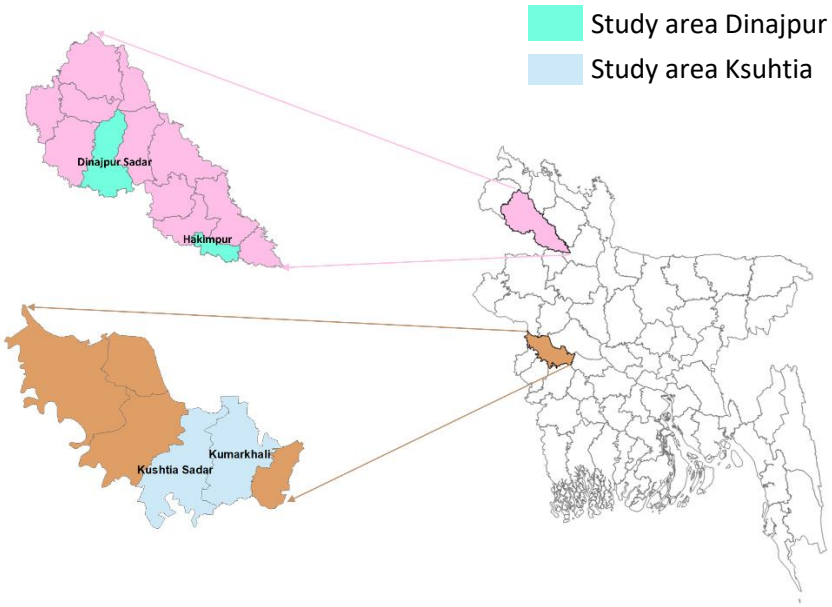

Figure 1: Study sites

Study participants

The study included children aged between 0 and 59 completed months who were admitted to the paediatric indoor department of the participating health facilities. Additionally, government-employed nurses who work in the paediatric indoor department and have received training on the inpatient register were also included as participants.

Development and implementation of inpatient register

A technical committee developed the inpatient register for newborns and sick children. Data from case record forms and registers used in pediatric inpatient departments were collected to gain insights into how pediatric patients were managed. Several consultative workshops were

organized to create the inpatient register. key decisions made during this process can be found in (Annex 2). The inpatient register is structured in a way that the details of one patient can be documented on a single page. Each page is divided into two rows, with the first row to be completed upon admission, and the second row to be filled out at the time of discharge. Nurses working in the inpatient wards are responsible for filling up this register based on the information recorded in the individual patient case record forms. Table 1 outlines the variables present in the register, and figure 2 provides a more comprehensive list. A monthly reporting form was developed by the technical committee based on the register and is meant to be completed by facilities and sent to the National Newborn Health and IMCI Programme. The committee also formulated a comprehensive implementation plan that covers implementation sites, training procedures, register distribution, and monitoring and supervision processes.

Columns to be filled up at the time of admission		**Columns to be filled up at the time of discharge:**	
Column 1:	Serial no	*Column 9:*	Investigation done
Column 2:	Registration no	*Column 10:*	Care received during admission
Column 3:	Date & time of admission	*Column 11:*	Drugs received during admission
Column 4:	The place where the child first came in this facility	*Column 12:*	Final diagnosis with ICD 10 code during discharge
Column 5:	Child's identity, address and parent's mobile phone number	*Column 13:*	Outcome of treatment
Column 6:	Information on referral in this facility	*Column 14:*	Comments & signature
Column 7:	Physical examination at admission		
Column 8:	Danger sign present at admission		

Table 1: Variables of the inpatient register

Serial No	Registration No	Date & Time of Admission in Pediatric department	The place where the child first came in this facility	Child's identity, address and parent's mobile phone number	Information on referral in this facility	Physical examination at admission	Danger sign present at admission	
1	2	3	4	5	6	7	8	
			☐ IMCI Corner/Outdoor ☐ Emergency	Name of the child: Age: ..... Year ..... Month ..... Day Gender: ☐ Male ☐ Female ☐ Other gender Mothers Name: Fathers Name: Mobile Number: Address: • House/Holding no: • Village/Moholla: • Union/Ward: • Upazila/Municipality/City Corporation: • District:	Was the child referred to this health facility? ☐ Yes ☐ No From where was the child referred? ☐ Other units of the same health facility ☐ Govt medical college hospital/ Specialized hospital ☐ District hospital ☐ MCWC ☐ Upazila health complex ☐ UHC ☐ Community Clinic ☐ Private hospital /Clinic/ Chamber ☐ NGO hospital /Clinic ☐ Others (Specify):	Weight: ..... Kilogram Height: ..... cm Temperature: ..... ☐ ◦C ☐ ◦F Respiration Rate: ..... /min Heart Rate: ..... /min Oxygen Saturation/SpO_2 ..... % MUAC: ..... cm Stridor: ☐ PRESENT ☐ ABSENT Edema: ☐ PRESENT ☐ ABSENT Anemia: ☐ PRESENT ☐ ABSENT Dehydration: ☐ PRESENT ☐ ABSENT Visible Birth defect: ☐ PRESENT ☐ ABSENT ☐ Others (Specify):	**0-59 days** ☐ Not feeding well ☐ Convulsion/ history of convulsions ☐ Drowsy or unconscious ☐ Movement only when stimulated or no movement at all ☐ Fast breathing ☐ Grunting ☐ Severe chest indrawing ☐ Hypothermia (< 35.5°C or < 96°F) ☐ Hyperthermia (≥ 37.5°C or ≥ 99.5°F) ☐ Central cyanosis ☐ Bulging fontanels ☐ Apnoea ☐ Persistent Vomiting	**2-59 months** ☐ Unable to drink or breastfeed ☐ Convulsion/ history of convulsions ☐ Lethargic or unconscious ☐ Vomits everything

