

## TECHNOLOGY-DRIVEN PERSUASIVE SYSTEM FOR PRE-NATAL HEALTHCARE DELIVERY IN NIGERIA USING PERSUASIVE STRATEGY.

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**Abstract:** Because of the advent of various diseases and epidemics, the healthcare system has been a major source of concern around the world in recent years. Today's Nigerian medical system suffers from a lack of quick, accurate, and dependable software solutions that can assist healthcare practitioners in making real-time decisions to manage urgently and, in some circumstances, complex medical problems. In addition, the cost of processing and evaluating huge volumes of data in a medical setting is considerable, particularly in terms of time consumption. As a result, the goal of this research is to create and implement a hybrid persuasive technology for antenatal healthcare that will provide critical health information to pregnant women and nursing moms in remote *locations*. The system was designed using Object-oriented Analysis and Design Methodology (OOAD). The system successfully integrated diverse patients' medical records from several hospitals. This study's findings suggest that persuasive strategies (social comparison strategy, normative influence strategy, recognition technique, and so on) affect antenatal healthcare and, as a result, behavior change in users. The research contributes both theoretically and practically to software engineering and design. It lays the groundwork for future studies on persuasive technologies in healthcare.

**Keyword:** Behavior Change, Maternal healthcare. Persuasive strategy, Mobile Health Technologies.

### I. INTRODUCTION

The pervasiveness of the computer and mobile technology has resulted in the application, and integration of digital technologies into every aspect of our lives [1] [2] It is vital to mention that health and wellness is one of the main sectors where technologies have been used to enhance diagnosis, treatments and aftercare services. These types of assistance are commonly referred to as E-health technology. It is the use of information and communication technologies (ITC) for health in Europe (W. H. O. 2016). Maternal and child health is a crucial health domain where mobile and smart phones have been used to support expecting and nursing moms alike [3]. The Nigerian prenatal health system (AHS) for both rural and urban people is plagued by a high rate of maternal mortality as a result of poor health practices and a lack of engagement with smart e-health solutions. Antenatal care is the care offered to pregnant women in order for them to have a healthy pregnancy and baby. Antenatal care is a major contributor to the high maternal mortality rate and one of the fundamental components of maternal care on which moms and babies rely. As a result, antenatal care is an important method for improving mother and newborn health. There is a growing interest in researching how persuasive methods might be operationalized on both online and mobile technologies to assist users perform target behaviors in a variety of domains. However, there is a scarcity of research papers on how such technologies could be developed to encourage sustainable antenatal care in developing African nations. As a result, this research will focus on antenatal health care to demonstrate how to properly build and execute a persuasive technology to promote optimal antenatal health in particular and mother health in general.

#### Problem Statement

One of the primary difficulties to the adoption of adequate antenatal healthcare in communities is pregnant women's negative attitudes/behaviors, as well as healthcare staff's delayed responses to expectant mothers' healthcare demands. Governments and healthcare stakeholders have made a number of measures to encourage the adoption of acceptable prenatal healthcare habits, including the provision of healthcare facilities and workers (though they are insufficient) and a number of other social enlightenment programs. These techniques, however, have failed to deliver the expected results because expectant individuals are unaware and may have various social, cultural, and geographical explanations. Other issues affecting typical antenatal healthcare systems. Include:

1 Inadequate access to antenatal health information and care. As a result, pregnancy and childbirth problems are the major causes of death, sickness, and disability among women of reproductive age in underdeveloped nations. Several studies have demonstrated that inadequate prenatal care is related with poor pregnancy outcomes.

2 There are no persuasive mechanisms in place to encourage expectant moms to engage in beneficial and healthful activities and practices. There are no social programs in place to acknowledge, thank, or compensate these women for attending antenatal checkups on time. Furthermore, there are no mechanisms in place to help inspire both pregnant women and community health professionals to conduct target behaviors.

#### Research Question

- (a) What are the community's prevalent attitudes and behaviors about prenatal care among pregnant mothers?
- (b) What initiatives may be implemented in the community to encourage optimal prenatal care behaviors?

