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# Enhancing Management of Nutrition Information Using Mobile Application: Prenatal and Postnatal Requirements

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**Abstract:** Malnutrition contributes to over one half of the deaths of children under age of five years in developing countries and is the single greatest cause of child mortality in Tanzania. Investigations reveal that the issue of malnutrition is aggravated by lack of nutritional information especially in rural communities. Absence of proper tools makes collection, management and access to nutrition information very difficult. The aim of this study is to improve accessibility of nutritional information by taking advantage of the advanced mobile technologies to integrate a mobile-based information management platform with existing Health Information Systems. The platform will give mothers instant access to nutritional tips, allow them to interact with nutrition practitioners and help in record keeping. In this paper, we present the requirements of a mobile application for managing prenatal and postnatal nutritional information. The requirements have been established from interviews with the various stakeholders and literature reviews. The established requirements become a necessary input towards development of a complete mobile-based nutrition information management platform, which is to be integrated with existing health information system.

**Keywords:** Mobile application, nutrition information, requirement specification.

## 1. Introduction

Nutrition information is information that provides general knowledge supporting understanding associations between food and health. Managing this information plays a critical role in improving health care provision at facilities.

According to the Tanzania Communications Regulatory Authority (TCRA), mobile phone technologies are now in the hands of more than 31 million people in Tanzania and the number of internet users has kept growing significantly reaching 9.3 million users in 2014; equivalent to 20% of the 45 million people in Tanzania. [1].

When developing the mobile application for managing nutrition information, requirement analysis as the first stage in the system development must be well documented to generate the desired specifications. This paper presents functional and non-functional requirements as well as the design for developing an integrated mobile application to enhance management of nutrition information using Arusha city as a case study.

The requirements specification process highly depends on the knowledge to allow communication between the user and system developer so as to develop the right system [2]; it serves as the basis for the design, implementation, testing and maintenance of the target system. This paper focuses on the requirements needed to enhance collection and delivery of nutrition information by using an integrated mobile application that will facilitate an interactive flow of nutrition information.

## 2. Objectives

Currently, the issue of malnutrition in Tanzania is aggravated by various challenges including poor access to appropriate nutrition information especially in rural communities. However, it was difficult to use the technology in the past because of poor mobile phone penetration and readiness. As a result, there have been very few mobile technologies based nutrition information management systems, which match our context. Recently, mobile phone penetration and readiness have significantly increased and therefore it is anticipated that nutrition information management systems that are designed according to the current socio-economic (affordability) and physical environment (connectivity) realities have the potential to bring about real change.

Nutrition information needs to be easily accessed and shared to improve service delivery and influence change in nutritional status. Access to different information contributes to poverty reduction and improved quality of life, especially for people living in rural areas [14]. The difficulty of access to information about nutrition greatly affects mothers and children particularly those living in remote areas.

In response to this, the study aims to enhance collection and delivery of nutrition information by using an integrated mobile application that will facilitate an interactive flow of nutrition information between nutrition practitioners, researchers and patients especially mothers.

### 2.1 Justification

Data models of most systems are poorly designed. As a result, users are flooded with information when using the system. In our study, we take that into consideration when designing a more effective data model by categorizing nutrition information into tips and recommendations.

## 3. Methodology

The requirement gathering exercise was conducted in the Arusha region. The method used in this study was based on qualitative research methods, which consists of an investigation that seeks answers to a question [3]. Interviews were conducted for the collection of information. We interacted with the nutrition practitioners together with prenatal and post-natal mothers, asking some questions and noting down the important data for requirement specifications. Other methods such as literature review were also used.

### 3.1 Literature review

Various studies have been done to collect basic information about this study. Review of different studies related to mobile technology for enhancing management of nutrition information was conducted. Likewise, the empirical literature helped in scrutinizing other alternatives to solve the problem of inefficiency management of nutrition information.

Mobile technology in Tanzania: Mobile technology is the technology used for cellular communication. In the context of this study it refers to the tool used for enhancing management of nutrition information. In Tanzania, there has been a widespread use of mobile technology in various sectors including health and it has proven to be a vital medium for accessing and dissemination of information. The mobile phones appear mostly compatible to work in health and there is a growing body of evidence that demonstrates the potential of mobile communications to radically improve healthcare in some of the most remote and resource-poor environments [4]. Mobile phones have been the most widely growing media technology in Tanzania in recent years compared to other media [5], and due to extensive availability and their inexpensiveness mobile phones are perceived as potentially powerful tools for behavioural change [6].