Investigation done	Care received during admission	Drugs received during admission		Final diagnosis with ICD 10 code during discharge		Outcome of treatment	Comments & signature
9	10	11		12		13	14
☐ CBC ☐ S. Electrolytes ☐ C Reactive protein ☐ Blood sugar ☐ Blood grouping and Rh Typing ☐ S. Bilirubin ☐ Blood C/S ☐ Urine C/S ☐ Urine RME ☐ Chest X-ray ☐ CSF study ☐ Stool R/E ☐ Others (Specify):	☐ Thermal care ☐ Oxygen ☐ Cup feeding ☐ NG feeding ☐ IV fluid ☐ Phototherapy ☐ Oral antibiotic ☐ Injectable antibiotic ☐ Blood transfusion ☐ Nebulization ☐ Therapeutic milk (F75/F100) ☐ Catheter ☐ Others (Specify):	☐ Inj. Ampicillin Date from ..... To ..... ☐ Inj. Ceftriaxone Date from ..... To ..... ☐ Name of the Medicine: Date from ..... To ..... ☐ Name of the Medicine: Date from ..... To	☐ Inj. Gentamicin Date from ..... To ..... ☐ Name of the Medicine: Date from ..... To ..... ☐ Name of the Medicine: Date from ..... To ..... ☐ Name of the Medicine: Date from ..... To	☐ Newborn sepsis P36.9 ☐ Septicaemia of older children A41.9 ☐ Diarrhoea with severe dehydration A09 ☐ Drowning W74 ☐ Severe Pneumonia J18.9 ☐ Bronchiolitis J21 ☐ Bronchial asthma J45 ☐ Respiratory tract infections J98.7 ☐ Birth asphyxia P21 ☐ Anaemia D64.9	☐ Severe Acute Malnutrition (SAM) E46 ☐ Dengue A97.9 ☐ Thalassaemia D56 ☐ Convulsion of newborn P90 ☐ Febrile convulsions R56.0 ☐ Pyrexia of unknown origin R50.9 ☐ Prematurity and low birth weight (LBW) P07 ☐ Urinary tract infection N39.0 ☐ Neonatal jaundice P59.9 ☐ Meningitis G03.9 ☐ Rheumatic Fever I00 ☐ Others (Specify).....	☐ Discharge with advice ☐ Discharge on request ☐ Discharge on risk bond (DORB) Time & Date of discharge: ..... ☐ Referred Time & Date of Referral: ..... Place of referral: ..... ☐ Absconded ☐ Death Time & Date of Death ..... Cause of Death: ..... Has the MPDSR Death notification form been filled? ☐ Yes ☐ No	

Figure 2: Comprehensive list of the register

Development process

This process starts and adopt a stakeholder engagement conceptual framework. Four steps were followed to engage the stakeholder in different steps of register development, design and implementation plan.

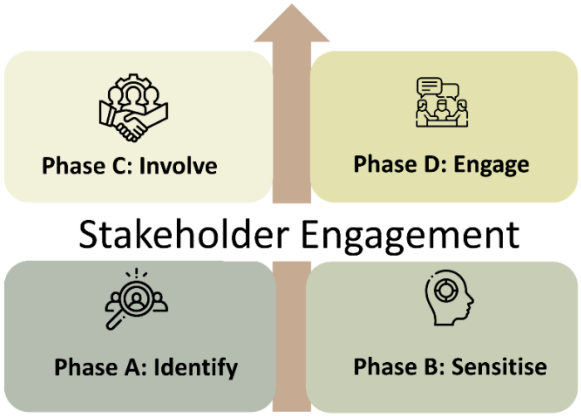

Figure 3: Stakeholder engagement framework

A comprehensive four-phase stakeholder engagement process was employed to implement an inpatient register for newborns and sick children. The process began by identifying and prioritizing potential stakeholders at the national and district levels. Eight organizations involved with newborn and child health were identified, and 30 participants from various sectors were involved in workshops to raise awareness about the register's introduction. These stakeholders also participated in the register's design, development strategies planning, and implementation phases. The phases were led by the National Newborn Health and IMCI Program with support from various partners. A technical working group reviewed existing registers and helped prepare training materials. Feedback from each workshop was crucial in finalizing the register.

