



**ITU Workshop on  
Spectrum Management for  
Internet of Things Deployment  
(Geneva, 22 November 2016)**

**Emerging use cases for digital  
health in LMICs relevant to  
5G applications**

***Dr. Garrett Mehl***  
Scientits

**ITU WORKSHOP ON SPECTRUM  
MANAGEMENT FOR INTERNET  
OF THINGS DEPLOYMENT**

**GENEVA, SWITZERLAND  
22 NOVEMBER 2016**

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# Emerging use cases for digital health in LMICs relevant to 5G applications

Dr. Garrett Mehl, Scientist

22 November, 2016

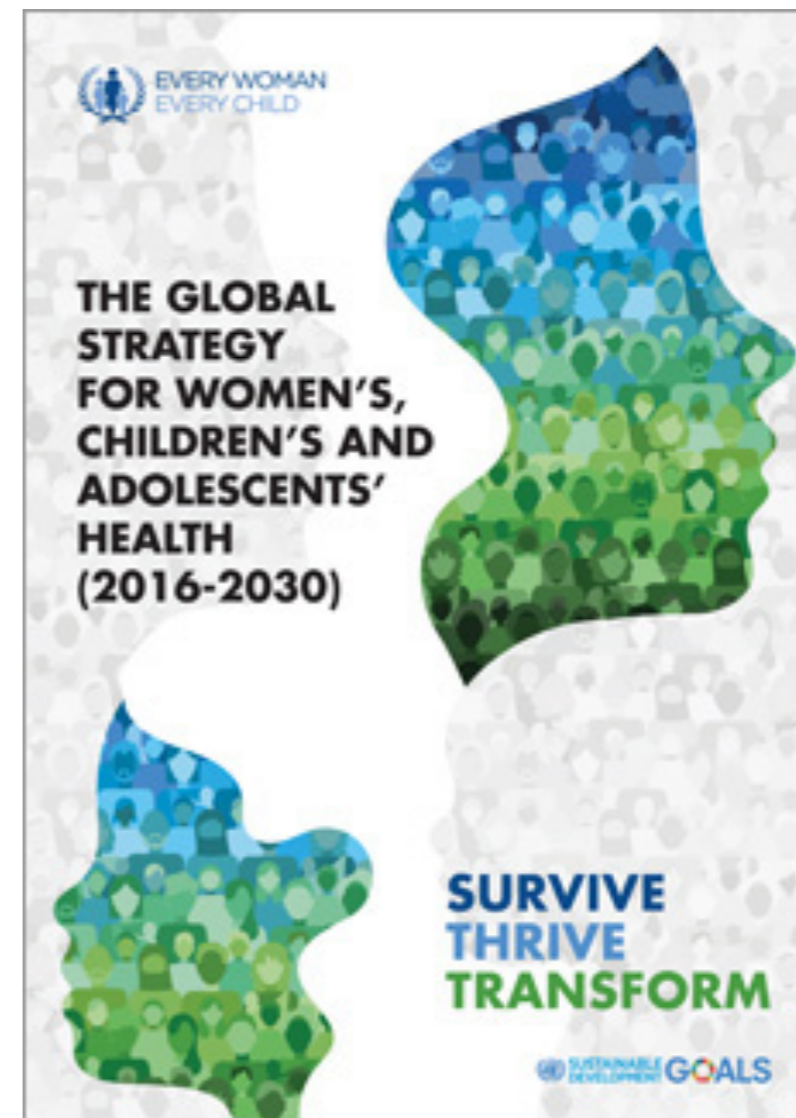


# Universal Health Coverage

“All people, irrespective of socioeconomic status, should have **access to quality** health services they need, **without** incurring **financial hardship.**”

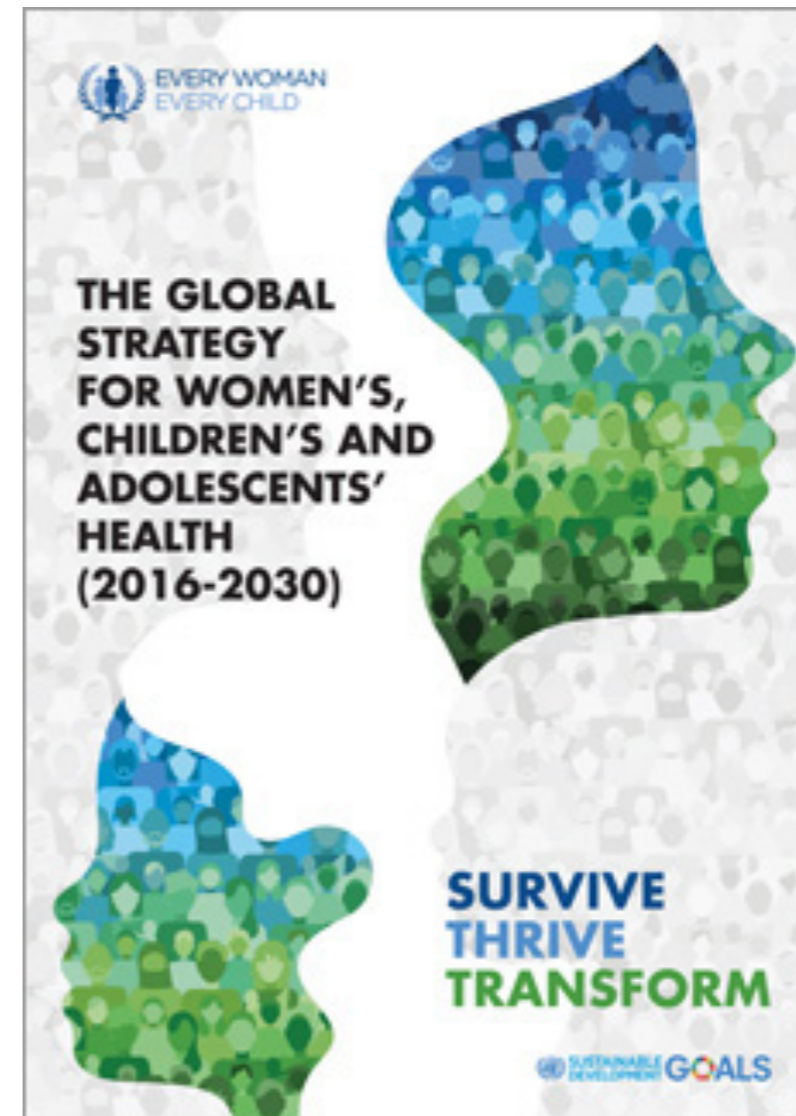
# Global Strategy for Women's, Children's and Adolescents' Health, 2016-2030

“Far too many women, children and adolescents worldwide still have little or no access to essential, good-quality health services and education, clean air and water, adequate sanitation and good nutrition”



# Global Strategy for Women's, Children's and Adolescents' Health, 2016-2030

- In order to realize the and achieve the vision detailed in the Global Strategy, **Innovation** will be essential.

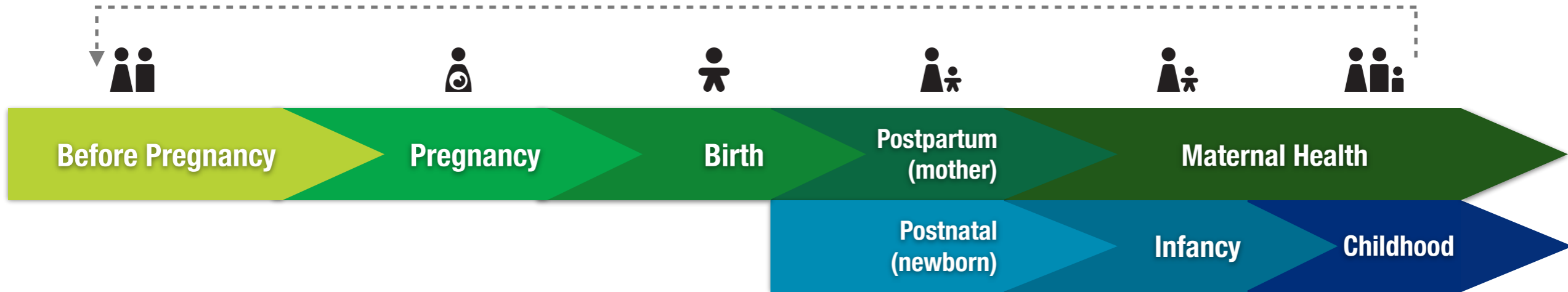


UNDP • UNFPA • WHO • World Bank  
Special Programme of Research, Development  
and Research Training in Human Reproduction