Malnutrition situation in Tanzania: In Tanzania malnutrition is a contributing factor in an estimated 130 children deaths every day [7] and half of all children deaths are attributable to malnutrition [8]. Despite improvements over the past years, the rate of malnutrition among Tanzanian children remains high. Malnutrition is also linked to one-third of all under-five deaths, making it the single largest cause of under-five deaths in Tanzania. In addition, approximately 22% of children are underweight (low weight-for-age), which is a composite measure of long- and short-term under nutrition. The Sustainable Development Goals (SDGs) aim to end all forms of hunger and malnutrition by 2030, making sure all people – especially children and the more vulnerable – have access to sufficient and nutritious food all year round and this involves the use of technology for improvement [9]. Information systems such as MTUHA/HMIS, TDHS, FSNA/RVA and MUCHALI are used to collect and manage nutrition information at different levels. These systems collect only a subset of the key nutrition indicators and major nutrition indicators such as optimal infant feeding indicators have not been considered. In addition to this there are weaknesses regarding collection, management and use of nutrition data, including limited access, dissemination and sharing of nutrition information [10].

Other related work: CARE developed mobile phone applications for early childhood development (ECD), as part of their efforts to tackle malnutrition. This application was designed to connect people in isolated communities with information and skills to assess, protect and improve the health of children [11]. However, the limitation of this study is that there is no single magic bullet for nutrition and early childhood development. Mobile Alliance for Maternal Action (MAMA) uses technology to improve health and nutrition outcomes among pregnant women and new mothers and their infants in resource poor settings. It empowers women in low resource settings to improve and protect their own health and that of their children and families. MAMA uses mobile technology to deliver time sensitive, stage based information on critical health issues directly to expectant and new mothers [12]. The Tanzania Healthy Pregnancy, Healthy Baby Text Messaging Service (HPHB) otherwise known as Wazazi Nipendeni, offers free maternal and early childcare health information to subscribers of all networks. The service seeks to assist health professionals in the dissemination of information typically shared during antenatal care (ANC) visits [13]. This study uses SMS as delivery channel and SMS recipients cannot respond to messages, which would be beneficial for answering questions and collecting data.

#### 4. Technology Description

In this study, the requirement specifications involve functional and non-functional requirements. Functional requirements capture the intended behaviour of the system which may be expressed as services, tasks or functions the system is required to perform [15]. The study also argues that, non-functional requirements capture required properties of the system and show how structural aspects of the system should be accomplished. The requirements for developing an integrated mobile application for enhancing management of nutrition information have been specified in tables below. Table 3 shows non- functional requirements and Table 4 shows functional requirements of the system.

Tip definition: A tip is a set of nutritional information concerning nutrition improvements added by nutrition practitioners for the user. The key items which make up a tip are shown in Table 1 below.

*Table 1: Tip key items*

ITEM	DATA TYPE
Title/Subject	Text
Date posted	Date/Time
Tip detail	Text

Author	Text
Category	Text

Recommendation definition: A recommendation is a set of nutritional information that is suggested by nutrition practitioners to users based on the user's described information. The key items which make up a recommendation are shown in Table 2 below.

Table 2: Recommendation key items

ITEM	DATA TYPE
Title/Subject	Text
Recommendation detail	Text
Nutrition practitioner	Text
Date replied	Date/Time

Table 3: Functional Requirements for Nutrition Management Information System

REQUIREMENTS	DESCRIPTION	ACTOR
Add recommendation	The nutrition practitioner is the one who can add recommendations for the user based on nutrition status.	Nutrition practitioner
Add nutrition tip	Nutrition tips will be added to the system by nutrition practitioner based on request from a user and normal addition without request from the user.	Nutrition practitioner Researcher
Edit recommendation	Recommendations will be edited by the specific nutrition practitioner who provided it to the user.	Nutrition practitioner
Edit nutrition tip	The nutrition practitioner is the one who can edit the specific provided nutrition tips to the system.	Nutrition practitioner
Search user	The nutrition practitioner will be able to search users based on user's ID.	Nutrition practitioner
Generate report	The researcher is the one who can generate reports based on necessary nutrition information provided by the system.	Researcher
View nutrition tip	The user of the system will be able to view nutrition tips provided without requiring any authorization.	User
Request new tip	In case specific nutrition tip is not available in the system, the user can request it.	User
View recommendation history	Recommendations history will be viewed by the user and nutrition practitioner.	User Nutrition practitioner
Give reminder	The user is the one who will receive reminders as notifications based on required situation.	User
Register user	The issue of registration will involve all actors of the system.	User, nutrition practitioner, researcher, system administrator
Approve user	The system administrator is the one who will approve user of the system	System administrator

