

# Development and Evaluation of a Mobile App for Guiding Rabies Prophylaxis among Health-Care Professionals in India

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## Abstract

**Background:** The majority of dog-mediated human rabies as well as rabies-related human deaths are reported from low-income countries of Asia and Africa where access to appropriate postexposure prophylaxis is limited or nonexistent. At present, India is second in position after China in terms of having the highest number of mobile phone users surpassing the United States. **Objective:** In this context, we decided to develop a user-friendly, technically less demanding, mobile App for health-care professionals, which is accessible even without Internet facility. **Methodology:** The current study was conducted in four phases, namely assemblage of informational contents on rabies, development of the software, assessment of the reliability of the questionnaire tool and evaluation of the mobile App. The evaluation of App was conducted among physicians and nursing staffs in a tertiary care referral hospital. **Results:** The information content was prepared referring national and international guidelines. The App was designed with Hypertext Markup Language 5 for presentation on the World Wide Web and was coined the name of “RabiApp.” This is a hybrid App of the native App and web App, allowing the information to be stored in the local server. The mobile App was assessed using a validated and reliable questionnaire after confirming the internal consistency by means of Cronbach’s alpha. The overall Cronbach’s alpha for the main scale was 0.788, which was a respectable score. **Conclusion:** The developed App is a user-friendly, easily accessible platform, which can help health-care professionals in making decisions regarding rabies wound management, treatment, and prophylaxis.

**Keywords:** Health-care professionals, India, mobile App, RabiApp, rabies

## INTRODUCTION

Rabies is a neglected tropical viral disease which is vaccine preventable, and cases are being reported from more than 150 countries across the globe.<sup>[1]</sup> This zoonosis is mainly transmitted to humans by the bite of rabid dogs, accounting for 99% of all human rabies cases.<sup>[2]</sup> The United Against Rabies Collaboration formed by international organizations such as World Health Organization (WHO), World Organization for Animal Health Office International des Epizooties (OIE), Food and Agriculture Organization of the United Nations, and Global Alliance for Rabies Control is aiming to achieve zero human rabies deaths by 2030.<sup>[2]</sup> India alone accounts for 35% of the global rabies burden, claiming 18,000–20,000 lives annually.<sup>[3]</sup> Even though very effective postexposure prophylaxis (PEP) is available in many low-income countries, the treatment received is inadequate, partial, or delayed, resulting in increased

mortality.<sup>[4]</sup> A constant incidence of rabies has been observed in India for more than a decade without any declining trend owing to uncontrolled canine population, irregular canine vaccination, limited knowledge of many medical professionals concerning proper PEP, and irregular supply of anti-rabies vaccines as well as immunoglobulin in primary health-care facilities.<sup>[5]</sup>

Both smartphones and the Internet have enabled “health communication” through cloud-based systems, promoting collaborations and sharing of files. In the coming years,

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smartphones will surpass other means of mass education such as radio and television. Meanwhile, the United Nation's commitment to providing Internet accessibility even in the least developed regions of the globe by 2020 is an added advantage to this fact.<sup>[6]</sup> Social networking can connect doctors, health-care workers, social activists, and patients, providing a baseline platform to further knowledge and awareness. In the era of mobile journalism, technology can actively participate in the prevention of fatal diseases such as rabies. Previous studies have highlighted the importance of various mobile Apps for evidence-based information for health-care providers.<sup>[3,7]</sup> Mobile devices and Apps are supportive accessories for health-care professionals facilitating increased access to point-of-care tools, which, in turn, promote better clinical decision-making and improved patient outcomes.

Our objective was to develop a user-friendly software tool which facilitates appropriate decision-making by health-care professionals. This App was developed to guide the professionals through updated recommendations ensuring appropriate management of bite wound, vaccination schedule, the cost of vaccines, and answers to frequently asked questions (FAQs). All the components were incorporated to develop a multi-level interactive mobile App which facilitates awareness about postexposure vaccination as well as preexposure vaccination in humans, after an animal bite. This App targets health-care professionals in order to ensure valid, timely and comprehensive postexposure management of animal bites in low-income countries.

## METHODOLOGY

The current study was conducted in four phases, namely, assemblage of informational contents on rabies, development of the software, assessment of the reliability, and questionnaire used for evaluation of the mobile App.