World Health  
Organization

# Maternal and child continuum



# Public Health Interventions of known efficacy exist and are well described

COMMUNITY LEVEL/HOME



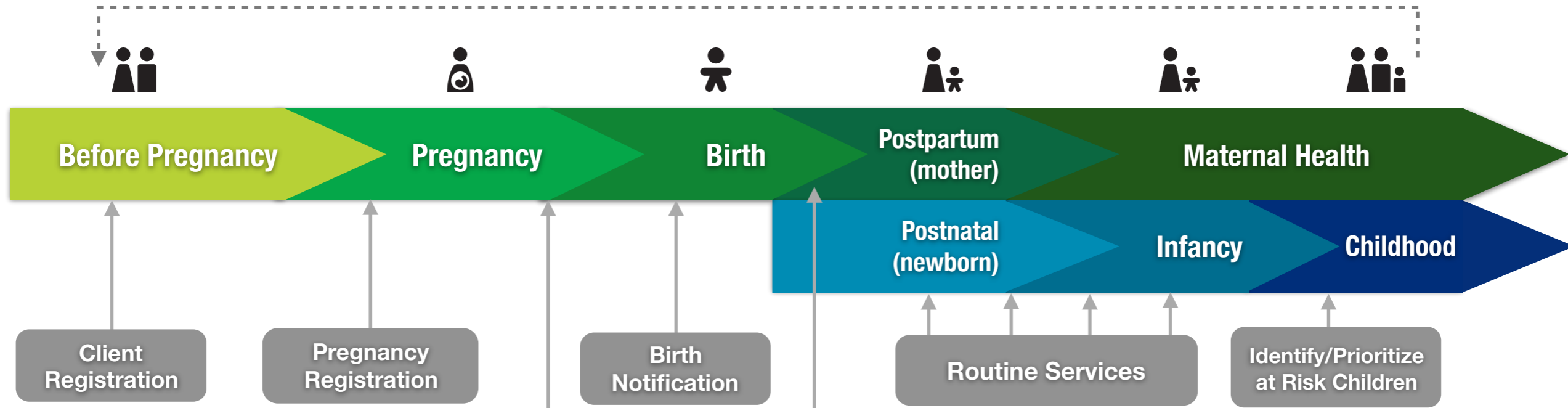
FIRST LEVEL/OUTREACH



REFERRAL LEVEL/DISTRICT HOSPITAL

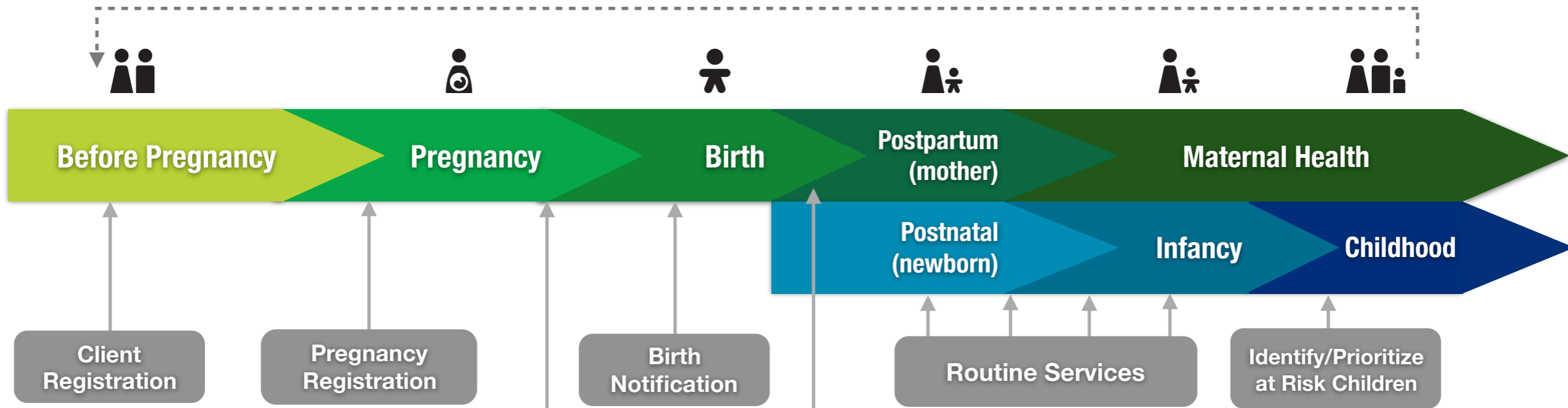


# Important Digital Strategies Across Continuum



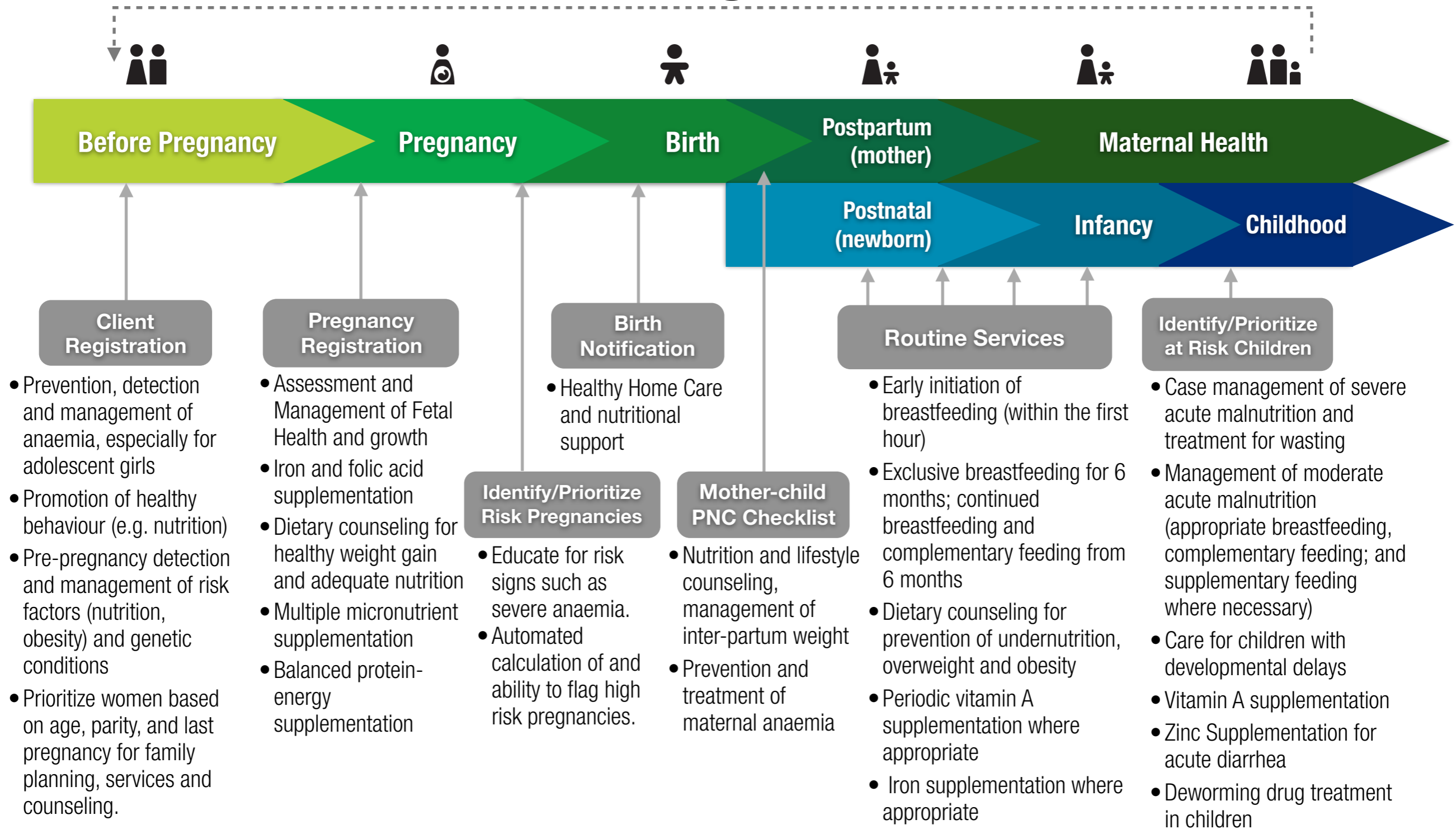


# Nutrition Interventions Across Continuum



**WHO Essential Nutrition Interventions**

# mHealth Nutrition Strategies Across Continuum



# Challenges in reaching vulnerable populations



# Integrated digital systems for Universal Health Coverage

**Quality**

**Coverage**

**Affordability**

**Measurement & Accountability**

# Digitally-Enhanced Responsive Accountability

Knowing **who is in need** of services,  
having the **necessary human resources**  
and commodities in **adequate supply**,  
and **connecting these together** at the  
right time and place.

# Typical Current Situation

- Dominant paper systems are used in a **sub-standard manner**; digital systems still emerging, but uncoordinated
- **Limited access** to and **usability** of resulting data
- **Data collected** is often not used to guide health workforce point of care care service provision, or decision-maker supervision or planning
- Statistical **modeling** and data estimations are used to **fill gaps for planning and decision-making**
- Most routine digital systems are **not nationally scaled**
- Few digital systems **interoperate** with other tools, or use **common data standards**

# Paper Registers

Phone  
Memo

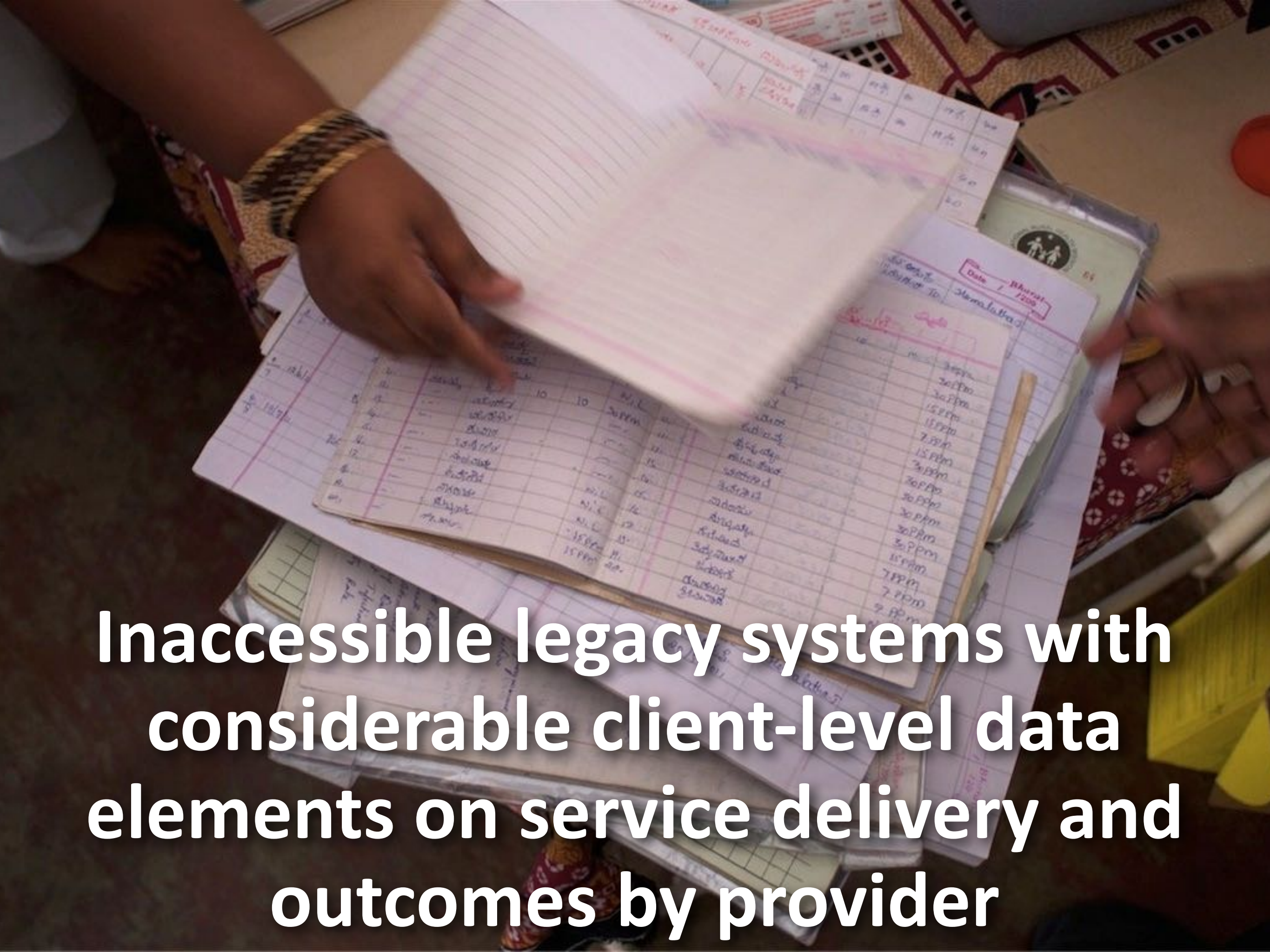
GOVERNMENT OF KARNATAKA  
DEPARTMENT OF HEALTH & FAMILY WELFARE SERVICES  
RCH PROJECT  
**ANC REGISTER**

1077/20  
6

NAME OF HOSPITAL... P.H.C. Bheryan

FROM 2008 - TO

2010

A close-up photograph of a person's hand pointing at a ledger with handwritten entries. The ledger is open to a page with columns for dates, names, and times. The text is in Kannada. The background shows a cluttered desk with various papers, a pen, and a small container. The overall scene suggests a manual data entry or record-keeping process.

