Using mHealth Interventions to Improve Vaccination Coverage

Dr. Abdul Momin Kazi, MBBS, MPH, PhD (Candidate),
Assistant Professor (Research)
Department of Pediatrics & Child Health
The Aga Khan University, Karachi, Pakistan

The New York Times

Opinion

We're Ignoring the Biggest Cause of the Measles Crisis

Text messages the Magic Pill

The New York Times

Slowing the Coronavirus Is Speeding the Spread of Other Diseases

Many mass immunization efforts worldwide were halted this spring to prevent spread of the virus at crowded inoculation sites. The consequences have been alarming.

INTERNATIONAL

THE NEWS

'Automated text, voice messages increase vaccine coverage in Sindh's underserved areas by 26pc'

News Desk

Customized e-health messages communicated to underserved areas of Sindh through Interactive Voice Response (IVR) system led to a 26 percent increase in vaccine uptake, revealed a study conducted by researchers of Aga Khan University.

According to the details issued by the AKU communication department, the exercise with the theme "Paigham-e-Sehat" comprised a randomised con-

The Paigham-e-Sehat study saw researchers from the AKU and the University of British Columbia partner with digital health and telecommunications specialists to develop a variety of mobile campaigns containing targeted

These messages were then delivered through four different mediums to generate evidence on the most effective means to boost demand for routine immunisation.

Participants in the study were also consequently divided into four different groups, one of which received a one-way series of SMS messages providing information on the benefits of immunisation.

The second group got an interactive sequence of SMS reminders and educational messages," Dr Momin Kazi, an assistant professor in paediatrics at child health at the AKU was quoted to have said.

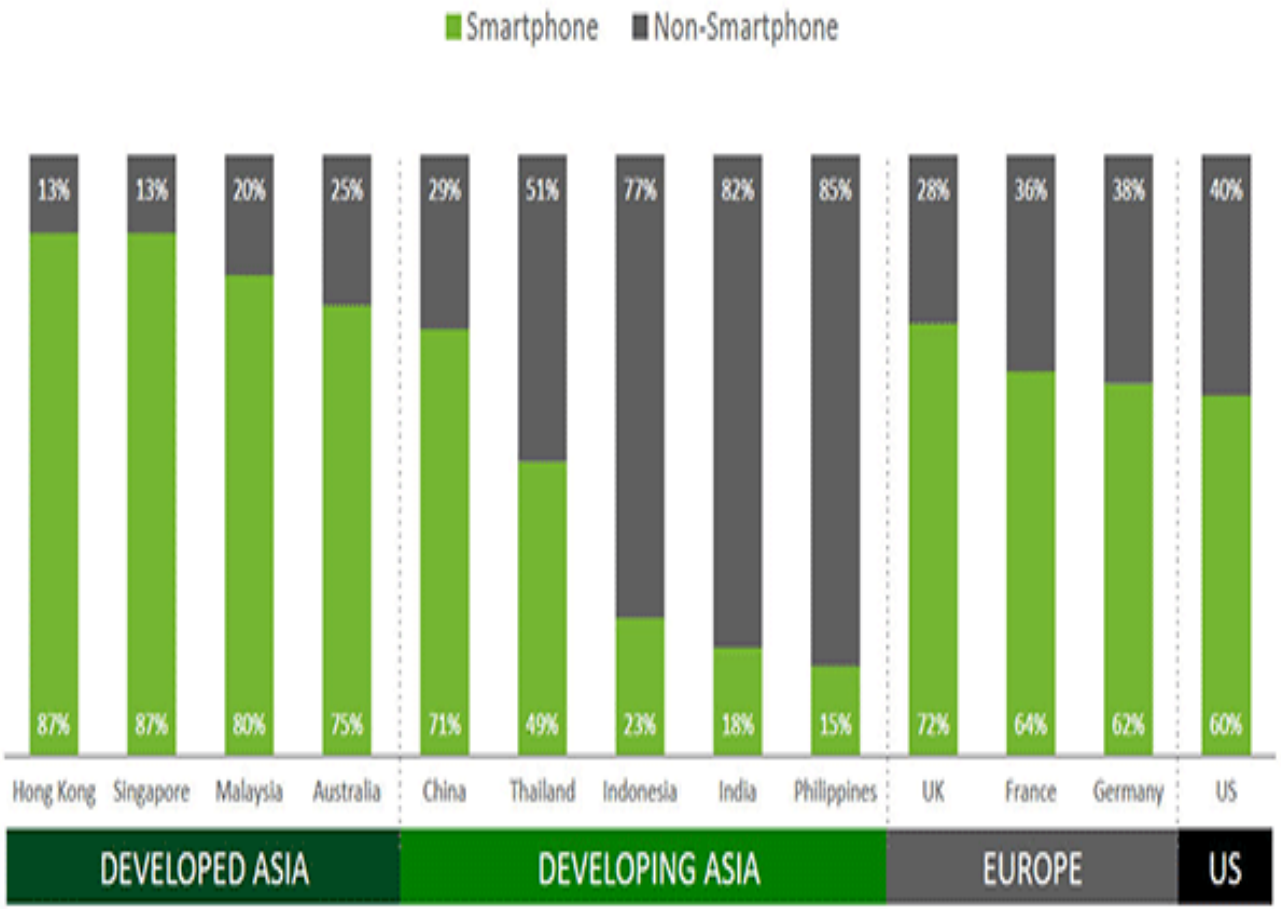
According to Dr Kazi, the study has generated novel insights into the value of voice messages, which is an innovative medium for health awareness.