Table 4: Non-functional Requirements for Nutrition Management Information System

REQUIREMENT	DESCRIPTION
<b>Maintainability</b>	<ul style="list-style-type: none"> <li>The system will allow upgrading to smartphone usage operation when needed. This can be done by other researchers.</li> </ul>
<b>Operability</b>	<ul style="list-style-type: none"> <li>The system will interface with SQL database.</li> <li>The system will be written in PHP.</li> <li>The system will be supported by android which is easily accessed.</li> </ul>
<b>Performance</b>	<ul style="list-style-type: none"> <li>The system will provide enough time for the user to access and interact with the system.</li> </ul>
<b>Security</b>	<ul style="list-style-type: none"> <li>The system will allow authorized users to access their confidential information. These users will provide username and password to login to the system.</li> </ul>

Table 3 above shows the interactions between the actors (nutrition practitioner, user, researcher, system administrator) and the nutrition management information system. As part of the modelling process, the functionality of the system has been defined using use cases shown in Table 4 above. Use case describes the proposed functionality of the system and interactions between external actors and the system under consideration [16]. A complete set of use cases specifies all different ways to use the system, and thus defines all behaviours required by the system. At a high level of abstraction, the entire functionality of the nutrition management information system is captured in the conceptual use case diagram shown in Figure 1 below.

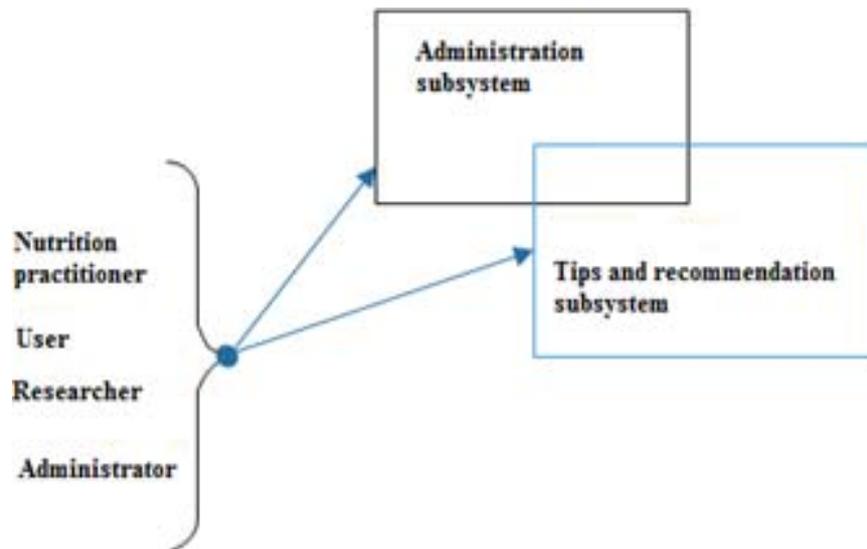


Figure 1: Conceptual use case diagram shows functional requirements

## 5. Developments

A model of the domain is mapped to requirements that prescribe further system development [17]. This makes it important for description of key aspects of the system and how it fits within the domain of its operation.

The envisioned application is expected to be operating in Tanzania. Any person with a mobile phone and who wishes to get access to nutrition information will be allowed to get access. This application will be integrated with existing health care system so as to give chance of supporting an interactive flow of information in supporting access, dissemination and management of nutrition information.

Focus has been set on maternal health and so the nature of end users can easily be anticipated. Generally, this application is expected to be used in an environment where-by users are of different levels of literacy, sex and financial status. According to the National Telecommunications reports, more than 70% of Tanzanians have access to mobile phones making mobile phones the best tool for issuing nutrition information to the majority of people in the country.

For this application, it is obvious that a genuine source of nutrition information needs to be modelled. A nutrition practitioner has been modelled to be the right source of information. This is planned this way so as to make sure that end users of the system get access to correct information. Both the end users and nutrition practitioners are modelled as not having expertise in information technology. The researcher has been modelled to generate reports based on nutrition information and system administrator to monitor overall activities of the system including user approval. Figure 2 shows the conceptual domain model of nutrition information system.