**Inaccessible legacy systems with considerable client-level data elements on service delivery and outcomes by provider**





GOVERNMENT OF KARNATAKA  
DEPARTMENT OF HEALTH & FAMILY WELFARE SERVICES  
RCH PROJECT



ANC REGISTER

NAME OF HOSPITAL.....*ಬೆಂಗಳೂರು*.....

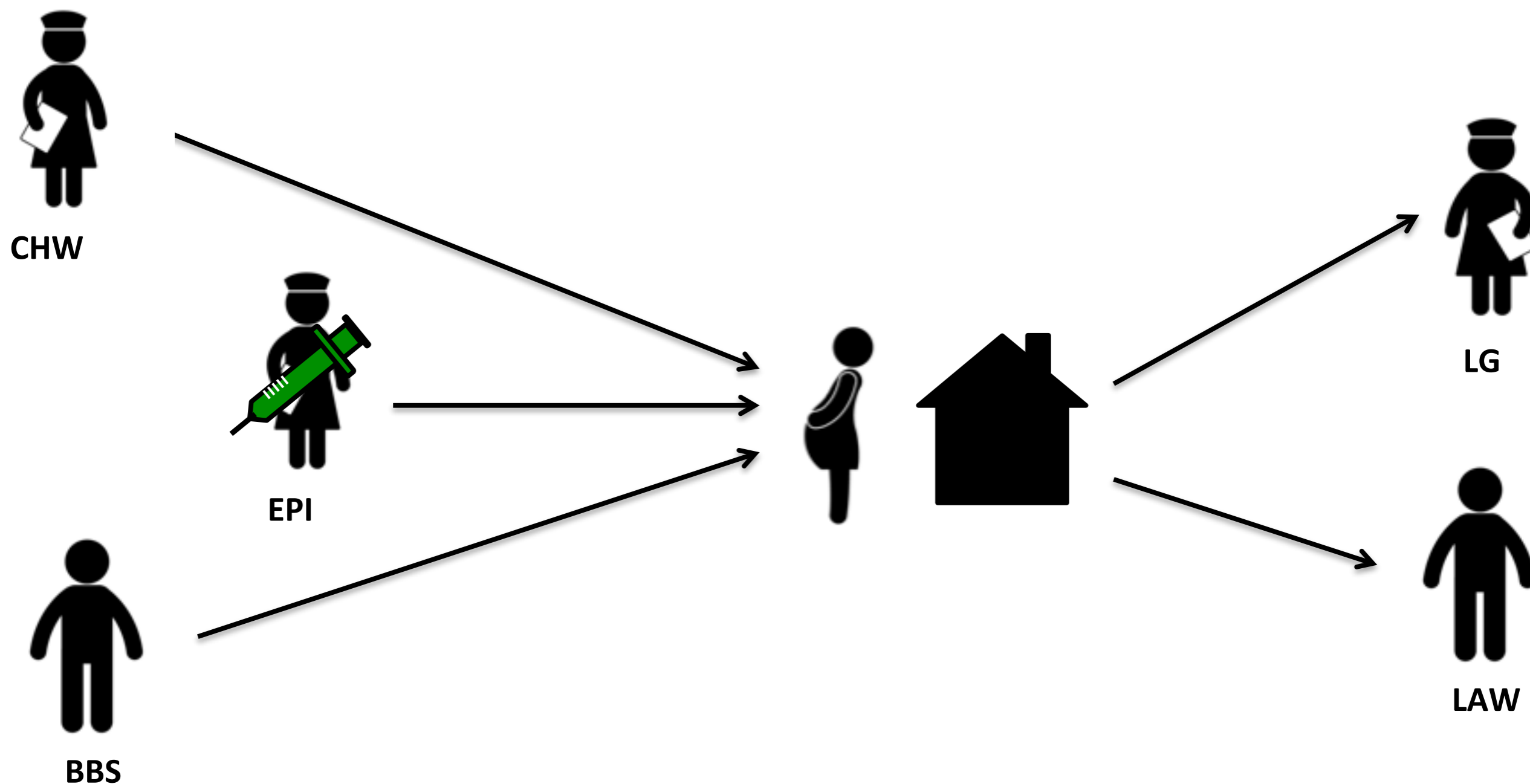
MONTH.....*ಏಪ್ರಿಲ್ - 11*.....

Sl. No.	EC No. On	Date of Registration	Name and Address (In Full)	Age	Religion	1. Education + 2. Occupation + 3. BPL/SC/ST	No. of living children		Gravida	Duration of Pregnancy in Weeks	LMP EDD	Service provided - Follow up FS / TT / Other											
							M	F				I	II	III	IV	V	VI	VII					
<i>1.</i>		<i>1/4/11</i>	[Redacted]	<i>22y</i>	<i>2020</i>	<i>5th</i>	-	-	<i>Gr</i>	<i>12 weeks</i>	<i>21/1/11</i>	<i>20/4/11</i>	<i>20/5/11</i>	<i>17/5/11</i>	<i>20/6/11</i>	<i>5/7/11</i>							
		<i>30/3/11</i>	<i>wt. 35kg</i>																				
		<i>20/4/11</i>	<i>wt. 40kg</i>																				
		<i>20/5/11</i>	<i>wt. 41kg</i>																				
		<i>20/6/11</i>	<i>wt. 44kg</i>																				
		<i>5/7/11</i>	<i>wt. 45kg</i>																				
<i>2/4/11</i>		<i>1/4/11</i>	[Redacted]	<i>24</i>	<i>ST</i>	<i>10th</i>	<i>1</i>	<i>0</i>	<i>Gr</i>	<i>12 weeks</i>	<i>6/4/11</i>	<i>30/6/11</i>	<i>1/11</i>	<i>30/8/11</i>									
		<i>19/4/11</i>	<i>B.P. 110/70 mmHg</i>	<i>wt. 60kg</i>		<i>1019195</i>	<i>wt. 3.200gms</i>																
		<i>1/5/11</i>	<i>B.P.</i>	<i>wt. 63kg</i>		<i>BPL</i>	<i>wt. 3.200gms</i>																
		<i>3/6/11</i>	<i>wt. 63kg</i>																				
		<i>7/4/11</i>	[Redacted]	<i>26</i>	<i>2020</i>	<i>PUC</i>	<i>1</i>	<i>0</i>	<i>Gr</i>	<i>12 weeks</i>	<i>8/4/11</i>	<i>31/10/11</i>	<i>14/11</i>	<i>2/3/11</i>	<i>14/3/11</i>	<i>6/4/11</i>							

Inaccessible data for health workers

Data collection, screening  
service delivery and  
reporting are four  
separate  
functions

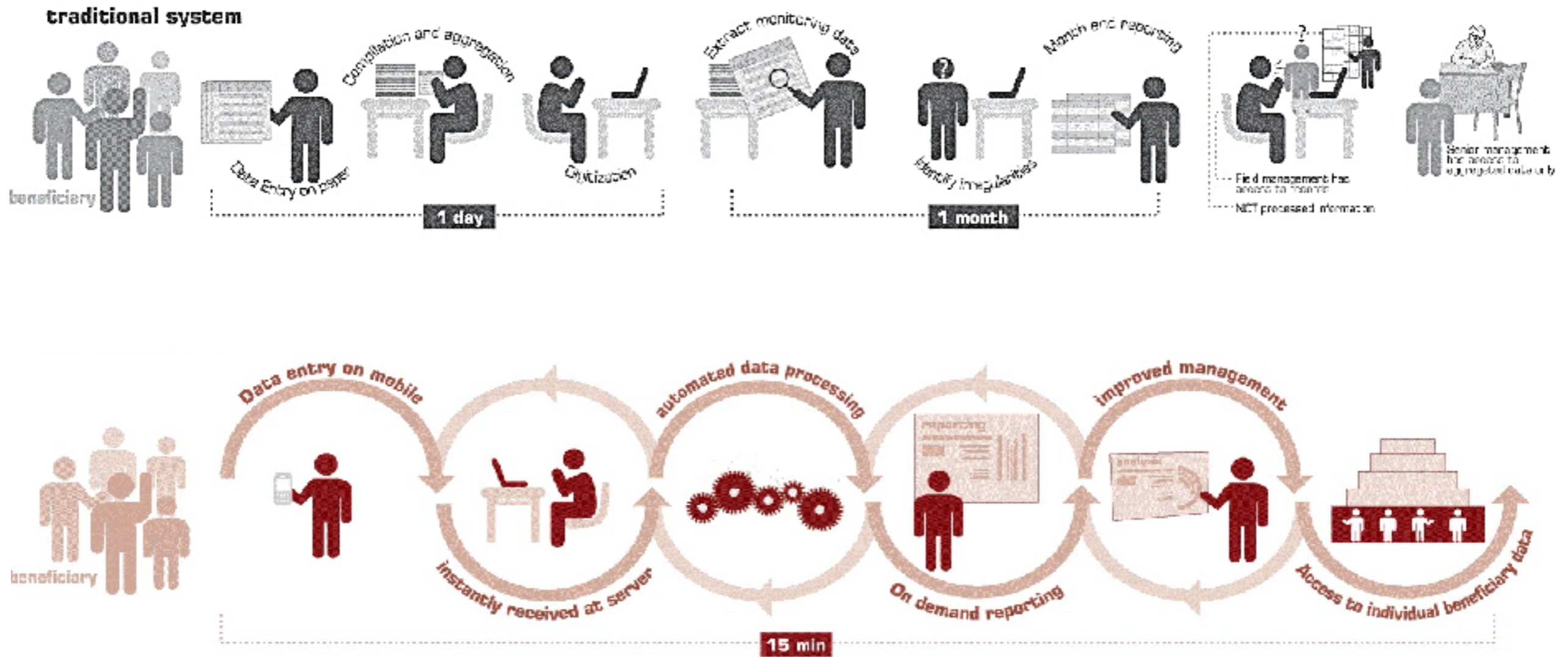
# Households are visited by Multiple **Non-Interacting** Health Cadres Responding to Pregnant Women, Reporting to Multiple Agencies