The study's findings, he said, were particularly useful in contexts where literacy is a challenge, where a variety of local languages and di-

Mobile phone usage across the world

SMARTPHONE PENETRATION

https://www.nielsen.com/bd/en/insights/article/2013/the-asian-mobile-consumer-decoded0/



https://www.brookings.edu/wp-content/uploads/2019/04/20190410_futuredevelopment_Mobile_ownership_2018.jpg

7.7 billion Mobile phone subscribers globally

8.5 billion daily person to person SMS in 2018 globally

Average 32 SMS per mobile phone on a daily basis

However less than 1/3 of the population use Smart phone and hence Interventions that can be used in simple function phone is recommended for generalizability

Textrequest reports USA,2018

Kazi et al JMIR 2018

mHealth Based Intervention- Requirement

Mobile Network's Accessibility or internet

- Mobile phone Coverage

Population access to mobile network

- Usage
- Literacy level
- Technology Savvy

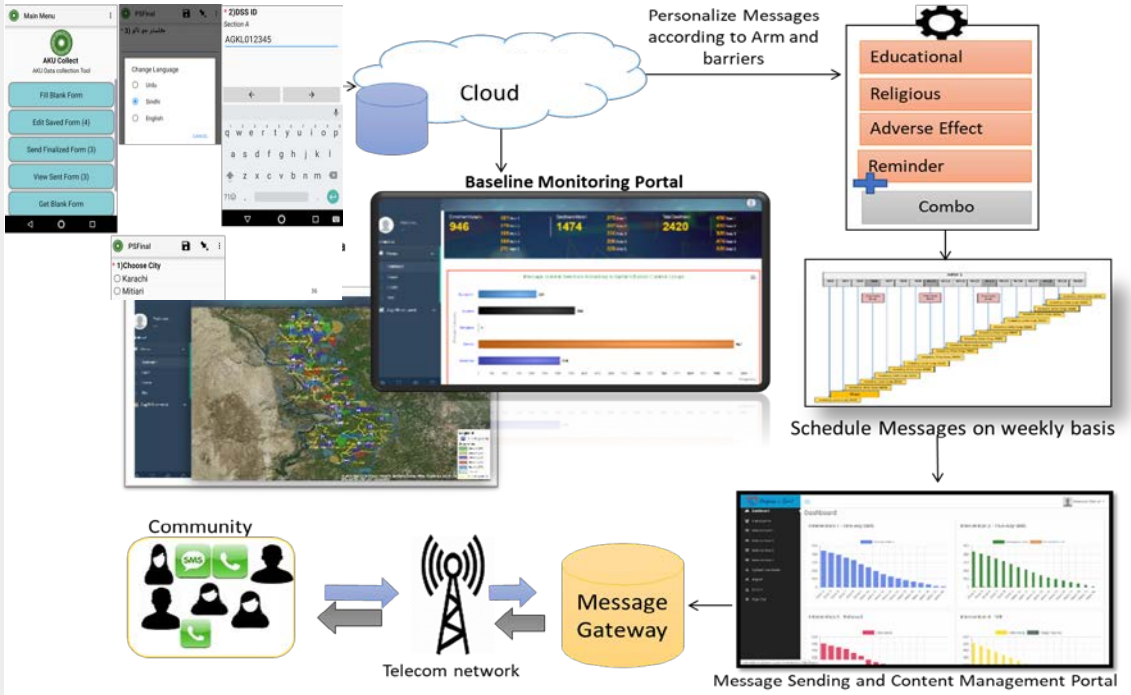
Availability of Electricity

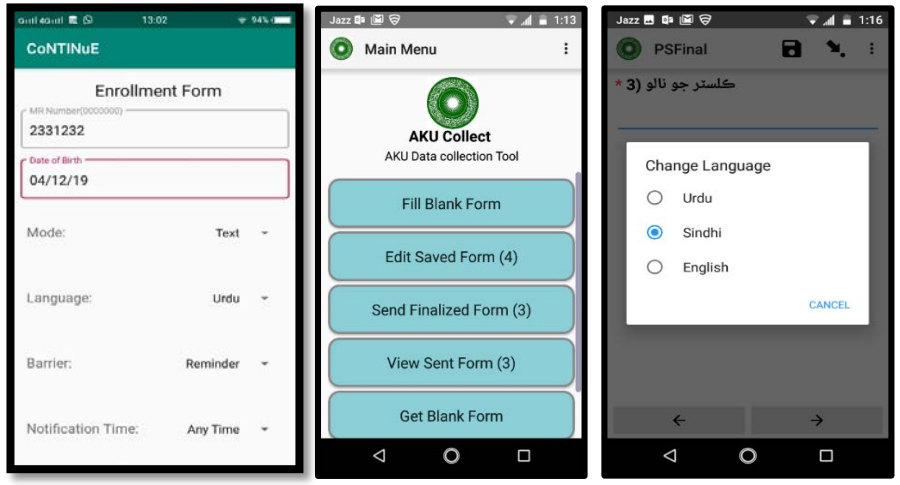
- Timely Charging of Mobile phones

Device Security

- Theft

Infrastructure and Applications





SMS

Text

Automated calls

Text Message Categories

- **Reminder/Recall**
- **Educational**
- **Interactive**

"Your child [name] is due on [date] at [clinic] for vaccines."

Immunization protects your child against killer diseases such as polio, whooping cough, diphtheria, measles, pneumonia and tuberculosis.

[first name] is due for [vaccine or checkup or vaccine and checkup]. Reply 1 for us to call you to schedule , 2 if you will call us or STOP to end messages [practice name and phone number].