### II. LITERATURE SURVEY

Persuasion simply means to motivate or encourage action toward achieving definite goal (s). Knowingly or unknowingly, people, organizations, institutions, and governments frequently employ persuasion, and tend to influence the public every time we speak or perform certain activities, with the aim of making someone perform or carry out a particular target behavior. For

example [5] discovered that human-human social facilitation and cooperation are employed to urge community inhabitants to live a healthy lifestyle. Persuasion can result in a voluntary change in people's attitudes and behaviors. Several studies have found that computer technology can be used to induce attitudinal and behavioral changes (human-computer persuasion). This has increased study interest in the use of appropriate technology to assist potential users in carrying out specified behaviors in various realms of human existence. Technology of Persuasion (PT) Persuasive technologies or systems are interactive technologies (mobile or desktop applications) that aim to persuade individuals or groups to change their attitudes and behaviors without using coercion or deception [6]. Designers in persuasive computing capitalize on the powerful roles that technology plays in everyday life to create interactive systems that may be used to encourage and reinforce beneficial behaviors in a variety of settings [8]. According to [9], in his dissertation titled "culturally relevant persuasive technology" [10] defined the word persuasive technology (PT) as "any interactive computing system designed to change people's attitudes or behaviors." PTs can be built to assist different groups of persons in different geographic places in carrying out their intended activities. Models for Persuasive System Design Designers have created ground-breaking methods for creating persuasive solutions that encourage people to perform their desired behaviors over time. The two most popular of these models are Fogg's 8-step design process (Fogg, 2002, 2009) and the persuasive system design (PSD) model depicted by (Oinas-Kukkonen & Harjumaa, 2009). According to (Fogg, 2009), the eight-step design process for designing PT interventions is as follows:

1. Target a basic behavior: First, the designer must break down the enormous goal into a series of seemingly insignificant targets that anyone can easily complete.

2. Choose a target audience: Fogg believes that the designer should know and comprehend the target audience. "Finding the right combination of behavior and audience is critical to laying the foundation for the subsequent steps in the design process," he believes.

3. Determine what is keeping the target behavior from being performed: The designer should determine what is preventing the behavior from being performed - is it a lack of motivation? Is it a lack of ability? Is there a lack of a timely trigger to prompt behavior performance? Or is it a blend of all three? There is a strong need for a user study to discover how to thoroughly investigate users, their behaviors, the factors impacting them, generating persuasive user profiles, and personalizing PT interventions to users. The behavior hypotheses are being tested in a user research.

4. Use a technology channel that the target audience is familiar with: The best channel is usually determined by three factors: the target behavior, the audience, and what is stopping the audience from adopting the behavior.

5. Locate past PT cases that are related to the current problem: This requires locating an existing intervention that is relevant to the PT you want to create. According to Fogg, one of the obstacles in obtaining relevant examples is that the design team will not always know if a specific PT intervention is successful. Most contemporary PTs do not make these aspects obvious because they are not based on behavioral theories or audience data.

6. Be like a successful person: The designer would need to create his or her own PT based on the results of the user survey done in step 3. This is necessary to avoid either or matching the incorrect audience to the wrong behavior.

7. Quickly evaluate and repeat: This phase encourages iterative improvement. A succession of tiny, quick tests is more effective than a single large test. 8. Build on previous success: PT designers can build on previous success by making the desired behavior more sophisticated or by integrating more audiences

The expansion should be slow and systematic, with one or two features differentiating it from the success gained in step 7. Persuasive Techniques The steps for creating persuasive systems are described in Section 2.4. However, in order to create these persuasive interventions, designers will need to implement some persuasive methods, often known as techniques. A variety of persuasive tactics are available to inspire people to change their attitudes and behaviours. Cialdini (2006), for example, identified six persuasive concepts that are essential principles of persuasion. While Fogg identified seven persuasive methods for motivating individuals to attain a certain objective(Fogg, 2002), (Oinas-Kukkonen & Harjumaa, 2009) expanded on Fogg's work to develop an all-encompassing method consisted of twenty-eight (28) persuasive system design (PSD) framework. In this research work, we use the PSD framework (Oinas-Kukkonen & Harjumaa, 2009). We chose this framework since it is the most widely used in PT design around the world. The strategies are divided into four (4) categories based on the type of support they may provide to potential customers.

As indicated in Figure 3, they are primary task support, dialogue support, system credibility support, and social support.

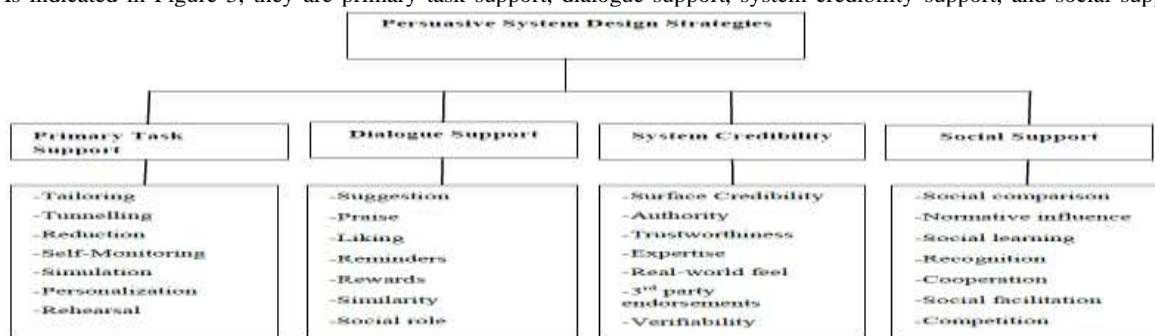


Figure.3: Persuasive Strategies of the PSD framework. Source: (Oinas-Kukkonen & Harjumaa, 2009)