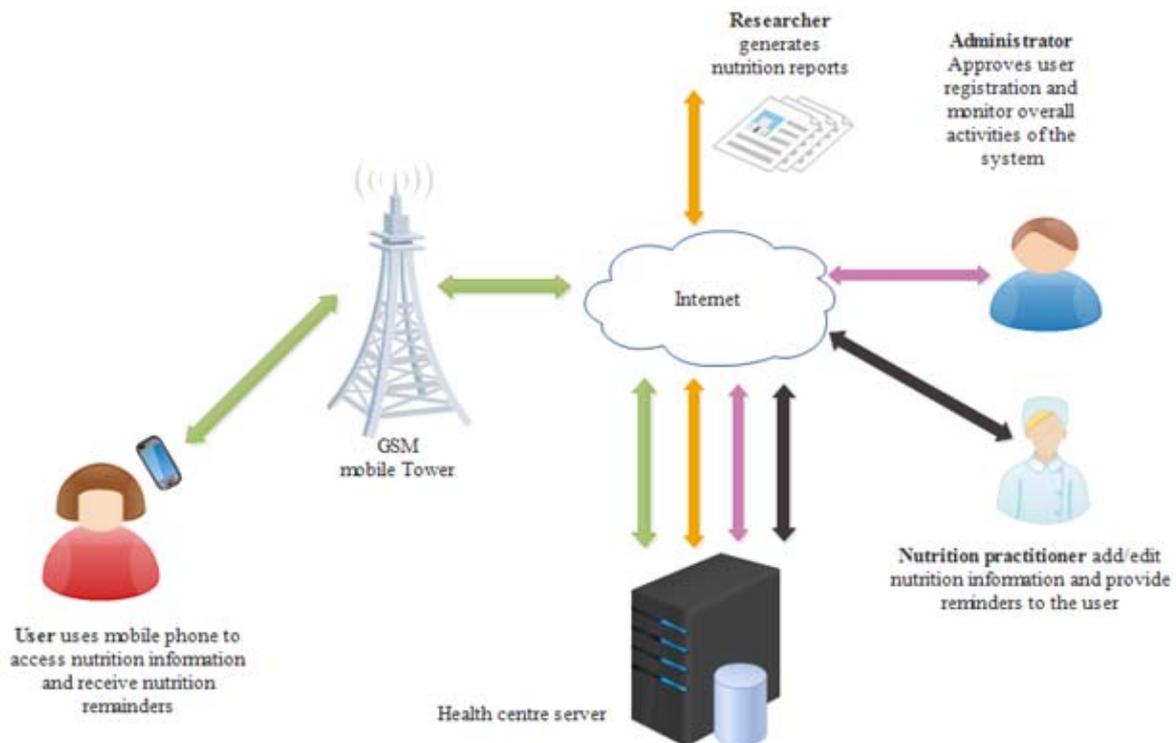


Figure 2: Conceptual domain model of the system

## 6. Results

The study collected data using multiple data collection tools. The data collected from the interviews were basically analysed for their relevance or irrelevance with literature review. The issues that came up in the interview were generally agreeable to several of the respondents.

On the first broad theme for the interview, nearly all respondents acknowledged that the issue of malnutrition is aggregated by several challenges. Poor access to appropriate nutrition information especially in rural communities, access is poor because most information is stored offline and not in digital form and there are no means for online access to available nutrition information, which is largely not integrated.

Secondly, regarding the second interview theme, the respondents agreed that nutrition information is provided verbally only with no emphasis and there is no nutrition information handling which is done.

Therefore, developing a mechanism that will contribute towards achieving accessibility of nutrition information is consequently a necessity.

## 7. Business Benefits

In this study an integrated mobile application was designed to provide effective collection and dissemination of nutrition information so as to ensure timely access and better delivery of nutrition information, improves access to nutrition information by facilitating an interactive flow of nutrition information and bridge the information gap by simplifying report process which will lead to effective planning, decision making and policy formulation. The developed system can easily go to production after enhancing some features such as security.

## 8. Conclusions

The developed nutrition information management system whose specifications have been presented in this paper provides simple but efficient means of managing nutrition information, it addresses the identified major challenges by taking advantage of the current emergent penetration of mobile phones as tools to manage nutrition information so as to allow interaction without time and place restrictions. These devices have been proved to be increasingly reliable and affordable and its coverage is adequate. The designed system changes the traditional models by categorizing nutrition information into tips and recommendations so as to prevent users to be flooded with information when using the system. Recommendations have been made on having the system that can record the nutrition information without relying on the users' visits to the clinic.

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