BARRIERS TO IMMUNIZATION

- Vaccine Hesitancy
- Lack of knowledge
- Forgetting due date
- Lack of trust
- Adverse effects
- Religious and social barriers

Kazi et al JMIR 2018

9 USA and 3 LMIC (12 studies)

Mobile phone based messages - Global data on

14 USA and 7 LMIC (21 studies)

Type of Intervention	Details	Type of messages	Vaccines covered
SMS based	10	3 reminder messages only and 8 both reminder and educational messages	All childhood vaccinations, MMR, HPV, Influenza and MCV4 or TDAP
Emails	2	Both reminder and educational messages	Pneumococcal vaccine and HPV series

Increase in vaccine uptake and series completion – **1.18 (1.11-.125)**

For parents of children aged 18 and younger – **1.22 (1.15- 1.30)**

This study provided evidence that digital push technologies have a modest, positive impact on vaccine uptake and series

K.M. Atkinson et al. 2019

Type of Intervention	Details	Type of messages	Vaccines covered
SMS based	18	14 studies one-way SMS reminders 1 on one-way SMS reminder plus monetary incentive , 1 on two-way SMS reminders	All childhood vaccinations, HPV, MMR, Influenza
SMS and Automated calls	3	combination of SMS and phone call reminders	HPV, MCV Tdap and Varicella, Influenza
Automated Call	1	Automated calls reminders	All childhood vaccinations

All types of messages as compared to control showed increase vaccine uptake - **1.23 (1.12-.136)**

Messages involving adolescents vaccine only - **2.05 (0.92 4.52)**

The review shows potential for mobile phone based interventions to improve immunization coverage for children and adolescents

Kazi et al personal communication

Systematic Review APPS for Vaccination Coverage

28 studies included

9: pre-post studies
6: cross sectional survey
4: Longitudinal
3: RCT
2: Non-RCT
2: Qualitative
1: Economic
1: Interrupted time series

1: Cost effectiveness outcomes

Usability and Acceptability outcomes

5: Usability
1:Acceptability
3:Both

Participant Perception studies outcomes

9=Perception of Parents
1=Teenagers
1=Mother and vaccination service provider

Primary Purpose of Apps

11: Education
8: Record Keeping
3: Reminders

25 Unique APPS

3: Immunize CA App
2: Morbiquiz
20: studies – different apps

The quality of the included studies was moderate to poor, with many aspects of the methodology being unclear

Uptake on Vaccination Outcomes

9: Vaccination uptake (9/28)
4: Showed significant Improvement in Vaccination coverage (Pre/post design)

1. 17% (*P*=.03)
2. 5% (*P*<.001),
3. 9.7% (*P*<.001), and
4. 17.9% (rural) and 16.4 (urban; *P*<.001 for both)

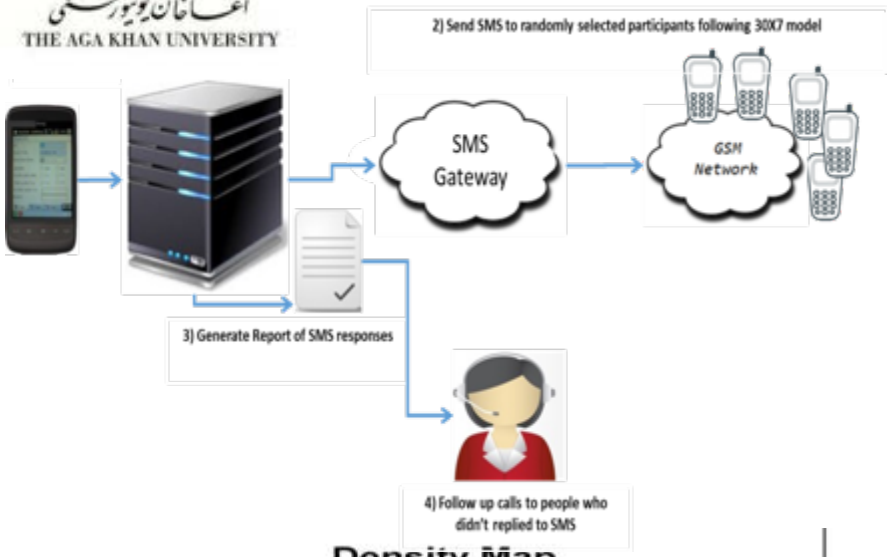
Vaccination Knowledge and Decision making outcomes

10: Impact of the vaccination apps on knowledge/learning

4: Showed statistically significant Improvements (*P*≤.05)
2:No Improvement
4:Improvement but not statistically significance

Caroline et at, 2020.