### Persuasive Technology and Behavior Modification

A number of studies in human-computer interaction (HCI) and persuasive technology, as well as in the health and wellness domain, have been conducted to compile a list of key motivational techniques that HCI designers should be aware of if they want to encourage desirable health behavior (Orji & Moffatt, 2016). Among other critical difficulties was how information

could be utilized to persuade citizens to make a change: "information must be simple to understand, relied on, draw attention, and be retained" (Froehlich et al., 2010.).

According to (Oinas-Kukkonen & Harjuma, 2009), a behavior change support system (BCSS) is a social information system with emotional and behavioral effects designed to shape, alter, or strengthen attitudes and behaviors; or the act of conforming without compulsion or deception. It is a type of persuasive technology (PT) intervention that is aimed at providing contents, and features that help users take on new behaviors, make behavior.

#### Mobile Health Technologies

Technologies are terms used to describe mobile technologies that aim to motivate users to become more conscious of their health behaviors and activities (Iyawa & Hamunyela, 2019). They are intended to encourage or assist users in adopting attitudes and behaviors that are beneficial to their overall health and well-being. Users will be able to conduct their intended behaviors without compulsion or force with the use of this type of technology. Various types of mobile applications have been developed for a number of goals, including encouraging users to change or improve their health-related behaviors. In this part, we will discuss some of the health domains in which mobile interventions have been used.

1. Mental Health: There are mobile applications that promote mental and other related health concerns. The Gwam-Okwu App, for example, was created to help mental health patients seek and get expert attention from community health workers from the comfort of their own homes (Nkwo, Suruliraj, & Orji, 2020).

2. Sexual Health: In addition to mental health (Ndulue & Orji, 2018) create a compelling game that informs and teaches people about sexually dangerous behaviors. It was designed to urge players to become more aware of their own sexual actions and to play safe by employing various precautionary measures. The system was designed to work on both cellphones and Tablet PCs in order to determine which platform consumers preferred. According to the findings of this study, users felt it be a helpful tool for learning about the consequences of clandestine sexual interactions.

3. Healthy Eating: (Orji & Mandryk, 2014) created an app to aid in tracking and encouraging users to adopt healthy eating habits. It also depicts behaviours that lead to bad eating habits and the implications for the individual's health and fitness. There have been initiatives to create games to promote healthy eating habits (Orji et al., 2017). 4. Maternal Health: While (Hackett et al., 2018) explored the impact of smartphone-assisted prenatal home visits on women's usage of facility delivery in Africa, (Mahmud & Keyson, 2013) created a mobile diagnostic system to help antenatal care in developing nations.

### III. METHOD

The Survey Research Design Model. (Resnick & Bernstein, 2013) Adapted. The Study's Population: The study's population consisted of all expecting moms who had ever attended one of the three (3) community health centers. There were 173 expecting mothers in the population. The researcher employed the random sampling technique to collect a sample of 173 expecting moms for the study. The 173 participants all responded. Data Collection Method: The structured questionnaires were distributed to the participants directly. The responders completed the questionnaire in the manner specified. After the questionnaires were completed, the researcher collected them from the respondents

Data Analysis Method: The data gathered in this study were analyzed using mean and standard deviation to answer the research objectives. Each of the various scale components was assigned a nominal value as follows:

Strongly Agree (SA)	4
Agree (A)	3
Disagree (D)	2
Strongly (SD)	1

Data Analysis Method: The data gathered in this study were analyzed using mean and standard deviation to answer the research objectives. Each of the various scale components was assigned a nominal value as follows: Strongly Agree (SA) 4 Agree (A) 3 Disagree (D) 2 Strongly (SD) 1

### IV. EMPIRICAL STUDY FINDINGS

This section contains the findings of an empirical study conducted to better understand the relationship between pregnant mothers' attitudes, behaviors and antenatal care practices. It also discusses techniques for motivating pregnant moms to engage in optimal prenatal care behaviors. The data gathered has been collated and analyzed in accordance with the study questions listed below.

a) **Research Question 1:** What are the community's prevalent antenatal care practices (attitudes and behaviors) among pregnant mothers?

Table 1 shows the average reactions of pregnant women to appropriate prenatal care methods.