Pictures from different sensitization workshops

Workshop arranged by NNHP & IMCI at IMCI conference room, EPI Bhaban (left)

Sensitisation workshop at Kushtia District(right)

Sensitisation workshop at Dinajpur District(left)

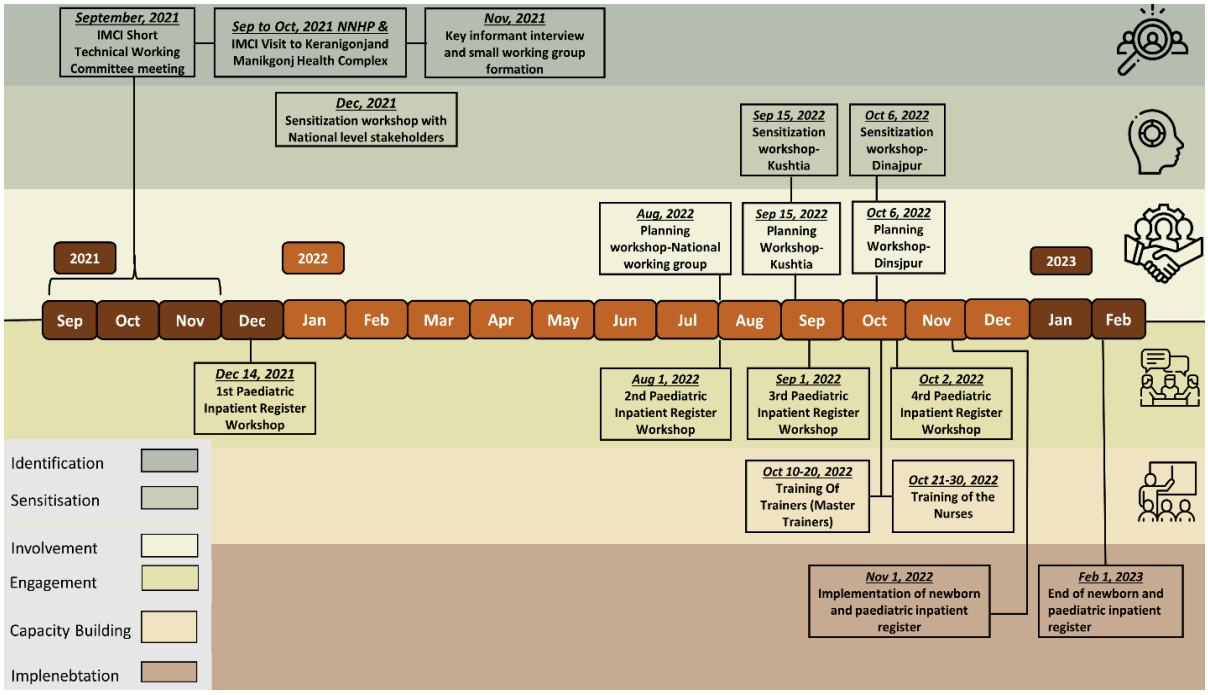

Figure 4: Timeline and activities

Implementation of Inpatient Register

The inpatient register is structured to document the details of one patient on a single page, with two rows: one to be completed upon admission and the other at the time of discharge. It was implemented in five districts between November 2022 and January 2023, with technical assistance from icddr,b, Save the Children, and the World Health Organization.

Register handover – Dinajpur district
November 1, 2022

Register handover –Kushtia district
November 1, 2022

Data Collection

The research was carried out during a three-month period from November 1, 2022, to January 31, 2023. To assess the usability and acceptability of the inpatient register among healthcare providers, an adapted version of the System Usability Scale (SUS) and Technology Acceptance Model (TAM) tools were employed. The SUS, a dependable tool for evaluating the usability of systems, products, or services, comprises a 10-item questionnaire featuring five response

options, ranging from "Strongly agree" to "Strongly disagree." SUS scores range from 0 to 100 and provide insights into overall user satisfaction and usability. Concurrently, the TAM, a widely recognized psychological model, was used to comprehend how healthcare providers perceive and embrace new information technology or systems. Data regarding SUS and TAM tools were collected from nurses who received training on the paediatric inpatient register in Kushtia and Dinajpur districts.