Monitoring of SIA campaigns- Phase1 and 2



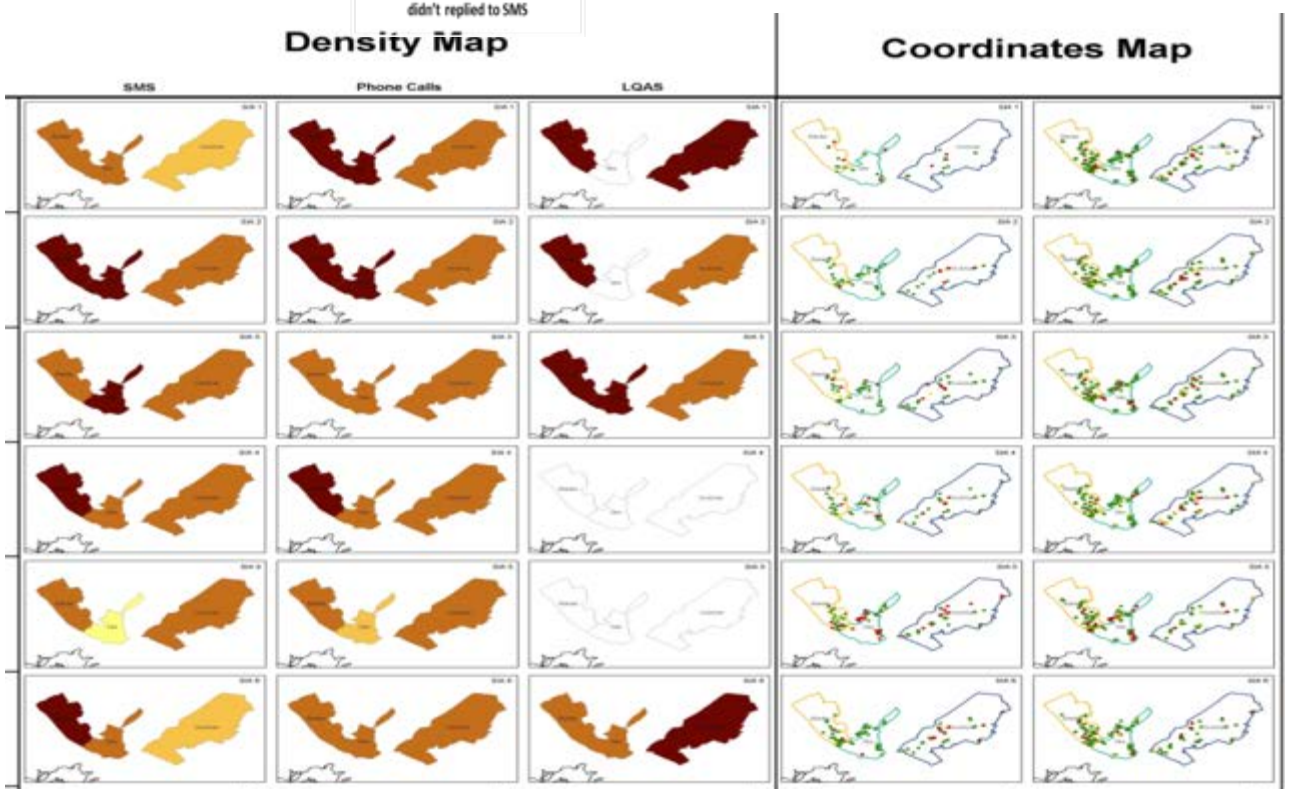
SMS Content - Urdu

Urdu SMS 1

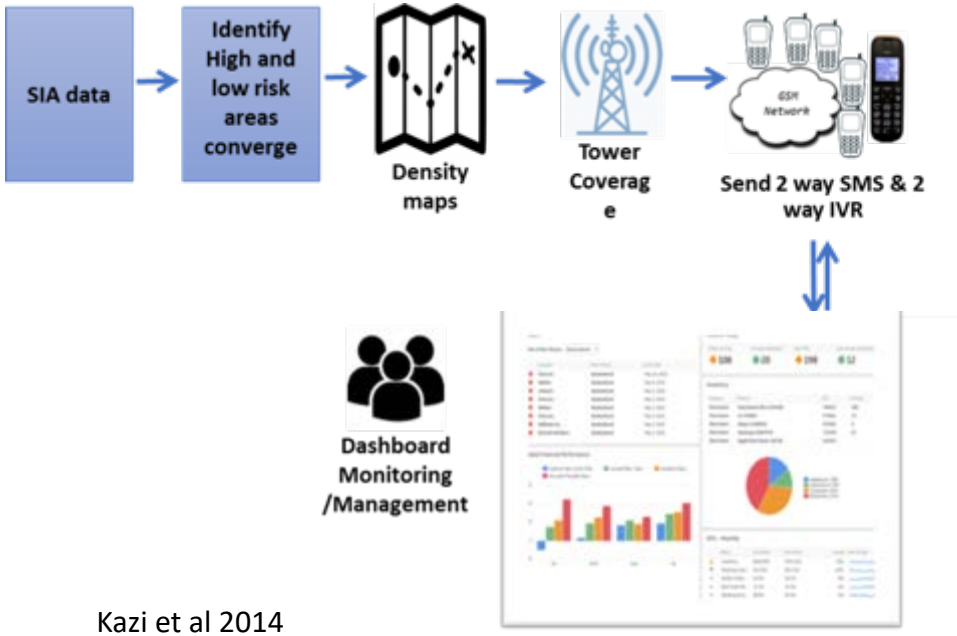
آغا خان یونیورسٹی : کیا پولیو کے قطرے پلانے والے پچھلے ہفتے آپکے گھر آئے تھے؟
ہاں P1 نہیں P2 معلوم نہیں P3 لکھ کر reply کریں

Urdu SMS 2

آغا خان یونیورسٹی: کیا (بچے کا نام) کو پولیو کے قطرے اس ہفتے پلائے گئے تھے؟ ہاں P1 نہیں P2 معلوم نہیں P3 لکھ کر reply کریں



eSurveillance through Tower Coverage- Pilot



Kazi et al 2014

Effect of Mobile Phone Text Message Reminders on Uptake of Routine Immunization in Pakistan: A Randomized Controlled Clinical Trial

- Automated one way reminder messages were sent in the week child was due - 6,10, 14 weeks schedule
- The coverage was consistently higher at each visit
  - Both the ITT and PP analyses
  - Only the RI coverage scheduled at 6 weeks, according to PP analysis, was statistically significant

- 94% of the participants approached had a mobile phone(household), and out of them 99% were comfortable in using text messages

Intention-to-treat and per protocol analyses of immunization rates at 6, 10, and 14 weeks.