S/N	Questionnaire Items	SA	A	D	SD	N	X	SD	REMARK
1	Lack of knowledge of proper antenatal care practices	6	55	24	88	173	2.28	0.91	REJECTED
2	Inability to visit the health centres during pregnancies– which complicates the matter	15	37	80	41	173	2.65	0.87	REJECTED
3	Poor sanitary habits of expectant mothers	93	14	8	58	173	3.32	1.37	ACCEPTED
4	Outright laziness/carelessness towards antenatal care	121	39	8	5	173	4.18	0.56	ACCEPTED
5	Ignorance of the health issues caused by poor antenatal care	40	92	9	32	173	3.30	1.01	ACCEPTED

Table 1 show that respondents acknowledged items 3, 4, and 5 as the most prevalent attitudes and behaviors of pregnant mothers toward antenatal care, with mean ratings of 3.32, 4.18, and 3.30, respectively. However, respondents rejected items 1 and 2 with mean score ratings of 2.28 and 2.65.

**Research Question 2:** What measures may be implemented in the community to promote optimal prenatal care behaviors?

Table 2 shows the mean responses to the interventions for encouraging proper prenatal care behaviors.

S/N	Questionnaire Items	SA	A	D	SD	N	X	SD	REMARK
14	Set up antenatal care centres at designated places within the community (reduction)	119	42	9	3	173	4.11	0.65	ACCEPTED
15	Offer remote services to these women to maintain a proper antenatal health (tailoring and personalization)	82	86	5	-	173	4.00	0.51	ACCEPTED
16	Recognize and Praise expectant mothers who keeps to all the antenatal care appointments	46	92	39	-	173	3.60	0.57	ACCEPTED
17	Reward expectant mothers who keeps to all the antenatal care appointments (competition and comparison)	163	0	6	4	173	4.36	0.78	ACCEPTED
18	Remind expectant mothers to keep to all the antenatal care appointments as at when due.	72	68	24	9	173	3.67	0.70	ACCEPTED
19	Help expectant mothers to learn about the dangers of not keeping to antenatal care appointments.	146	27	-	-	173	4.34	0.63	ACCEPTED
20	Regularly organize an interactive session with all the expectant mothers where important information about their health will be shared (cooperation)	133	29	1	10	173	4.14	0.80	ACCEPTED

According to Table 2, all seven items were acknowledged by respondents with a mean rating greater than 3.0 (the cut-off point) as techniques for motivating adequate prenatal care behaviors among pregnant moms in the community.

## V. RESULTS DISCUSSION AND SUMMARY OF MAJOR FINDINGS

This section discusses the major findings of this preliminary investigation in light of the preliminary studies' objectives, which were to understand the relationship between expectant mothers' attitudes/behaviors and antenatal care practices, as well as the effects of these attitudes and the relevant strategies that could be employed to motivate expectant mothers to embrace proper antenatal care practices:

(1).The most prevalent pregnant mother attitude and behavior include: bad sanitary habits, blatant laziness/carelessness toward antenatal care, and ignorance of the health risks induced by inadequate antenatal care. However, research indicates that these women do not always lack awareness about effective prenatal care methods. It also demonstrates that inability to visit health centers during pregnancies, which complicates matters, does not necessarily impair adherence to proper prenatal practices.

(2) According to the findings of this study, the following strategies could be implemented to incentivize adequate prenatal care behaviors among pregnant mothers: Set up antenatal care centers in strategic locations around the community (reduction), Provide these ladies with remote services to help them maintain appropriate prenatal health (tailoring and personalization). Recognize and reward expectant moms who attend all antenatal care appointments, and reward expectant mothers who attend all antenatal care appointments (competition and comparison).

## VI. CONCLUSION AND FUTURE WORK

Using a large-scale research of 173 pregnant women, this report studied how to effectively tailor persuasive and behavior change systems to expectant moms based on their present stage of change and motivation. It advances knowledge in the field of HCI by demonstrating that people's current stage of change plays a significant role in the perceived persuasiveness of different strategies, and that the strategies motivate for different reasons and through different mechanisms depending on the individual's stage of change. Based on the findings of this review, we identified particular gaps in the literature and give recommendations for further research:

1. There are no standardized methodologies or instruments in the PT literature for evaluating the effectiveness of PT, and most existing assessment approaches are based on subjective data that can be skewed. Alternative assessment and evaluation approaches would benefit the PT community. The persuasive community, in particular, would benefit immensely from research on objective evaluation methodologies.

2. Physical therapy studies are limited in their ability to effectively integrate behavior theories and practice into their design. This is most likely due to the fact that most PT designers frequently lack the abilities required to translate theoretical drivers of behavior into technology design objects.

We recommend that future research focus on establishing a complete framework for converting theoretical determinants into technological design components.

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