To evaluate the inpatient register's adoption, fidelity, and utility, we used participant enrollment and data extraction from inpatient registers and case record forms as data collection methods. A non-medical study staff collected basic demographic information (name, age, gender, admission date and time, and registration number) for all admitted children, regardless of their presence in the inpatient register. Trained data collectors extracted data from the inpatient register for children enrolled in the study who were subsequently discharged from the hospital. Similarly, trained study nurses extracted data from the case record forms for children whose information was obtained from the inpatient register, utilizing a specially designed data extraction form similar to the inpatient register. It was ensured that individuals involved in patient enrollment and data extraction from the case record forms had no access to the inpatient register's information. We also extracted data from pre-study case record form of one month (October 2022) using the same tool. The data collection process was conducted using a specialized Android-based application with pre-tested tools. All data collectors received one week of training, and a clinical supervisor oversaw the data extraction process, including re-extraction of data from 5% of the participants for quality assurance.

Nurses using the newborn and paediatric inpatient register (Dinajpur)

Nurses using the newborn and paediatric inpatient register (Khustia)

Data Analysis

The study assessed the inpatient register's primary outcomes, including usability, acceptability, adoption, fidelity, and utility. Usability was measured by healthcare providers' perception of the register's usability. Acceptability was measured by healthcare providers' acceptance of the register. Adoption was measured by the number of admitted newborns and children documented in the register. Completeness was measured by the completion of data elements such as investigation done, care received during admission, and drugs received during admission among children recorded in the register. Utility was measured by the quality of care provided to admitted children, including injectable antibiotics for newborn sepsis, and reporting outcomes such as final diagnosis and treatment outcome.

Usability and acceptability were measured by means with standard deviations (SDs) disaggregated by healthcare provider age, facility type, and district. We used independent t-tests to determine whether the difference of means between categories was significant. Adoption, fidelity, and utility were measured by proportions with 95% confidence intervals for patient's age, sex, facility type, district, and timing of assessment. We used proportion tests to determine whether the difference of percentage between categories was significant. ANOVA was used to check the difference for the categories of timing of assessment and patient's age. The statistical significance was reported at a 5% level of significance. For utility, we conducted a proportion test to check the difference in recording of final diagnosis between pre-study data and data collected during the study period. We also assessed agreement on reporting variables (oxygen given, Inj. Gentamicin, diagnosis- severe pneumonia, and outcome of treatment- refer) between government-appointed nurses posted in the inpatient department and study-appointed nurses. The level of agreement was expressed as both percent agreement with 95% SD and kappa coefficient. The following categories are used to interpret the kappa coefficient: poor (kappa $\leq$ 0.00), slight (0.01 $\leq$ kappa $\leq$ 0.19), fair (0.20 $\leq$ kappa $\leq$ 0.39), moderate (0.40 $\leq$ kappa $\leq$ 0.59), substantial (0.60 $\leq$ kappa $\leq$ 0.79), and perfect (kappa $\geq$ 0.80) (ref). Data analysis was conducted using Stata version 15.0

Results

Between November 1, 2022 to January 31, 2023, 5052 children aged less than five years got admitted in the paediatric inpatient department. Data extraction from inpatient register and case record forms was conducted for 4849 (96%) children and 4180 (83%) children respectively among those who were admitted in the inpatient department (figure 5).

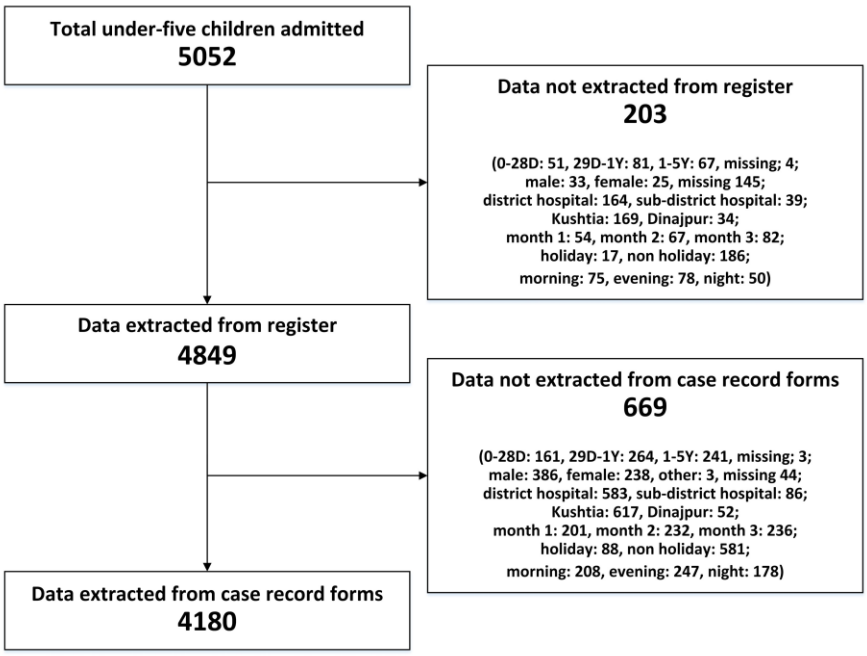

Figure 5: Sample size for assessments

Among children for whom data extraction was conducted from inpatient register, 2102 (43%) were aged between 29 days and 11 months, 2770 (61%) were male, 4011 (83%) were from Kushtia and 3909 (81%) were from district hospitals. 2069 (52%) were discharged with advice, whereas, 36 (1%) children died while hospital stay (table 2). We also conducted data extraction

from case record forms of 937 under-five children admitted in the paediatric department during pre-intervention period (October 2022). Among them, 367 (39%) were aged 0-28 days, 745 (80%) were from Kushtia and 810 (86%) were from district hospitals (Annex 3). We enrolled 176 healthcare providers who received training on inpatient register. Among them, all of them were nurses, 94 (53%) were aged less than 35 years, 111 (63%) were from Dinajpur and 149 (85%) were from sub-district hospitals (Annex 4).