Analysis and vaccination schedule	Intervention (n=150), n (%)	Control (n=150), n (%)	*P* value
Intention-to-treat			
Vaccination at 6 weeks	114 (76.0)	107 (71.3)	.36
Vaccination at 10 weeks	88 (58.7)	79 (52.7)	.30
Vaccination at 14 weeks	47 (31.3)	39 (26.0)	.31
Per protocol			
Vaccination at 6 weeks	86 (96)	102 (86.4)	.03
Vaccination at 10 weeks	67 (78)	77 (75.5)	.69
Vaccination at 14 weeks	36 (58)	39 (51)	.36

al JMIR 2018

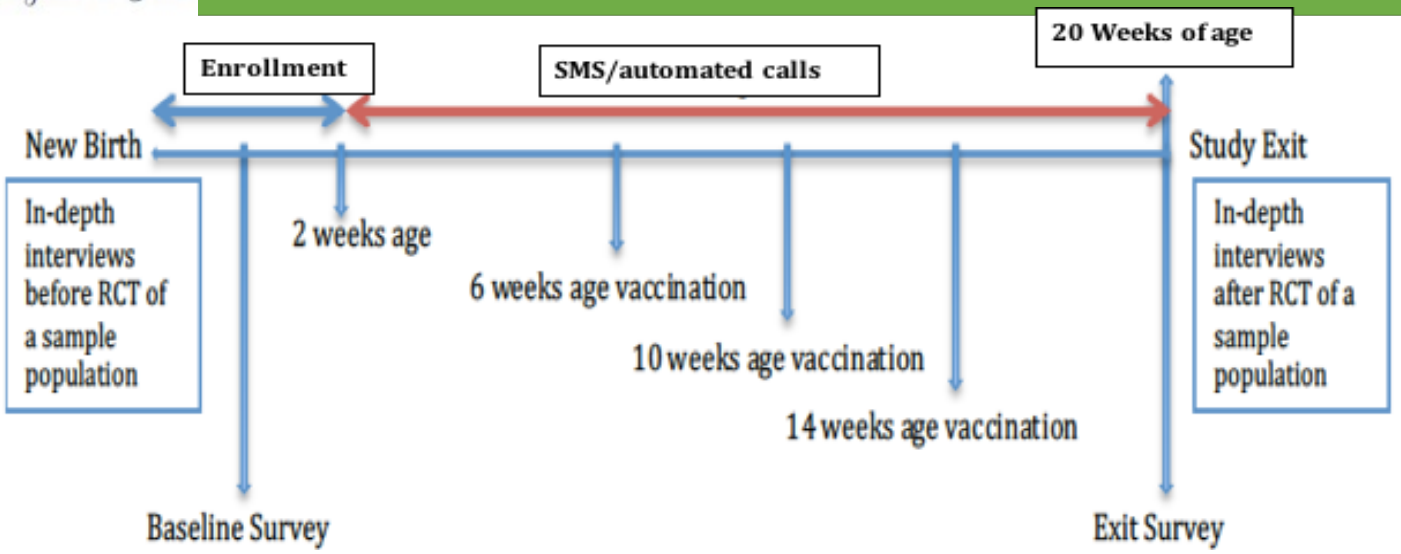
Key Findings

Automated simple one-way SMS reminders in local languages might be feasible for improving routine vaccination coverage

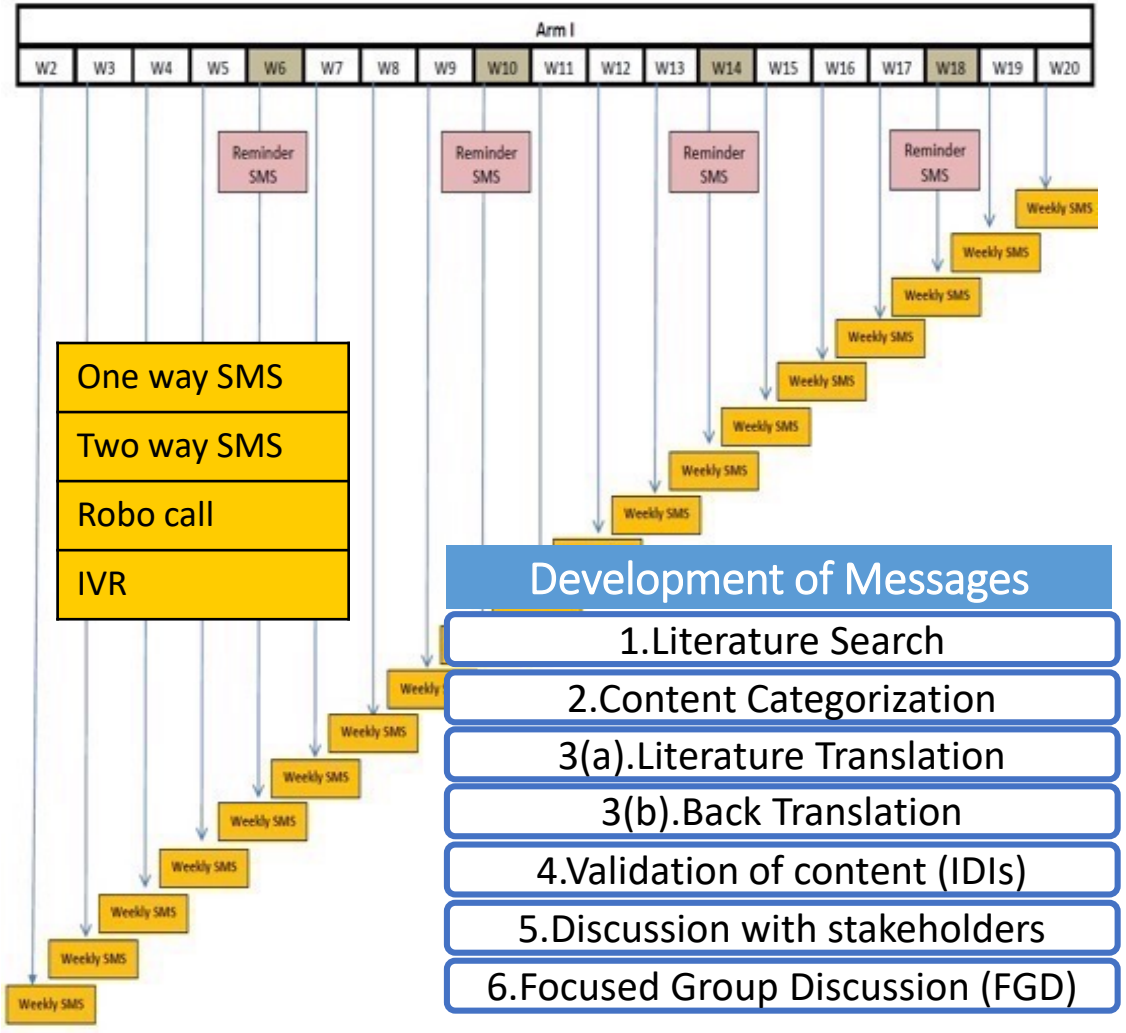
Whether SMS reminders alone alter parental attitudes and behavior needs to be evaluated by better-powered studies, comparing the different types and content of text messages