# Status Quo: Legacy Business Processes



# Health Systems are Complex



...but not impossible to optimize

# What is needed

- Accurate measurement and effective accountability requires strong **integrated information systems**, driven by country needs and uses.
- Robust digital tools that are complementary, offering value at **different levels** and across **health domains** in the health system,
- Digital tools that interoperate through **technical and semantic standards**, and share the same “**denominators**” - to define target populations

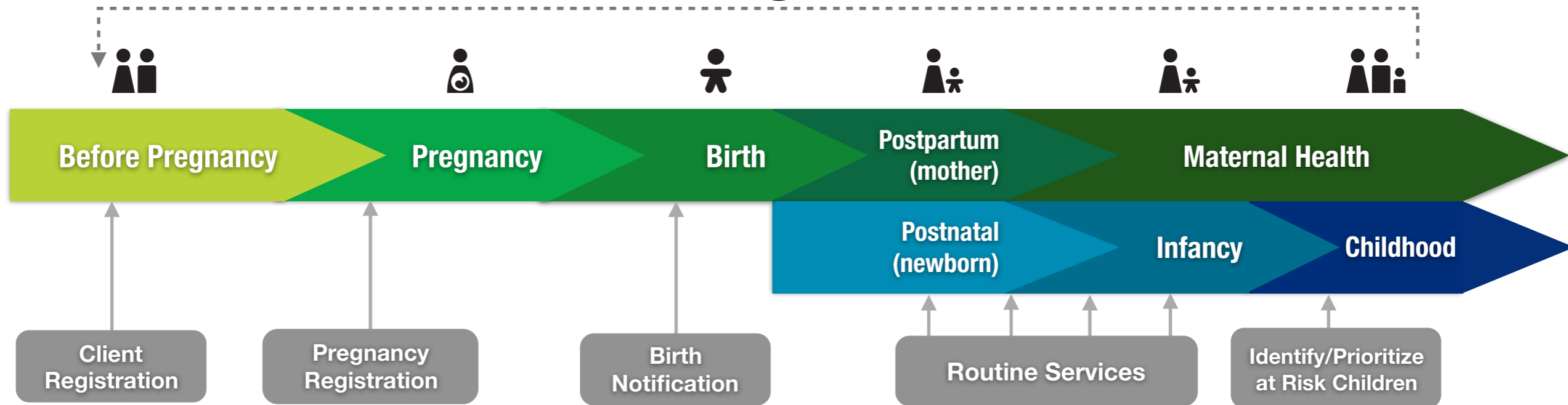
# Priority practices

- **Enumeration** of population, with defined **criteria for target populations**, and nutrition states
- Health cadre specific digital tools **with evidence-based content** that reflects domains of nutrition and existing information- and work-flows
- **Standardized data** elements and **indicators**, and reporting frameworks for health and nutrition status
- Use of **individual identifiers** and **records** that are persistent and ensure continuity of care
- **Systematic and routine screening** for identification of disease and nutrition states, and mechanisms for referral

# Common Use Cases



# mHealth Nutrition Strategies Across Continuum



**Digital Tools Relevant to Nutrition for Mothers and Children**

# Enumeration



... ensure that households in catchement areas are enumerated

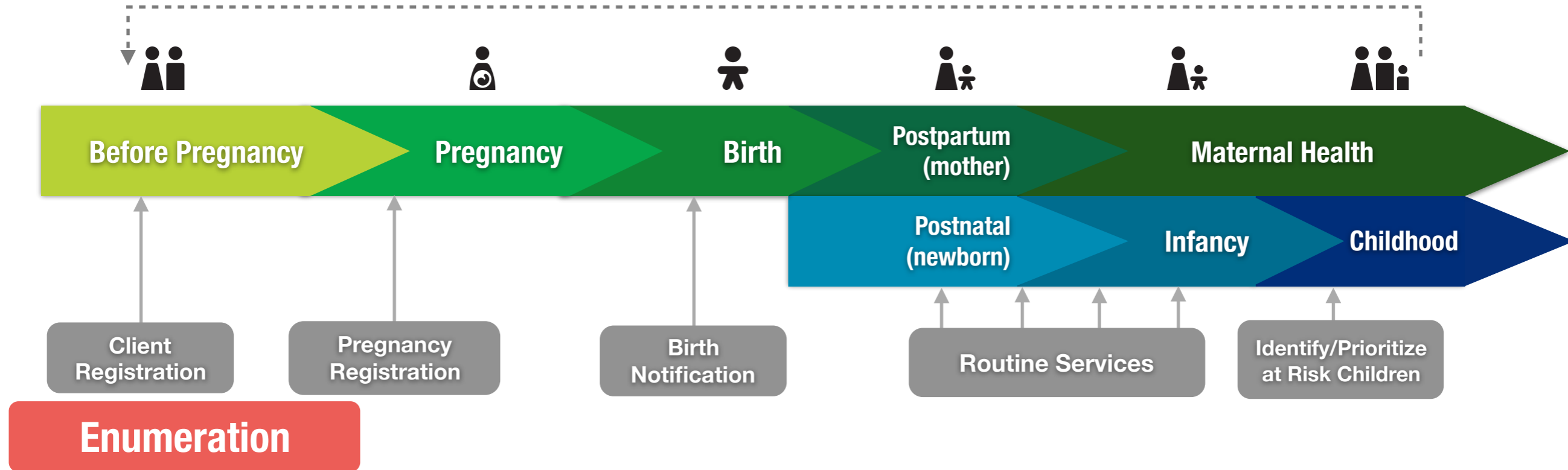
# Enumeration

## Requirements

- biometric registration
- facial recognition
- client lookup to ensure unique entry

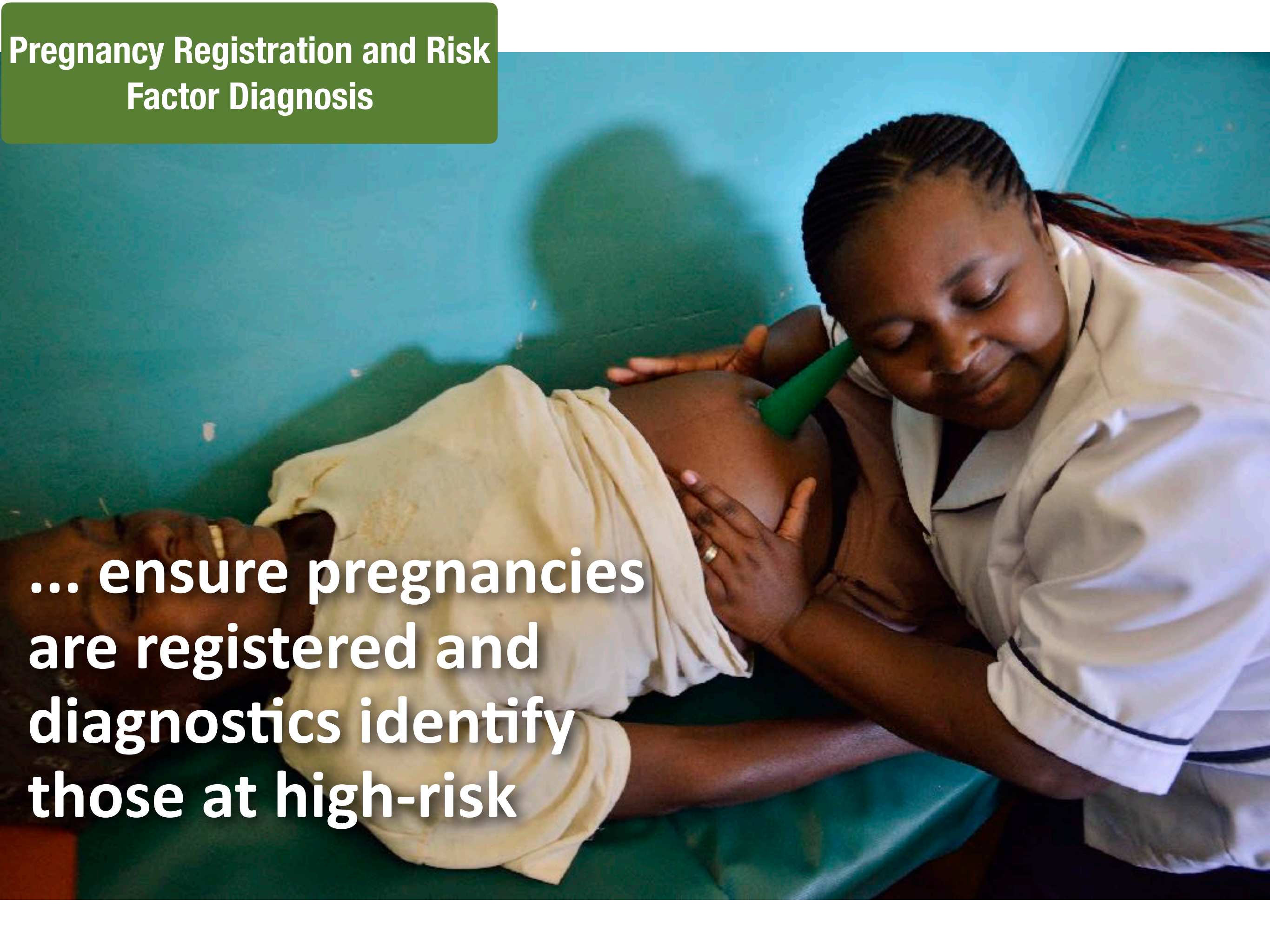


# mHealth Nutrition Strategies Across Continuum



## Pregnancy Registration and Risk Factor Diagnosis

... ensure pregnancies  
are registered and  
diagnostics identify  
those at high-risk