Characteristics	n	%
Age		
0-28 days	1210	25
29 days-11 months	2102	43
12-59 months	1532	32
Missing	5	
Sex		
Male	2770	61
Female	1795	39
Others	4	0
Missing	280	
District		
Kushtia	4011	83
Dinajpur	838	17
Missing	0	
Facility Type		
District hospital	3909	81
Sub-district hospital	940	19
Missing	0	
Month		
Month 1	1517	31
Month 2	1705	35
Month 3	1627	34
Missing	0	
Outcome of Treatment		
Discharge with advice	2069	52
Discharge on request	829	21
DORB	78	2
Refer	442	11
Absconded	517	13
Death	36	1
Missing	878	
Total (N)	**4849**	

Table 2: Background characteristics of the participants according to data extracted from inpatient register (N=4849)

Figure 6 presents the results of the assessments of WHO implementation research variables for inpatient register. During our assessment, average usability score among healthcare providers using System Usability Scale (SUS) was 73 (SD 14) and average acceptability score using Technology acceptance model (TAM) was 82 (SD 14) out of 100. The inpatient register recorded 96% (95% CI 95,97) of under-five children who were admitted in the paediatric inpatient department (adoption- actual use). The proportion of completed data elements in the inpatient register for "investigation done" was 24% (95% CI 23,26), for "care received during

admission" was 78% (95% CI 76,79), and for "drugs received during admission" was 85% (95% CI 84,86) (fidelity- completeness). The proportion of newborns with sepsis receiving injectable antibiotics according to the extracted data from the inpatient register was 62% (95% CI 47,75) (utility- quality of care). The proportion of missing data elements in the inpatient register for "final diagnosis" was 23% (95% CI 22,24), and for "outcome of treatment" was 18% (95% CI 17,19) (utility- reporting of outcome).

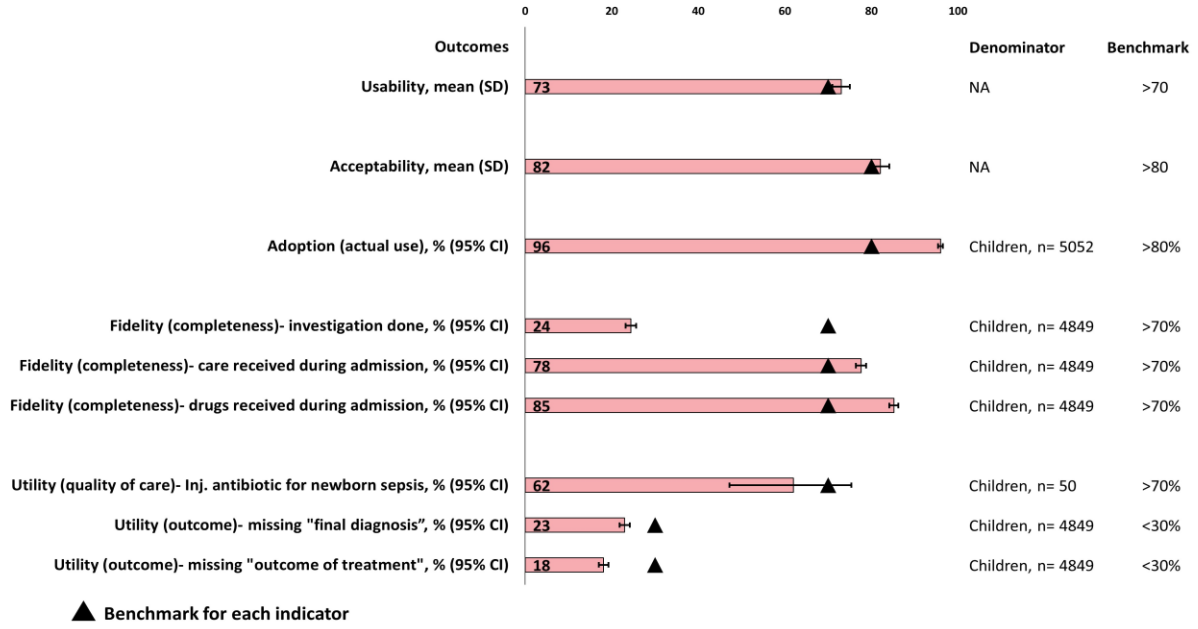

Figure 6: Assessments of WHO implementation research variables for inpatient register, presented in mean with SD for usability and acceptability indicators and percentage with 95% CI for fidelity and utility indicators (utility and acceptability, N= 176; adoption, N= 5052; fidelity-completeness and utility-outcome, N=4849 and utility-quality of care, N=50)