Information on perceptions, barriers, and text content according to the local settings that may affect SMS-based interventions should be assessed as well

To evaluate the role of mobile phone SMS messages and automated calls in improving vaccine coverage among children in urban and rural districts of Pakistan-Mixed method



INTERVENTION ARM	WEEKLY AUTOMATED SMS TEXT AND AUTOMATED CALLS FROM ENROLMENT TILL 20 WEEKS OF LIFE
ARM 1 (INTERVENTION)	Parents/caregivers will receive one way educational/ reminder/ proactive SMS messages related to routine immunization once a week till 20 weeks of age.
ARM 2 (INTERVENTION)	Parents/caregivers will receive two way (interactive) educational/ reminder/ proactive SMS messages related to routine immunization once a week till 20 weeks of age- parents will have the option to reply and receive more information related to immunization through text messages.
ARM 3 (INTERVENTION)	Parents/caregivers will receive one way educational/ reminder/ proactive automated phone call related to routine immunization once a week till 20 weeks of age.
ARM 4 (INTERVENTION)	Parents/caregivers will receive two way (interactive) educational/ reminder/ proactive automated phone call related to routine immunization once a week till 20 weeks of age- parents will have the option to reply and receive more information related to immunization through phone call.
CONTROL GROUP	NO INTERVENTION



Development of Messages

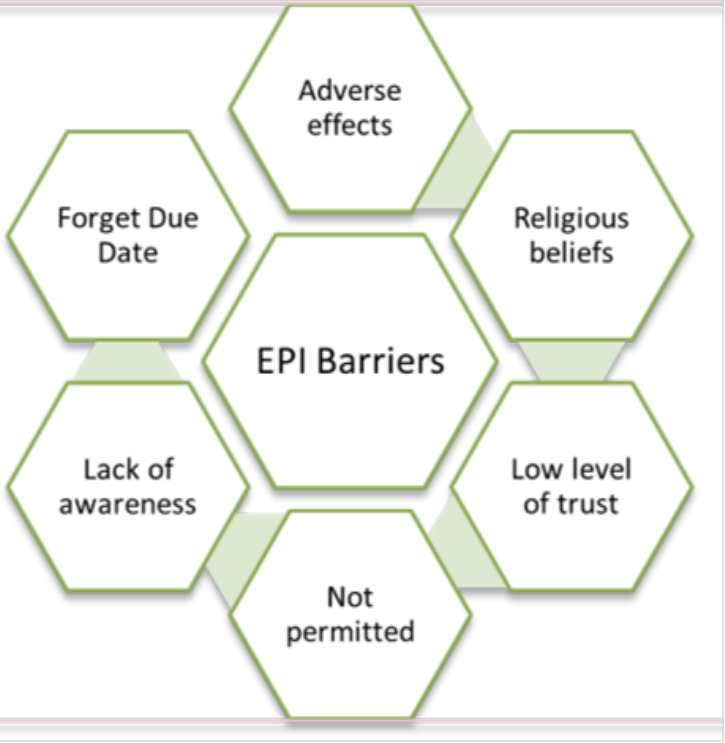
1. Literature Search
2. Content Categorization
3. (a). Literature Translation
   (b). Back Translation
4. Validation of content (IDIs)
5. Discussion with stakeholders
6. Focused Group Discussion (FGD)