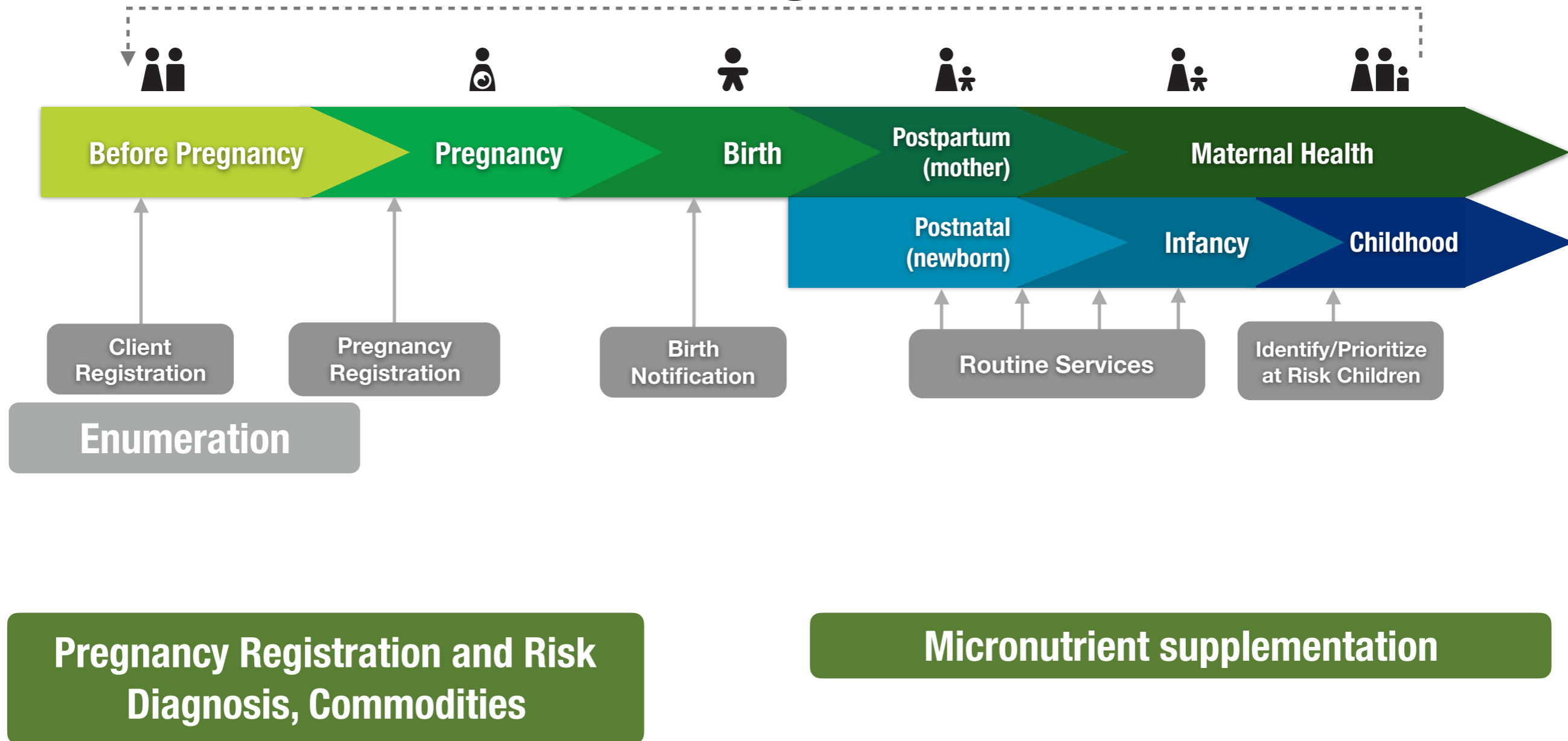
A healthcare worker in a white uniform is examining a pregnant woman's abdomen. The woman is lying down, and her abdomen is partially covered by a white cloth. The healthcare worker is using a green Doppler device to listen to the fetus's heart rate. The background is a teal wall.

## Micronutrient supplementation and Pregnancy Registration

### Requirements

- low-energy networked diagnostic tools
- high-bandwidth connectivity to expert care
- real-time commodity stock checks

# mHealth Nutrition Strategies Across Continuum



## Treatment & client management

... to ensure providers  
are able to identify  
their clients wherever  
they might be





## Treatment & client management

**... to ensure providers  
are able to manage  
clients and deliver  
essential interventions  
effectively**

# WHO Open Smart Register Platform

## OpenSRP

OpenSRP is an open source mobile health platform that allows frontline health workers to electronically register and track the health of their entire client population.









NAME	ID	DELIVERY INFO	COMPLICATIONS	PPFP	CHILD
Abhaya Puneeth Sambharwall	(24) 8008664	Date: 30/05/14 Place: PNC Type: Normal			Male Bth Wt: 3.4kg
Anitha Ansh Goradala	(21) 3452345	Date: 26/05/14 Place: PNC Type: Normal		LCD 1014-05-27 SDH	Male Bth Wt: 3.4kg
Geeta Guru Chikkahall	(29) 2383331	Date: 18/05/13 Place: SUBCENTER Type: Normal			Female Bth Wt: 3.4kg
Vidya Vive Chikkabheya	(25) 8884300	Date: 12/03/14 Place: SUBCENTER Type: Normal			Female Bth Wt: 3.4kg

# Antenatal Care View

ANC: 26/01 - 25/02      Hb/IFA      Search ANC Register

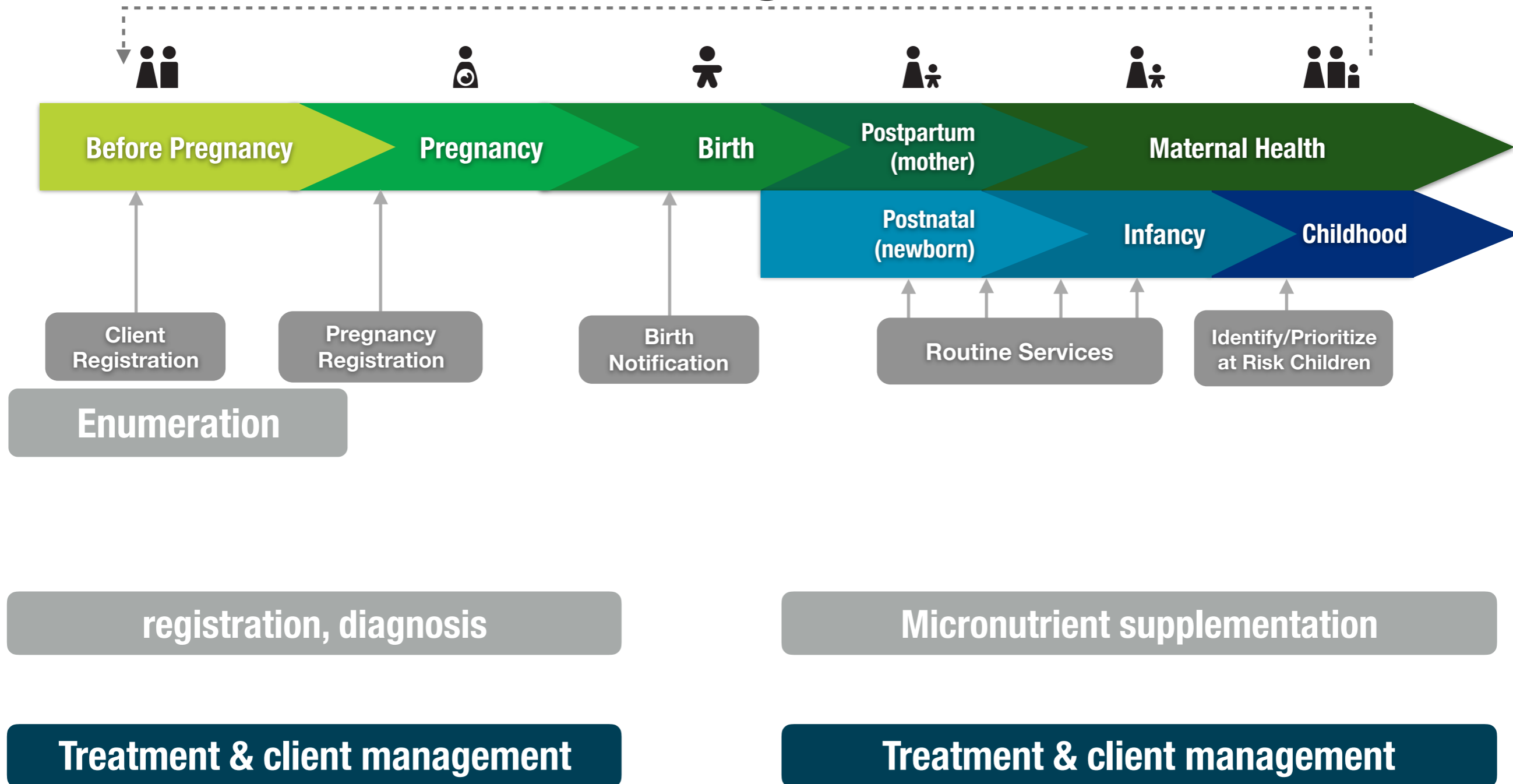
Sorted By: Name (A to Z), Village: All

NAME	ID	ANC STATUS	HB	IFA
 <b>Adhiti</b> (25) Rama Battiganahalli	ANC: 535 Thayi: 1234675	<b>2 weeks</b> LMP: 07/01/14 EDD: 14/10/14	■ 19/11    5 g/dl Hb Test Due 07/01	24/10 ✓ 30 Tablets IFA Tablets Due 08/12
 <b>Anitha</b> (26) Chendan Half Bherya	ANC: 21 Thayi: 1256783	<b>19 weeks</b> LMP: 14/09/13 EDD: 21/06/14	■ 09/12    2 g/dl Hb Test Due 07/12	✓ 100 Tablets IFA Tablets Due 18/12
 <b>Anitha</b> (25) Anish Geradada (O/A)	ANC: 0A32 Thayi: 3652365	<b>20 weeks</b> LMP: 04/09/13 EDD: 11/06/14	■ 11/12    12 g/dl ■ 10/10    7 g/dl Hb Test	✓ 100 Tablets IFA Tablets Due 25/01
 <b>Anjali</b> (24) Balangadar Battiganahalli	ANC: 71 Thayi: 2539681	<b>31 weeks</b> LMP: 21/06/13 EDD: 28/03/14	■ 17/11    5 g/dl ■ 31/08    6 g/dl ■ 13/01    5 g/dl Hb Test Due 13/09	08/10 ✓ 10 Tablets IFA Tablets Due 22/11
 <b>Arpitha</b> (17) Kumar Udayagiri	ANC: 15 Thayi: 9972693	<b>22 weeks</b> LMP: 25/08/13 EDD: 01/06/14	■ 10/12    5 g/dl ■ 03/09    5 g/dl ■ 31/08    14 g/dl Hb Test Due 17/11	14/10 ✓ 10 Tablets 08/10 ✓ 20 Tablets 30/09 ✓ 30 Tablets IFA Tablets Due 15/12
 <b>Asha</b> (25) Shashidhar G A Guppe (O/A)	ANC: 0A21 Thayi: 2535212	<b>38 weeks</b> LMP: 02/05/13 EDD: 06/02/14	■ 02/09    5 g/dl ■ 09/01    5 g/dl ■ 06/01    12 g/dl Hb Test Due 25/07	08/10 ✓ 10 Tablets 18/09 ✓ 30 Tablets 08/09 ✓ 100 Tablets IFA 180 On 08/10

## Requirements

- low power connected devices
- augmented reality to locate clients
- connectivity even in remote areas
- client lookup to ensure unique entry
- persistent health record with clinical chart images

# mHealth Nutrition Strategies Across Continuum




# Personalized Information

A photograph of a dirt road in a village. Two women are walking away from the camera. The woman on the left is wearing a white headscarf and a green patterned dress. The woman on the right is wearing a white headscarf with red floral patterns and a white dress with a red patterned shawl draped over her shoulders. She is carrying a young child on her back. The child is wearing a blue shirt and grey pants. In the background, there are simple buildings, palm trees, and other people. The sky is clear and blue.