Table 3 presents the influence of various patient, provider, and facility-related factors on the assessments of WHO implementation research variables for inpatient register. The cells marked with an asterisk indicate a statistically significant difference in mean or proportion. The mean System Usability Scale (SUS) and Technology Acceptance Model (TAM) scores were significantly higher in Dinajpur. The proportion of completed data elements in the inpatient register for "investigation done" and "care received during admission" was significantly higher in district hospitals, whereas the proportion of completed data elements in the inpatient register for "drugs received during admission" was significantly higher in sub-district hospitals. The proportion of missing data elements in the inpatient register for "final diagnosis" and "outcome of treatment" was significantly lower in Dinajpur and sub-district hospitals. The proportion of newborns with sepsis receiving

	Usability		Acceptability		Adoption (actual use)		Fidelity (completeness)- investigation done		Fidelity (completeness)- care received during admission		Fidelity (completeness)- drugs received during admission		Utility (quality of care)- Inj. antibiotic for newborn sepsis		Utility (outcome)- missing "final diagnosis"		Utility (outcome)- missing "outcome of treatment"	
	mean (SD)	P value	mean (SD)	P value	% (95% CI)	P value	% (95% CI)	P value	% (95% CI)	P value	% (95% CI)	P value	% (95% CI)	P value	% (95% CI)	P value	% (95% CI)	P value
Patient related factors																		
Age																		
0-28 days					96(95,97)		24(22,27)		80(78,82)		86(84,88)		50(34,66)		27(24,29)		22(20,25)	
29 days-11 months					96(95,97)	0.256	28(26,30)	<0.001*	79(77,81)	<0.001*	88(87,89)	<0.001*	29(4,71)	0.537	21(19,23)	<0.001*	16(14,18)	<0.001*
12-59 months					96(95,97)		20(18,22)		73(71,76)		80(78,82)		33(1,91)		23(21,25)		17(16,19)	
Sex																		
Male					99(98,99)	0.675	25(23,26)	0.894	77(75,78)	0.203	85(84,87)	0.697	44(24,65)	0.972	24(22,25)	0.125	19(17,20)	0.189
Female					99(98,99)		24(22,26)		79(77.80)		85(83,87)		43(23,66)		22(20,23)		17(15,19)	
Provider related factors																		
Age																		
<35 years	74(15)	0.088	83(14)	0.169														
≥35 years	72(12)		81(13)															
Facility related factors																		
Facility type																		
District hospital	75(19)	0.221	72(21)	0.005*	96(95,97)	0.669	30(28,31)	<0.001*	78(77,79)	0.041*	84(83,85)	<0.001*	57(39,73)	0.009*	24(23,26)	<0.001*	21(19,22)	<0.001*
Sub-district hospital	73(13)		84(11)		96(94,97)		2(1,3)		75(72,78)		89(87,91)		15(2,45)		17(15,20)		7(6,9)	
District																		
Kushtia	64(16)	<0.001*	69(11)	<0.001*	96(95,97)	0.838	28(27,29)	<0.001*	75(73,77)	<0.001*	85(84,86)	0.838	59(41,75)	0.007*	25(24,27)	<0.001*	19(18,21)	<0.001*
Dinajpur	78(9))		90(7)		96(95,97)		8(6,10)		80(78,82)		85(82,87)		19(4,46)		12(10,14)		13(10,15)	
Timing of assessments																		
Month 1					97(95,97)		23(21,26)		75(73,77)		84(82,86)		38(20,59)		27(24,29)		20(18,22)	
Month 2					96(95,97)	0.287	27(25,29)	<0.001*	80(78,82)	0.006*	85(83,86)	0.113	50(26,74)	0.435	19(17,21)	0.915	17(15,19)	0.117
Month 3					95(94,96)		23(21,25)		77(75,79)		87(85,88)		67(22,96)		24(22,26)		18(16,20)	

Table 3: Influence of different patient, provider and facility related factors on assessments of WHO implementation research variables for inpatient register, presented in mean with SD for usability and acceptability indicators and percentage with 95% CI for adoption, fidelity and utility indicators (utility and acceptability, N= 176; adoption, N= 5052; fidelity-completeness and utility-outcome, N=4849 and utility-quality of care, N=50

injectable antibiotics according to the extracted data from the inpatient register was significantly higher in district hospitals and Kushtia.

Figure 7 presents the percent distribution of final diagnosis extracted from case record form for pre-intervention phase and from inpatient register for intervention phase. The percentage of missing diagnosis decreased from 27% in the pre-intervention period to 23% in the intervention period which is statistically significant.