General Education | Education Adverse | Education Religious | Reminders | Combo

English	Roman Urdu	Urdu	Roman Sindhi	Sindhi

Qualitative Interviews

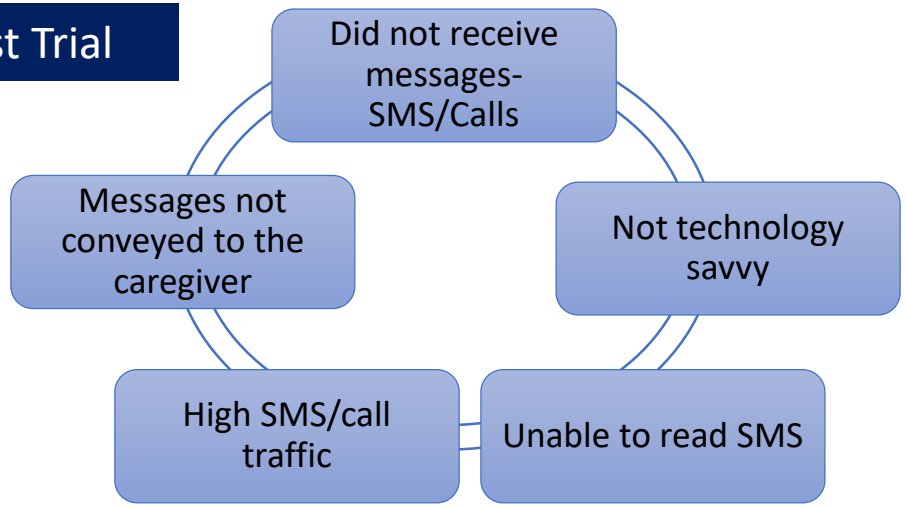
Barriers to Coverage



Messages

- **Preferred language for SMS**
- Roman Urdu and plain Urdu for urban site
- Sindhi written in sindhi script for rural site
- **Preferred language for automated calls**
- Urban for urban site and
- Sindhi for rural site

Post Trial



Trial Findings (n=3383)

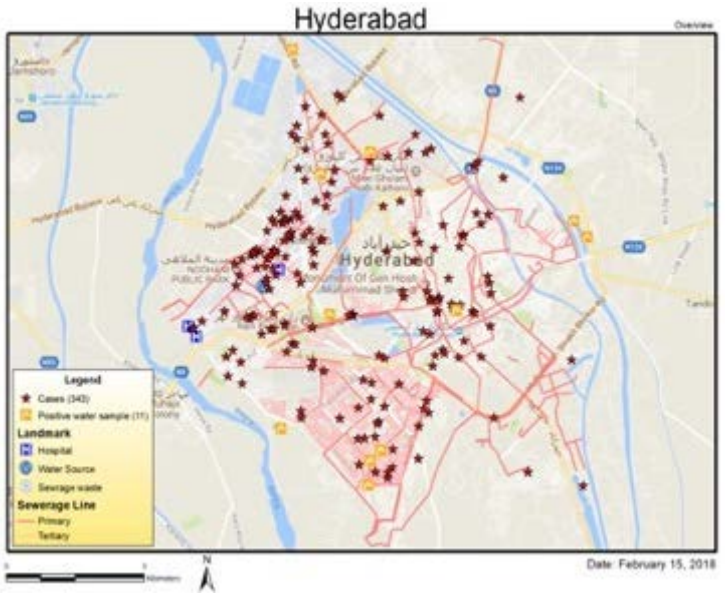
- 79.1% of the respondents used a simple function phone
- 99% of the study participants had access to mobile phone
- Around 50% and 38.4% of the mothers and fathers respectively had no formal education
- 54.5% and 13.8% fathers and mothers respectively owned a mobile phone

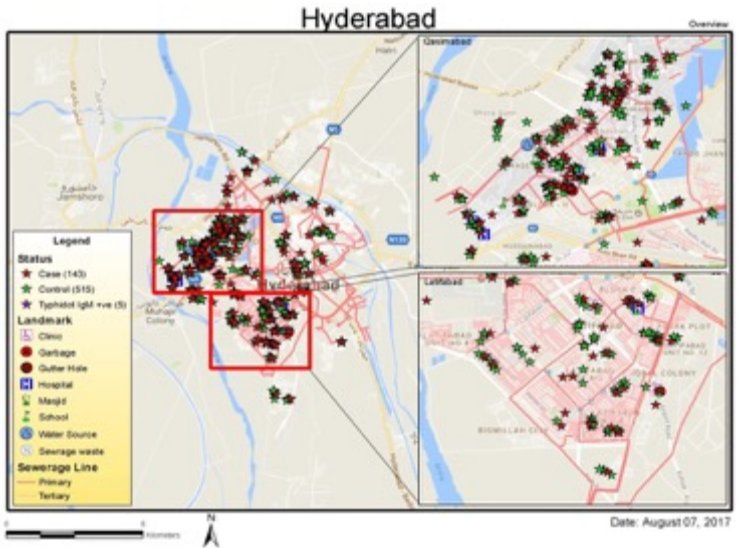
- **In the final PP model IVR risk ratio was 1.26 (p-Value 0.037) with Confidence Interval 1.01-1.52**

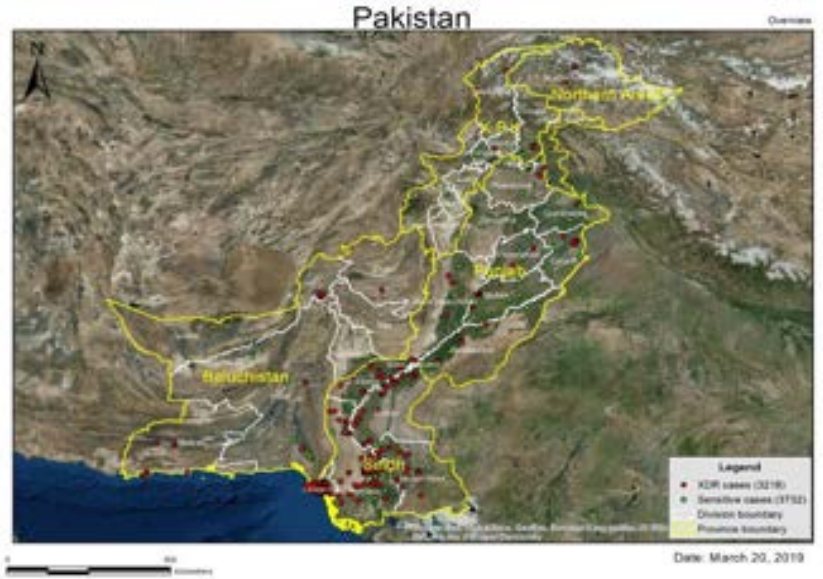
- Information regarding families' perceptions of vaccination and the daily life challenges helped to develop personalized mobile phone messages