### Content development

Based on primary classifications on the type of exposure and wound categorization, PEP recommendations, rabies immunoglobulin (RIG) dosage, and route of administration were structured. The necessary and mandatory materials for the content were obtained from the WHO Guidelines for Rabies Pre- and Post-exposure-Prophylaxis in Humans, Third Report 2018,<sup>[8,9]</sup> and Centers for Disease Control and Prevention (CDC) publication.<sup>[10]</sup> The material was further modified in accordance with Indian National guidelines for rabies PEP 2015.<sup>[11]</sup> The informational content was structured in the form of a story dashboard, which was classified into sections consisting of possible sources of rabies, modes of acquisition, classification of wounds, PEP, preexposure prophylaxis (PrEP), immunization of pet animals, and various animal bite wound-related information other than dogs, including a section on FAQs. These questions in relation to PEP and PrEP were prepared after referring WHO guidelines for rabies prophylaxis, National Centre for Disease Control, Delhi, CDC, Atlanta, and compiled.<sup>[9,11,12]</sup> The educational

flowcharts and pictorial representation of do's and don'ts after a bite, with links to WHO and national guidelines, were also enlisted. A list of anti-rabies vaccines and RIGs, along with prices, was prepared so that patients can access the cheapest and the safest prophylaxis available in India. Accurate wound management including wound irrigation and/or debridement, chemical treatment, physical examination for foreign bodies, the decision regarding wound suturing in case of severe or punctured wounds, complete course of RIGs, anti-rabies vaccine, tetanus toxoid injections, and antibiotics dosage were incorporated in the form of data flowcharts and algorithms. The FAQs were sectionalized into human rabies prophylaxis, animal rabies prophylaxis, and animal vaccination schedule. The informational content was validated by a senior virologist, a community medicine expert, a public health expert, and a public health veterinarian.

### Tool/website development

The web-based resources were organized after a thorough literature search of information repositories. The technical development of the tool was conducted by Infouna Technologies Pvt. Ltd., Court Road, Udupi which specializes in website/tool development and optimization. Different variations of data flow models were developed in the form of an algorithm which was later optimized through discussions. To refine the algorithm and data flow, several rounds of discussions were carried out between the vendor and the project team. Once the data flow and algorithm for the tool was finalized, the vendor developed the tool with the given algorithm and specifications for the functionality of the tool [Figure 1].

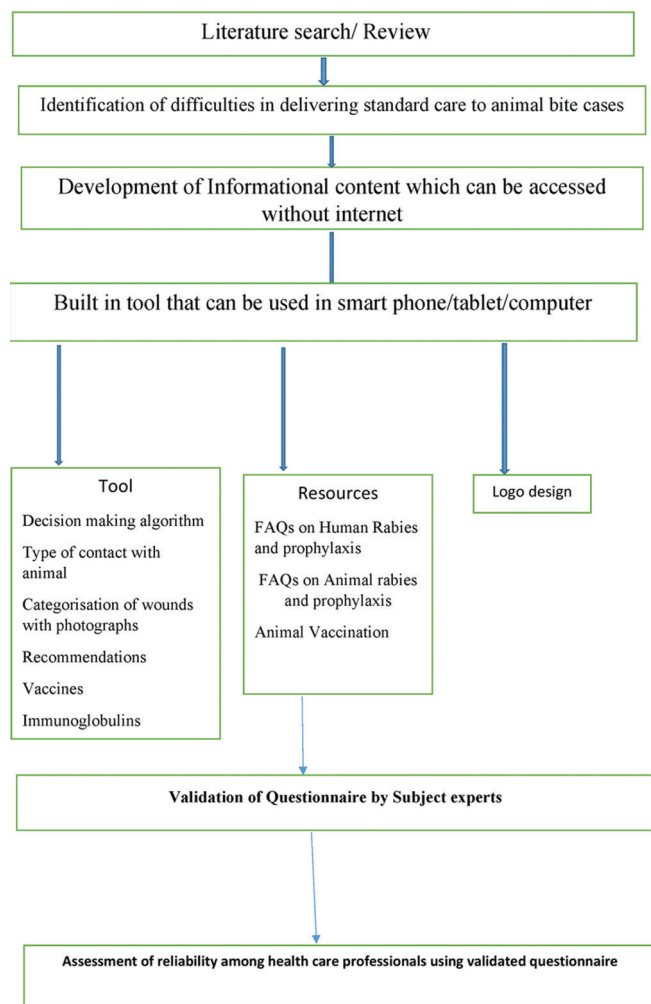
### Measurement of internal consistency of the questionnaire for evaluation of the mobile App

A questionnaire was prepared in consultation with communication experts and was validated by the public health officials for functionality, usability, and esthetics of the tool.<sup>[13]</sup> The reliability of the questionnaire was assessed by Cronbach's alpha.<sup>[14]</sup> A total of 16 questions were prepared, and each item was rated by a 5-point Likert scale.<sup>[15]</sup> Two components such as "App consumes less battery" and "App engages users positively" with an item-total correlation of <0.3 and Cronbach's alpha score of <0.70 were removed. For the final analysis, 12 items were included. Table 1 depicts Cronbach's alpha statistic for each subscale. The overall Cronbach's alpha for the main scale was 0.78, which was stated as respectable. The total score was calculated and interpreted.