**Clients may travel considerable distances**

# Personalized Information



**... Clients need personalized information to ensure they are empowered to seek services**

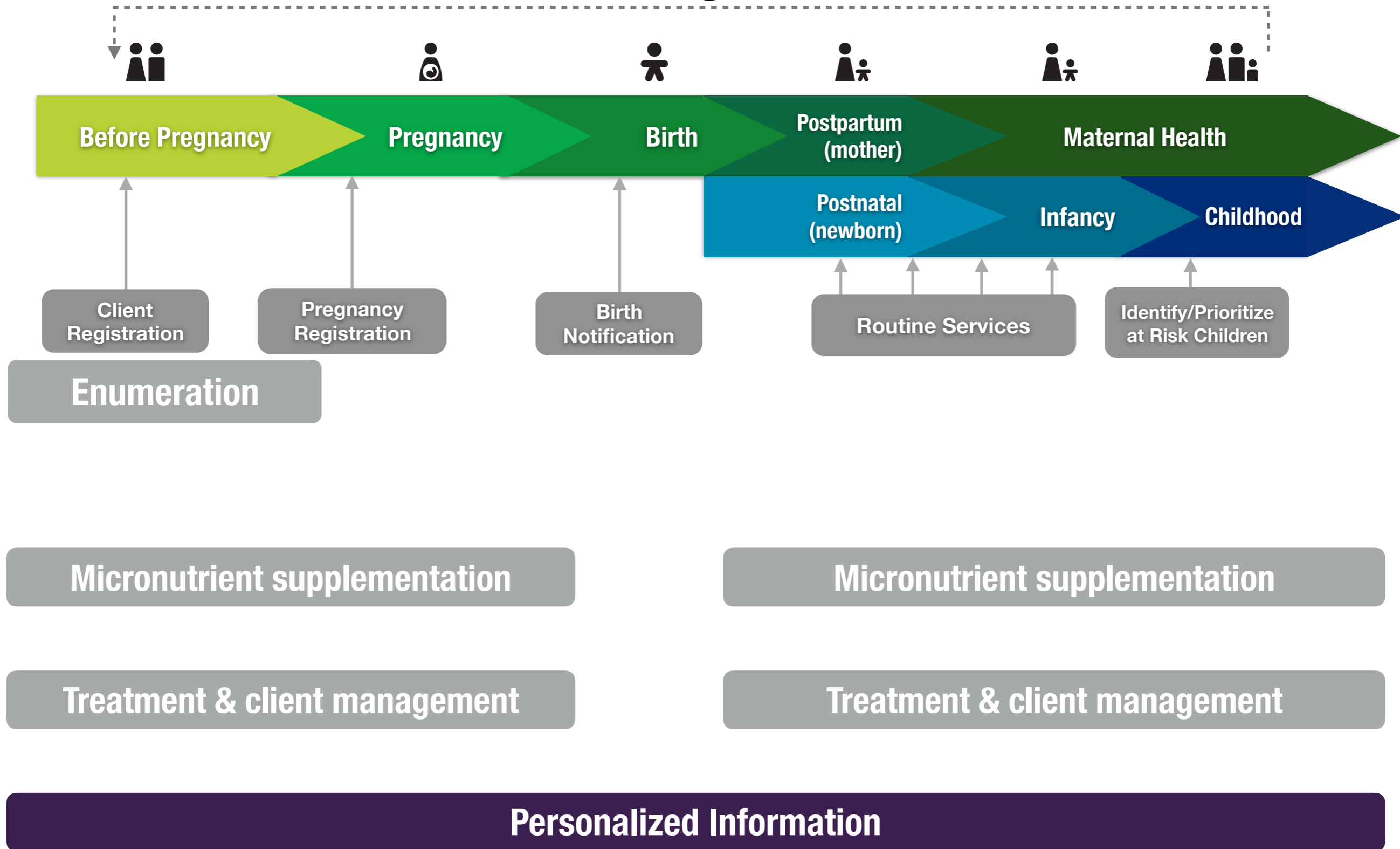
# Personalized Information

## Requirements

- connectivity even in remote areas
- sensors connected to providers
- networked lookup for realtime stock and facility status
- Ability to access personalized record
- Ability to access personalized information



# mHealth Nutrition Strategies Across Continuum



...can facilitate  
decision support,  
treatment, and  
referral

Diagnostics, decision support  
algorithms, to diagnose, refer

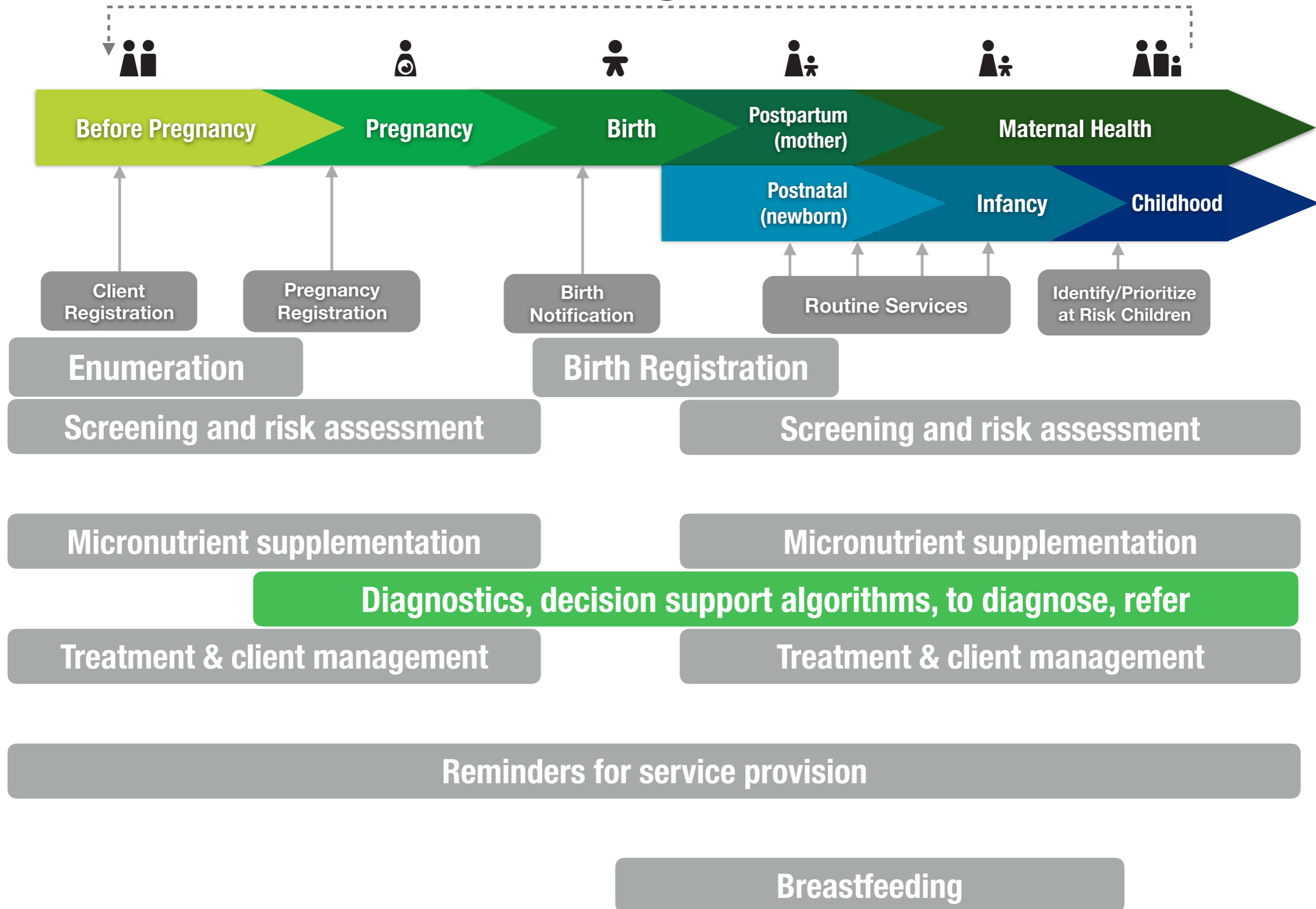


Diagnostics, decision support algorithms, to diagnose, refer

## Requirements

- connectivity even in remote areas
- machine learning from patterns of interventions and outcomes
- linked records to ensure continuity of care