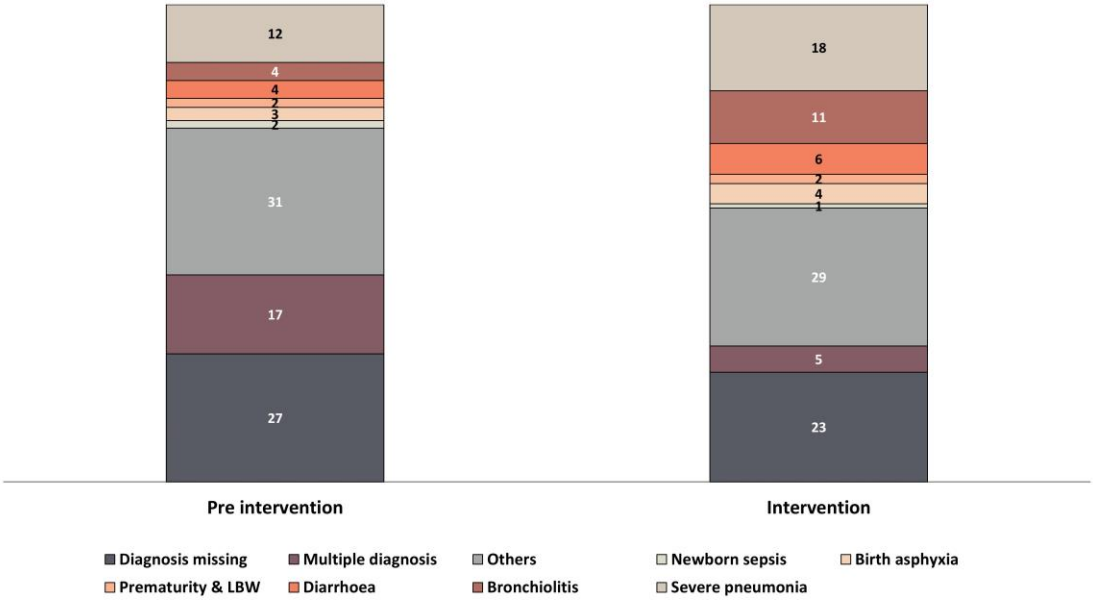

Figure 7: Final diagnosis extracted from case record form for the intervention phase and inpatient register for intervention phase, presented in percent distribution (pre intervention phase, N= 937 and intervention phase, N= 4849)

Table 4, we investigated the level of observed agreement between healthcare providers and study nurses regarding reporting different variables in the inpatient register. The kappa for overall level of agreement between healthcare providers and study nurses regarding reporting different variables in the inpatient register indicated moderate to substantial agreement. The percent agreement was significantly higher in sub-district hospitals for all reported variables except “Treatment Inj. Gentamicin”. The percent agreement for “Treatment Inj. Gentamicin” was significantly higher among children aged 12-59 months, in Dinajpur, and in the last month of assessment.

	Treatment oxygen given			Treatment Inj. Gentamicin			Diagnosis- Severe Pneumonia			Refer		
	Kappa	Agreement % (95% CI)	P value	Kappa	Agreement % (95% CI)	P value	Kappa	Agreement % (95% CI)	P value	Kappa	Agreement % (95% CI)	P value
Patient related factors												
Age												
0-28 days	0.28	72 (69,74)	<0.001	0.74	89 (87,91)	<0.001	0.74	97 (95,98)	<0.001	0.74	90 (88,92)	<0.001
29 days-11 months	0.41	69 (67,71)		0.76	90 (89,92)		0.66	84 (82,85)		0.66	98 (97,98)	
12-59 months	0.54	79 (77,81)		0.84	96 (94,97)		0.71	91 (89,93)		0.71	98 (97,99)	
Sex												
Male	0.46	72 (70,74)	0.405	0.78	92 (90,93)	0.869	0.70	89 (88,90)	0.631	0.70	89 (88,90)	0.096
Female	0.49	73 (71,76)		0.77	92 (90,93)		0.72	90 (88,91)		0.72	90 (88,91)	
Facility related factors												
Facility type												
District hospital	0.36	68 (66,70)	<0.001	0.73	91 (90,92)	0.638	0.70	88 (87,89)	<0.001	0.77	95 (94,96)	<0.001
Sub-district hospital	0.61	92 (90,94)		0.84	92 (90,94)		0.75	93 (91,95)		0.94	99 (98,100)	
District												
Kushtia	0.46	73 (72,75)	0.618	0.76	90 (89,91)	<0.001	0.72	88 (89,90)	0.549	0.79	95 (94,96)	<0.001
Dinajpur	0.36	72 (69,75)		0.75	99 (99,100)		0.53	90 (87,92)		0.76	99 (98,99)	
Timing of assessments												
Month 1	0.39	68 (66,71)	<0.001	0.72	90 (88,92)	0.019	0.69	88 (87,90)	0.436	0.80	96 (95,97)	0.552
Month 2	0.55	77 (75,79)		0.78	92 (90,93)		0.68	89 (87,91)		0.78	95 (94,96)	
Month 3	0.48	73 (71,76)		0.82	93 (92,94)		0.75	90 (88,92)		0.79	96 (95,97)	
Total	**0.47**	**73 (72,74)**		**0.77**	**92 (91,92)**		**0.71**	**89 (88,90)**		**0.79**	**96 (95,96)**	