The alpha score of <0.60 was considered unacceptable, and the score ranging between 0.65 and 0.70 was minimally acceptable. The scores varying between 0.70 and 0.80, 0.80 and 0.90, and above 0.90 were classified as respectable, very good, and excellent, respectively.<sup>[16]</sup> The questionnaire assessing the mobile App was pilot tested among 21 health-care professionals for validity and reliability at the Manipal Institute of Virology.

### Usability evaluation of the App among end users

The attitude regarding the usability of the smartphone App<sup>[14]</sup>



**Figure 1:** Flowchart of the RabiApp development. The figure depicts the essential components of RabiApp tool development

was evaluated among doctors and nurses working at the Outpatient Unit, Department of General Medicine, Kasturba Medical College, by means of a pilot-tested and validated questionnaire [Table 1]. Each participant noted one of the five levels of agreement/disagreement using the 5-point Likert scale. The data were analyzed using SPSS 15 (SPSS 15.0 for Windows (SPSS™ Inc., Chicago, IL, USA) software. Ethical approval for the study was obtained from the Institutional Ethics Committee (IEC) of Kasturba Hospital (IEC: 470/2019).

### Ethical issues

Before using the RabiApp, health-care professionals will take informed written consent from the participants or assent from guardians. All the participants will be given appropriate and timely management irrespective of their willingness for participation. The present mobile App does not store any personal information, photographs, or biometrics and works offline. Health-care professionals will inform participants about the situations in which they are obliged to reveal the participants' personal information and clinically significant information related to their health.

### RESULTS

#### Representative screenshots of the RabiApp tool

The App was designed with Hypertext Markup Language 5 (HTML 5) for presentation on the World Wide Web. A cross-platform JavaScript library, known as jQuery, was used to simplify the scripting. In order to present the document written in a markup language such as HTML along with bootstrap framework Cascading Style Sheets 3 was used. This framework allowed the user to access the tool from any popular medium such as mobile, tablet, or desktop platforms with customized themes as per the requirements of the developer. The App was named as RabiApp.

**Table 1: The internal consistency of questionnaire**

Components assessed for internal consistency	Scale mean if item deleted	Scale variance if item deleted	Corrected item-total correlation	Cronbach's alpha if item deleted
<b>Functionality</b>				
The App starts fast	52.713	6.835	0.579	0.761
Users can go back to previous screens	53.000	6.769	0.382	0.777
The users can change their response	52.7143	6.681	0.780	0.744
The app proceeds smoothly	52.723	6.881	0.728	0.749
App demonstrates fast response	53.012	7.385	0.671	0.753
Functions are quick	53.2857	8.220	0.304	0.783
Fast navigation to various features is possible	52.8571	7.209	0.424	0.774
<b>Usability</b>				
The App can be used in remote areas	52.643	7.786	0.370	0.778
The App facilitates appropriate care	52.928	7.764	0.307	0.783
The App covers adequate information regarding animal bite management	52.785	7.566	0.377	0.778
<b>Esthetics</b>				
The App is visually appealing	53.224	7.322	0.699	0.746
The App's layout is good	52.375	6.453	0.515	0.766
Overall score				0.788

The RabiApp is a hybrid App of the native App and web App, allowing the information to be stored in the local server. This facilitates customer access without the need for Internet connection and from any digital platform irrespective of the software (iOS, Android, Windows, etc.). For RabiApp, the screen view consists of viewing information in one area. There are five relevant screens such as RabiApp Home Screen, type of contact with the animal, PEP recommendations, immunoglobulins, and resources [Figure 2]. One screen view of choices leads to relevant answers if the appropriate option is clicked. We received the original version of the RabiApp tool on August 20, 2018.

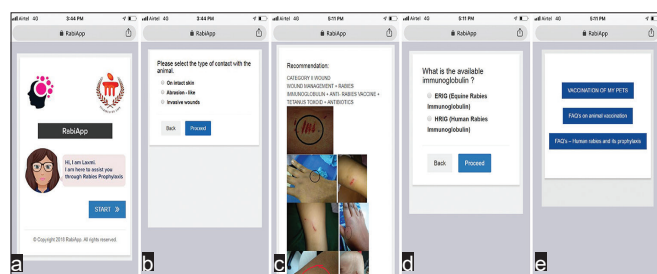
### Evaluation of the mobile App among end users

Fifty-three clinicians and 12 staff nurses working at Outpatient Unit of Medicine Department, Kasturba Hospital, Manipal, were approached for evaluating the mobile App. Out of the 65 health-care professionals, 45 clinicians and 5 staff nurses were willing with an acceptance rate of 76.9%. The main reason for not evaluating the App was busy work schedule. The overall score ranged between 12 and 60. The scores between 40 and 60 were considered “good attitude.” Meanwhile, a score between 21 and 39 was considered of moderate attitude and a total score below 20 indicated poor attitude.