# mHealth Nutrition Strategies Across Continuum



... can help ensure  
that essential  
commodities are of  
quality and in stock

**Maintaining stock of  
commodities**



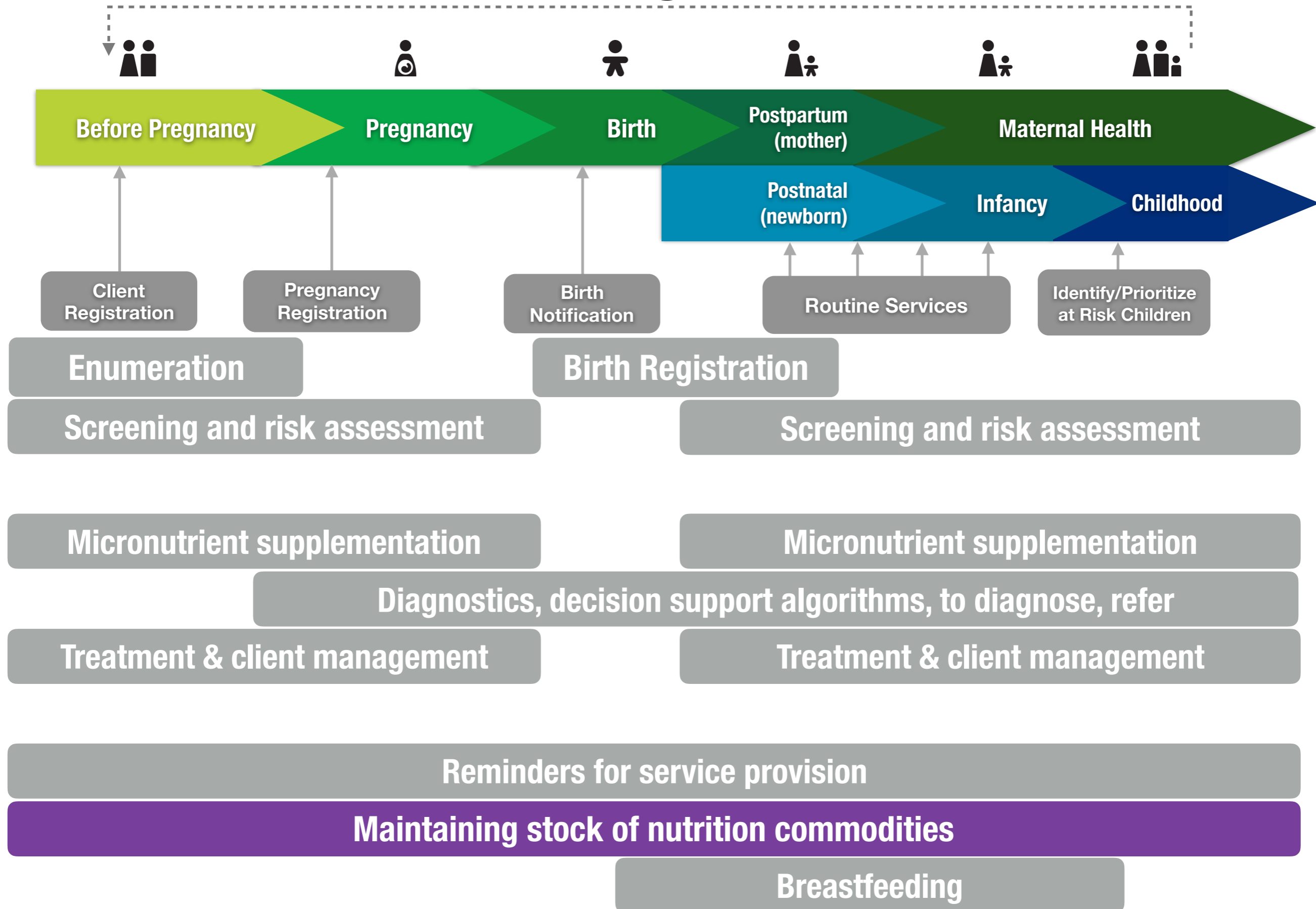
**Maintaining stock of  
commodities**

# Requirements

- connectivity even in remote areas
- real-time assessment of stocks and quality measures (temp)
- smart-approaches to preventing stock out and predicting needs

**Maintaining stock of commodities**

# mHealth Nutrition Strategies Across Continuum



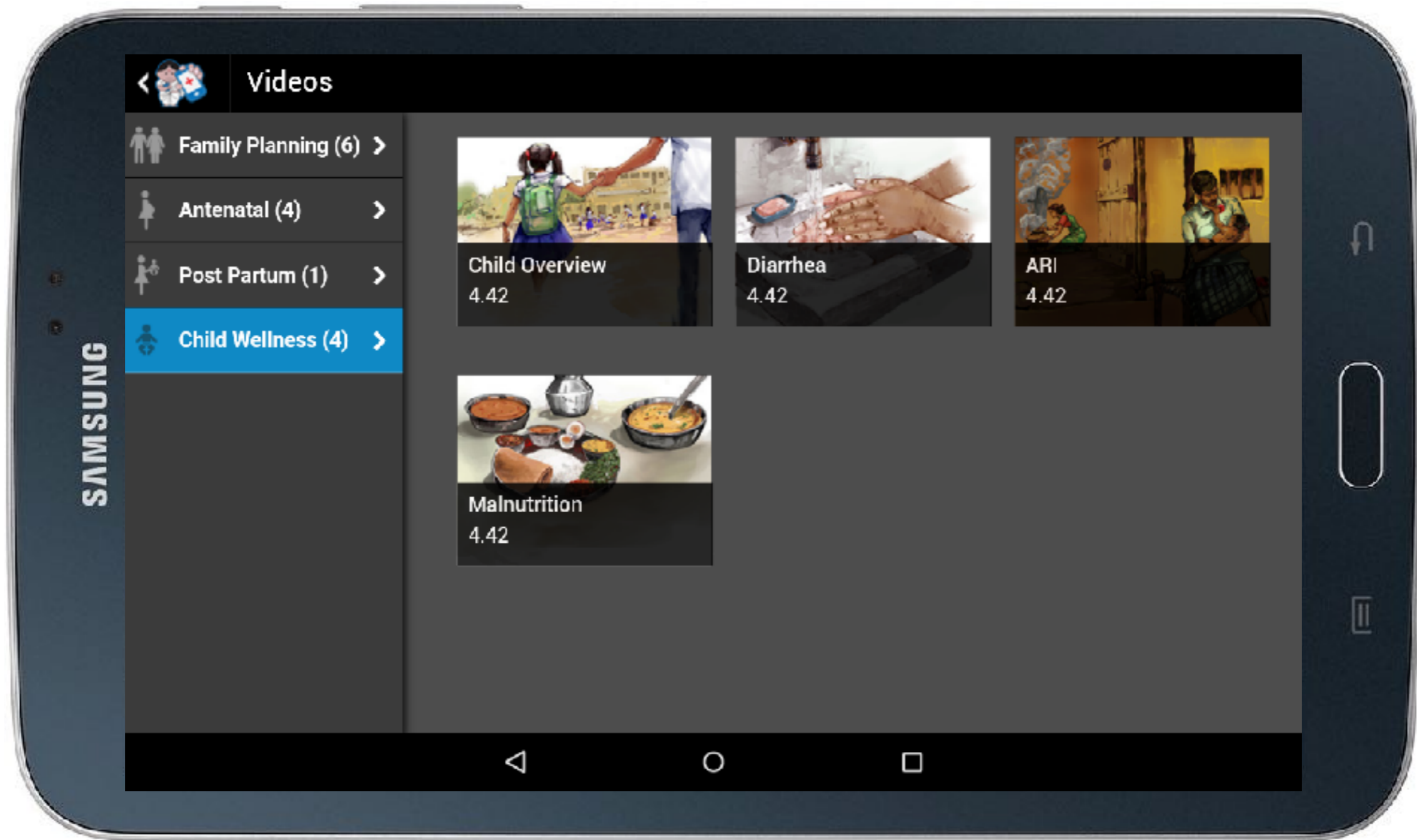


**Health promotion and dietary counseling, including use of multimedia**



**...can remind mothers to seek care for themselves and their children when needed**

# Health promotion and dietary counseling, including use of multimedia

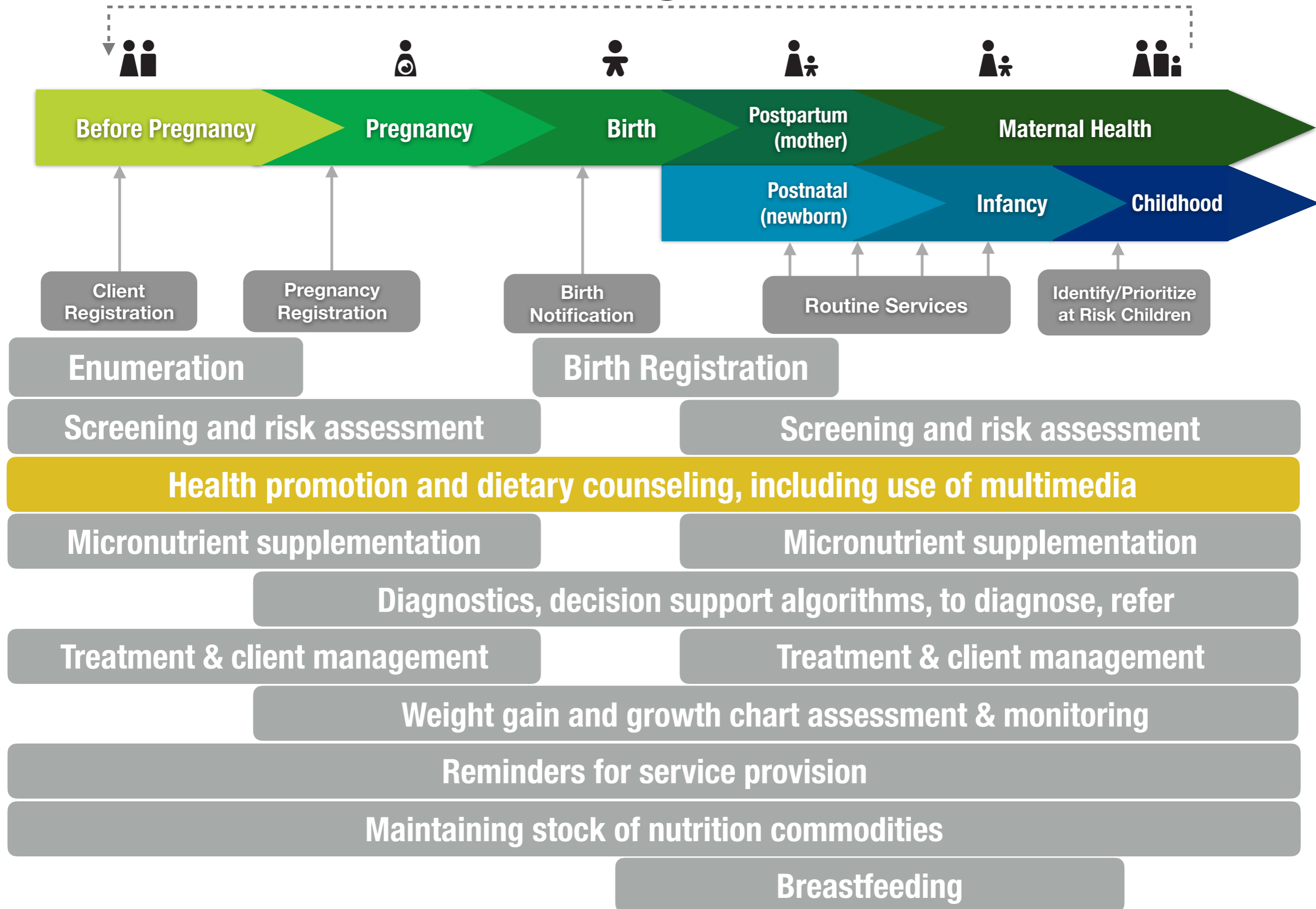


# Health promotion and dietary counseling, including use of multimedia

## Requirements

- ability to access multi-media tailored to client needs
- client access to content