Table 4: Influence of different patient, and facility-related factors on level of observed agreement between healthcare providers and study nurses regarding reporting different variables in the inpatient register, presented as kappa and percent agreement with 95% CI (N=4849)

Implication

The paediatric register has now been upgraded to the National Newborn and Paediatric Register. The Government of Bangladesh has requested development partners to assist in implementing this register in their supported districts before the next health sector programme begins. For instance, icddr,b has agreed to continue providing implementation support to Kushtia and Dinajpur districts. The Government has also decided to expand the inpatient register nationwide in the upcoming health sector programme. To facilitate this, NNHP & IMCI have allocated a separate budget for orientation, training, workshops, and printing of the newborn and paediatric inpatient register in the next operational plan. Furthermore, NNHP & IMCI have initiated discussions with MIS of DGHS for integrating monthly newborn and paediatric inpatient reports into the DHIS2.

Conclusion

In conclusion, the implementation of a standardized inpatient register for managing sick newborns and children in selected health facilities of Bangladesh has shown promising results. Usability and acceptability among healthcare providers were high, and the inpatient register was widely adopted. Data completeness and the quality of care provided were generally satisfactory, with room for improvement in data completeness in some areas

Annex

Annex 1: Primary research questions for successful demonstration based on WHO implementation research framework and implementation outcome variables guided by technical committee

WHO's framework	Research questions	Proposed indicator	Benchmark
Usability	What is the usability of the inpatient register among health care provider?	Average score using System Usability Scale (SUS)	>70
Acceptability	What is the acceptability of the inpatient register among health care provider?	Average score using Technology acceptance model (TAM)	>80
Adoption	Actual use: Do health care providers use the inpatient register?	Proportion of admitted newborn and children documented in the inpatient register	>80%
Fidelity	Completeness: Do health care providers fill up "investigation done" column of the inpatient register?	Proportion of completed "investigation done" column among newborn and children recorded in the inpatient register	>70%
	Completeness: Do health care providers fill up "care received during admission" column in the inpatient register?	Proportion of completed "care received during admission" column among newborn and children recorded in the inpatient register	>70%
	Completeness: Do health care providers fill up "drugs received during admission" column in the inpatient register?	Proportion of completed "drugs received during admission" column among newborn and children recorded in the inpatient register	>70%
Utility	Quality of care: Do the admitted children receive injectable antibiotic for newborn sepsis?	Proportion of admitted children receiving injectable antibiotic for newborn sepsis	>70%
	Outcome: Can we report "final diagnosis" from the inpatient register?	Proportion of missing data in the "final diagnosis" column in the inpatient register	<30%
	Outcome: Can we report "outcome of treatment" from the inpatient register?	Proportion of missing data in the "outcome of treatment" column in the inpatient register	<30%

Annex 2: Key decisions taken by technical committee regarding development of inpatient register

- Population: under-five children
- Cover all diseases but with special focus on pneumonia and serious infections
- Follow WHO pocket book for hospital care of children
- Take help from others registers for structure e.g. SCANU, KMC, EmONC register
- The register should allow tracking of use of antibiotics in inpatient department
- Use ICD-10 codes for diagnosis
- Develop monthly reporting form based on the register
- Register to be filled up by nurses from case-record forms

Annex 3 : Background characteristics of the pre-intervention participants according to data extracted from case record forms (N=937)

Characteristics	n	%
Age		
0-28 days	367	39
29 days-11 months	280	30
12-59 months	285	31
Missing	5	
Sex		
Male	96	64
Female	55	36
Others	0	0
Missing	786	
District		
Kushtia	745	80
Dinajpur	192	20
Missing	0	
Facility Type		
District hospital	810	86
Sub-district hospital	127	14
Missing	0	
Outcome of Treatment		
Discharge with advice	416	45
Discharge on request	285	31
DORB	5	1
Refer	73	8
Absconded	141	15
Death	0	0
Missing	17	
Total (N)	**937**	

Annex 4: Background characteristics of the government appointed nurses receiving training on inpatient register (N=176)

Characteristics	n	%
Age		
< 35 years	94	53
≥ 35 years	82	47
Missing	0	
District		
Kushtia	65	37
Dinajpur	111	63
Missing	0	
Facility Type		
District hospital	27	15
Sub-district hospital	149	85
Missing	0	
Total (N)	**176**	

Disclaimer

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