All the study participants expressed good attitude regarding the App. Majority of the study participants strongly agreed with all the 12 attitude statements (78%–92%), as shown in Table 2. None marked options such as “disagree” or “strongly disagree.” Even though the fact that the App works well without Internet access was strongly approved by most of the end users (78%), few were skeptical as the study setting was of semi-urban (22%).

## DISCUSSION

RabiApp facilitates appropriate decision-making by health-care professionals while encountering animal bite wound cases. The alpha testing as well as beta testing (user acceptance testing/end user testing) of the tool was observed to be respectable. To the best of our knowledge, this is the first mobile App developed in India for guiding health-care professionals regarding animal bite wound management.



**Figure 2:** Representative screenshots of RabiApp. (a) Home screenshot of RabiApp. (b) Screenshot depicting the type of contact with the animal. (c) Screenshot of postexposure prophylaxis recommendations. (d) Screenshot of immunoglobulins. (e) Resources

However, a mobile App to track stray dogs by global positioning system (GPS) and monitor mass canine vaccination program to prevent canine rabies was developed by the United Kingdom-based charity group known as “mission rabies,” which was implemented in various parts in India.<sup>[17]</sup> The mission rabies App permits fast data collection during rabies vaccination campaigns in Africa, Asia, and South America. A researcher from Tanzania, a low middle-income country, developed an App for health workers to record information on dog bite cases and treatment in 2016. This multisectoral mobile phone system assists in reporting of animal bites and human as well as animal vaccine use.<sup>[18]</sup> Haiti, a Caribbean State where an estimated 90% of adults have cell phones, uses text messages and reminders to improve vaccination coverage of dogs since 2017.<sup>[19]</sup>

The estimates of direct mortality and disability-adjusted life years due to rabies are often underestimated due to the poor surveillance, underreporting, frequent misdiagnoses, and absence of coordination among all the sectors involved in the management of the cases in developing countries. Less than half of the dog bite cases receive the modern cell culture-derived vaccine after being bitten by a rabid animal.<sup>[20]</sup>

Within a short span of time, we have developed a mobile smartphone App to assist the clinicians and nurses in managing animal bite wounds appropriately.<sup>[21]</sup> We have incorporated the recent WHO 2017 updates of rabies immunization. Beta testing was performed by the target population or end users at the real-time environment.

Smart Apps can be designed and developed for African and Asian countries, which report the majority of human rabies cases.

Upcoming versions of the App will assimilate notification systems for the general public including vaccination dates, GPS locations of nearest vaccination clinics with access to immunoglobulins, locally available anti-rabies vaccines, and education materials. Once the App is disseminated among end users, timely updating and scrutinization of the App are very essential in the public health perspective. A survey will be carried out to assess the influence of the App regarding the knowledge, attitude, and practice of health-care professionals in public as well as private health-care sectors. In order to achieve advanced accessibility and improved dissemination of the App, detailed data will be acquired on the user’s opinion of the App, including reasons for using as well as not using in the clinical setting. Such data will be used to include further additions to make the App more user friendly and informative. In future, the study team will be using the push notification function for alerting the health-care officials regarding recent updates such as any new cost-effective regimens.

In the present study, due to time as well as financial constraints, the study team had to opt for asynchronous testing. Another limitation was the absence of push alert notification function in the App.

**Table 2: Evaluation of the mobile App by health-care professionals (n=50)**

Statements	Number of health-care professionals reporting their attitudes				
	Strongly agree, n (%)	Agree, n (%)	Neutral, n (%)	Disagree, n (%)	Strongly disagree, n (%)
Mobile App starts fast	42 (84)	8(16)	0	0	0
Users can go back to previous screens	46 (92)	4 (8)	0	0	0
The users can change their response	43 (86)	7 (14)	0	0	0
The App proceeds smoothly	41 (82)	9 (18)	0	0	0
App demonstrates fast response	45 (90)	5 (10)	0	0	0
Functions are quick	43 (86)	7 (14)	0	0	0
Fast navigation to various features is possible	43 (86)	7 (14)	0	0	0
The App can be used in remote areas	39 (78)	10 (20)	1(2)	0	0
The App facilitates appropriate care	44 (88)	5 (10)	1 (2)	0	0
The App ensures adequate information regarding animal bite management	43 (86)	7 (14)	0	0	0
The App is visually appealing	42 (84)	7 (14)	1 (2)	0	0
The App layout is good	43 (86)	2 (4)	5 (10)	0	0

## CONCLUSION

To conclude, the RabiApp will assist in making quick and reliable evidence based decisions regarding rabies prophylaxis.

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## Conflicts of interest

There are no conflicts of interest.

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