# mHealth Nutrition Strategies Across Continuum

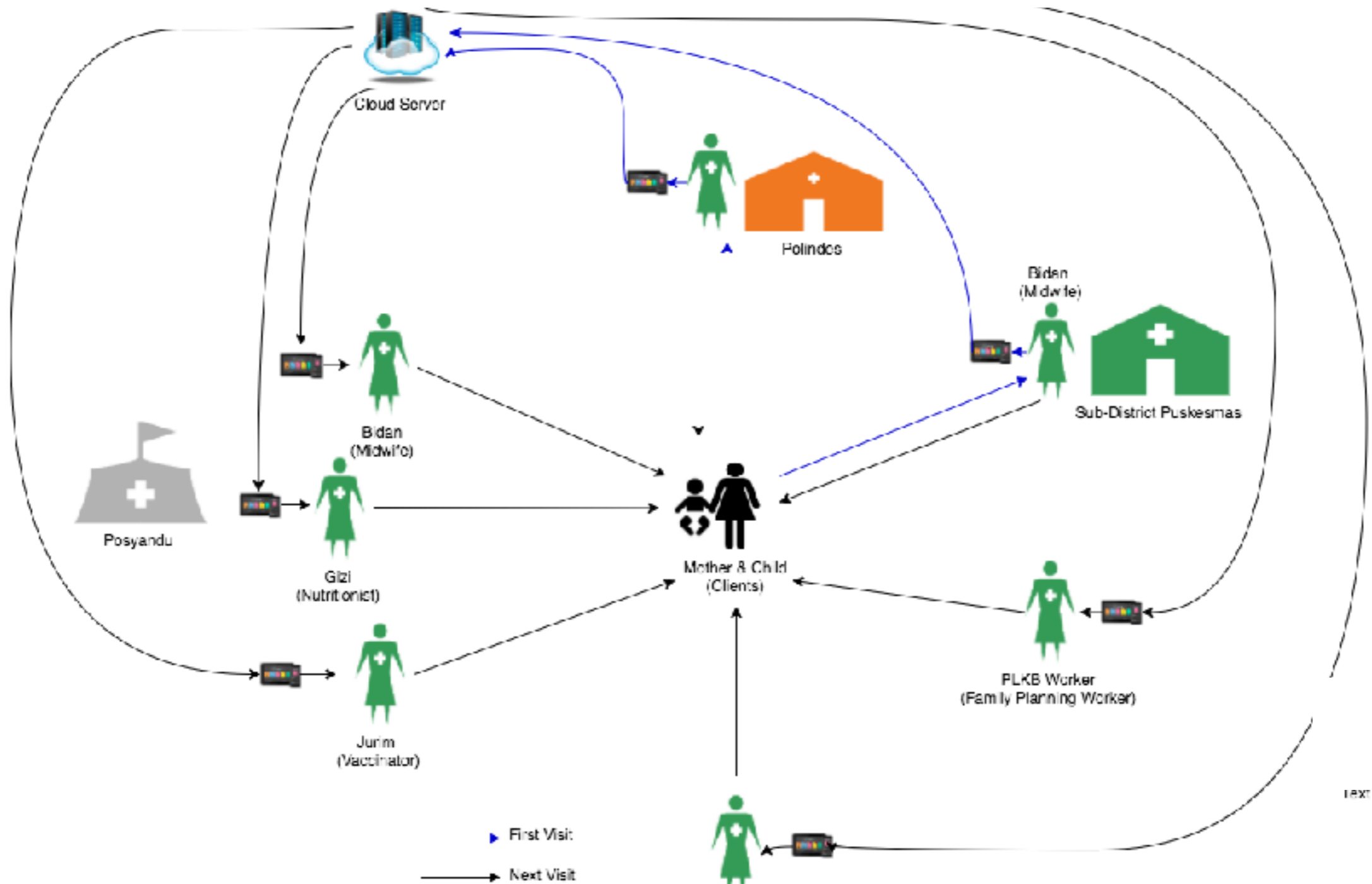


# Coordination and Data Reporting



# Coordination and Data Reporting

## Client Centered Care Provision and Data Flow: Dynamic data driven task allocation and customization



# Coordination and Data Reporting

Facilitates  
coordination  
among health  
workers

# Coordination and Data Reporting

Report Log - RapidSM x CHWs - Uploads - Rap x 4 9xxxx

Imported From Firef...

Recherche

Musique Jeux

NATION WIDE, 01/SEP/2013 - 19/SEP/2013

Import Reports Log -- CSV Export Reports Log -- EXCEL

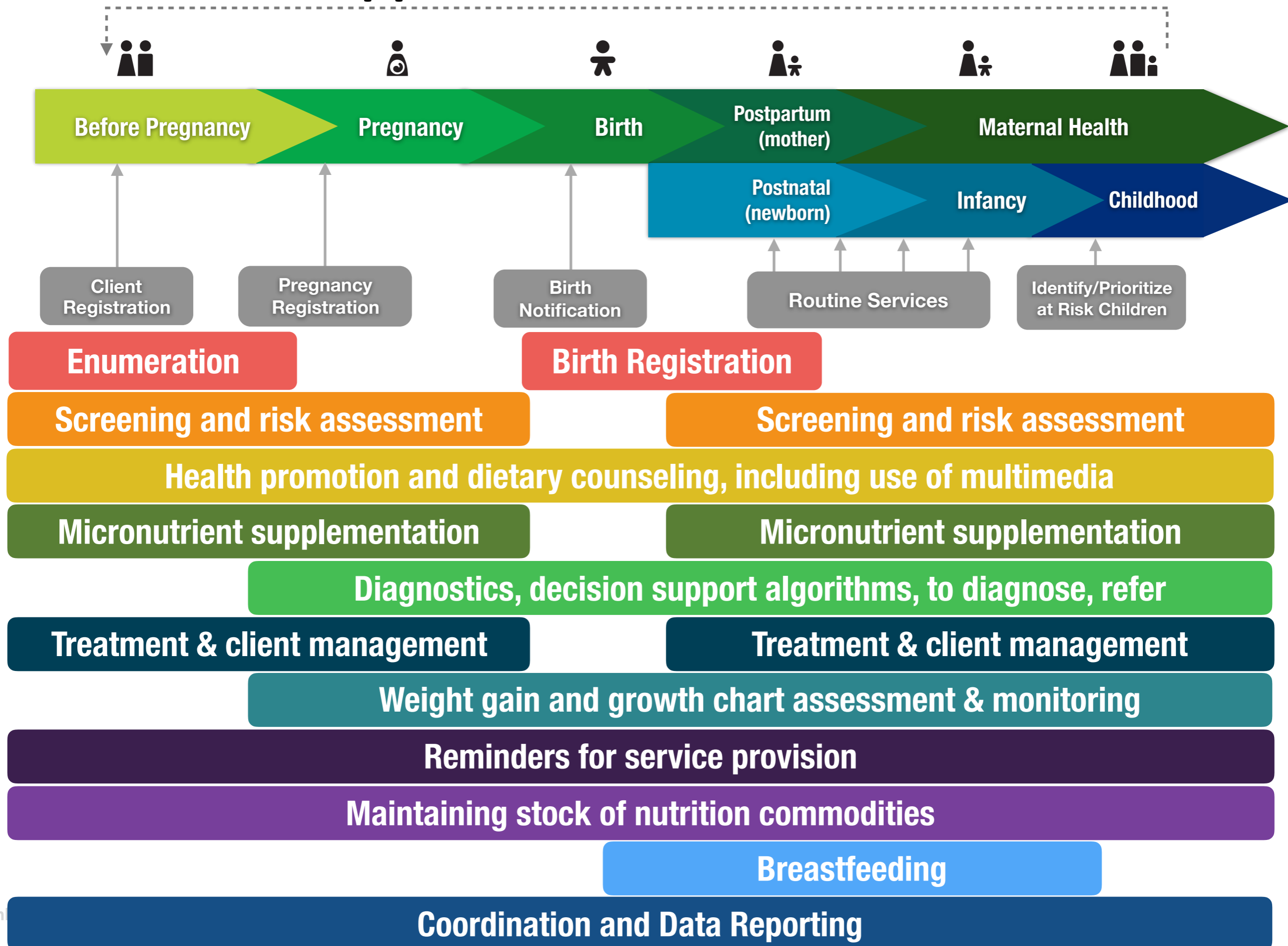
Date	Location	Type	Reporter	Patient	Description
19.09.2013	Rukoma Sake--Ngoma	Community Based Nutrition	1197570084131003	119877015	lementary Breastfeeding, Child Number=1, Child Weight=62.50
19.09.2013	Jarama--Ngoma	Pregnancy	1196170046070019	11987701	6.02.2014, Repetitive Miscarriage, No 9.00, Mother Height=158.00, Gravidity=4.00, as Handwashing, At Health Center/Clinic
19.09.2013	Police--Rukoma	Case Management	1195370036185034	119487002518108	rhea, Child Number=1, Patient Treated,
19.09.2013	Rukoma	Community Based Nutrition	1197680086139068	11990701636	ding, Child Number=1, Child

16:07 19/09/2013

Coordination is possible across cadres for services, and for reporting



# 5G and IOT Opportunities Across Continuum



# Value of IOT and 5G to Health in LMICs

- **Low latency** provides opportunity for diagnostics and biometrics
- **High-bandwidth** allows for large file transfers including multi-media for providers and clients
- **Connectivity** including mesh will provide ability to ensure information exchange can take place anywhere
- **IOT** will facilitate **remote monitoring** to track vital signs and quality of commodities, equipment monitoring
- **voice recognition** can support keyless data entry for even low skilled providers and clients
- **Networked** systems allow for personalized diagnostics and computations to be carried out at the point of care, anywhere

# Thank you

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**WHO, Switzerland**  
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**November 22, 2016**



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and Research Training in Human Reproduction



**World Health  
Organization**