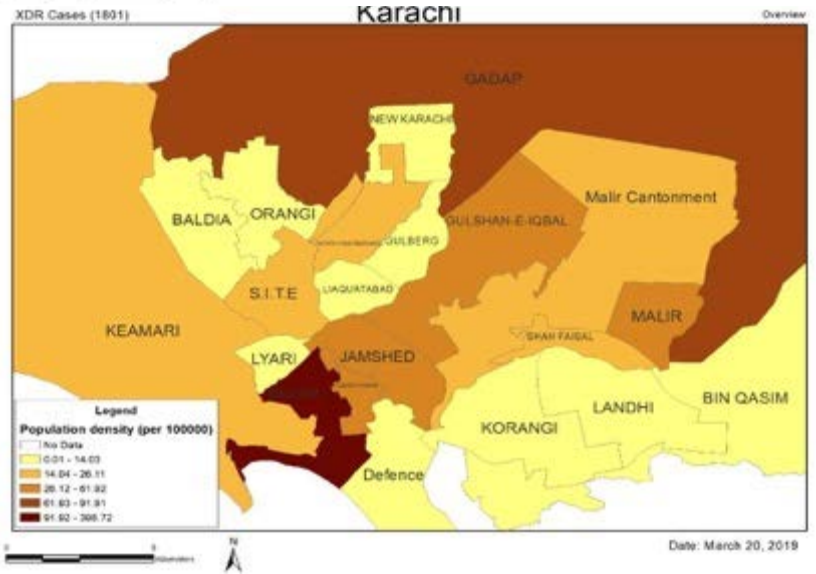
- IVR based intervention personalized according to barriers for immunization should be scaled up
- The **Intervention is useful** but too many families did not get the message

Outbreak investigation of ceftriaxone-resistant *Salmonella enterica* serotype Typhi and its risk factors among the general population in Hyderabad, Pakistan: a matched case-control study

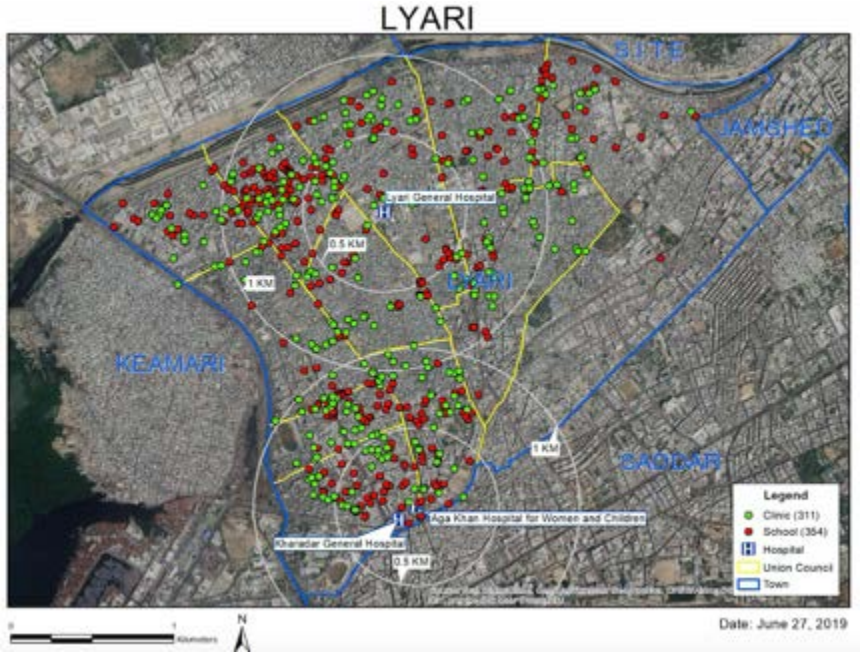








Pakistan approves vaccine against typhoid



Qamar et al. *Lancet Infect Dis* 2018

Challenges in the Use of mHealth Interventions to Increase Vaccination Uptake

Phone ownership/Access	• Father versus mothers • Males vs Females • Access within the community or village
Literacy	• Low literacy rates reduce effectiveness • Language of understanding • Roman local language
Type of messages (Vaccine hesitancy)	• Messages according to the barrier • Vaccine hesitancy forgot • Frequent exposure to messages can weaken
Appropriate infrastructure/not technology Savvy	• Meet the increased demands generated • Not able to receive or sent text messages • Not able to operate smart phones or App
Missed opportunities	• Services advocated for not available • None availability of vaccines or HCP

Conclusion

- Personalized mobile phone messages (barrier based) interventions should be scale up at the program level
- Need for well planned personalized and community-based Knowledge Translation interventions
- Connection with electronic immunization registries for engagement in care with caregivers of children in the routine immunization programs
- Mobile phone based interventions should be adapted to AI and ML models

- Implementation and evaluation both are essential for digital health based intervention
- Evaluating efficacy of digital intervention is important, however looking into “why and how question” is even more important
- Scaling up is complex, requires different stake holders and important to keep in mind “human factors”

Thank you

Study team and staff

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