Designing Technology to Overcome the Lack of Transmission of HPV Facts: Step One—A Theory of the Problem

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Abstract

*The lack of health knowledge among people may cause serious health problems. Cervical cancer, which kills hundreds of thousands of women around the world each year, is almost always caused by Human Papilloma Virus (HPV). Much is known about HPV that women could use to avoid infections, but widespread **lack of transmission of HPV facts** to women prevents them from taking the steps necessary to avoid infection. This paper theorizes about the problem of lack of transmission of HPV facts. Hence, "HPV Facts Transmission Model, Including Barriers and Resources Factors" has been identified. A "**theory of the problem**" [1] may assist in developing a "theory of the solution," in which to-be-developed IT artifacts could play an important role.*

1. Introduction

Lack of knowledge about diseases can cause a variety of health issues. Many diseases are widespread for this reason. Some of these diseases are chronic, such as diabetes, and others are sexually transmitted, such as the human immunodeficiency virus (HIV). In 2016, Limaye et al. surveyed more than 1,400 people in India, learning that 78% of them did not know the meaning of the word "diabetes" [2]. According to Mohan et al. (2005), there are likely to be 79.4 million diabetics in India by 2030 [3]. Additionally, it is estimated that in 2012 approximately 400,000 new HIV infections occurred due to lack of knowledge about the disease [4]. In South Africa, the number of HIV infection cases has increased, to a great degree because people are not knowledgeable [4].

A particularly troubling example of this issue involves cervical cancer—a worldwide problem, ranking as the second most common cancer type among women in the world. In 2012, 530,000 women had cervical cancer, and 270,000 died from it [5].

The human papilloma virus (HPV)—at the focus of this research—is a sexually transmitted disease that often leads to cervical cancer [5]. About 99.7% of cervical cancer cases are caused by HPV infections [6].

A vast amount of knowledge concerning HPV and how it is transmitted exists, much of which is available through public sources such as the "Centers for Disease Control and Prevention" website [7]. Unfortunately, knowledge about HPV does not seem to be readily transmitted to the people who need to know, especially to the women for whom it might help prevent cervical cancer. This lack of transmission of HPV facts is a problem that society, including the IS/IT research community, needs to address.

With the foregoing in mind, we have designed a research program with two main aims. The first is to gain an understanding of the phenomenon sufficient to support design research by theorizing about the problem, *lack of transmission of HPV facts.*[1] The second is to understand the role that technology can play in increasing women's awareness of HPV infections that cause cervical cancer. To this end, we have developed the "HPV Facts Transmission Model." The factors this model comprises will serve as a basis for further theorizing and design research concerning an IS/IT-based solution to the problem.

2. Background Literature

2.1. Lack of transmission of HPV facts

Sexually transmitted diseases (STDs) or sexually transmitted infections (STIs) are diseases or infections that develop by sexual relationship/contact. Some STD cases have no symptoms, while others do [8]. Some examples of STDs are HIV and HPV.

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[1] Markus [1] proposed that IS/IT researchers should develop *theories of problems* and *theories of solutions*, discussed below.

It is known that almost all cervical cancer cases are caused by HPV infections [6], and it is also known how HPV infections can be prevented. Yet in developing countries, eight out of ten cervical cancer patients die as the result of a lack of prevention programs [9]. According to Bosch et al. (2008), the percentage of women ages 15 and above with cervical cancer will increase to 50% by 2050 in developing countries [10].

Facts about HPV (e.g., its links to cervical cancer, how it is transmitted, and how to prevent infections) promote the prevention of cervical cancer [5], but such facts do not seem to be reaching women who are at risk. Marlow et al. (2007) surveyed British women and found that only 2.5% knew that HPV causes cervical cancer [11]. Mohammed Ahmed (2015) surveyed Saudi Arabian women and learned that 72.2% do not know about HPV or its consequences [12].

2.2. Theory of the problem

In IS research, one established view of theory defines five types of theory—theories for analysis, explanation, prediction, explanation and prediction (EP), and design and action [13]. Analysis theory aims to answer questions concerning what exists; this form of theory analyzes and describes; it does not provide causal statements or predictions. Explanation theory provides answers to causal questions, without offering prediction or precision. Prediction theory provides projections, including testable propositions, but lacks causal explanations. EP theory delivers predictions with both causal explanations and testable propositions. Theory for design and action specifies how to do something—it informs construction of an artifact to solve a problem [13].

Markus (2014) added two more types of theory to this typology—*theory of the problem* and *theory of the solution*. A theory of the problem explains what the problem is and why it occurs. There are three types of problems that might lead IS researchers to construct a theory of the problem: 1) those having to do with IT itself, 2) those which IT exacerbates, and those which IT might ameliorate [1]. We suspect that the kind of theory needed for the problem considered here is the last of these.

2.3. Theoretical foundation: Health Action Process Approach (HAPA) model

The Health Action Process Approach (HAPA) Model serves as a theoretical foundation in this paper. It has two tiers: a continuum layer and a stage layer. The continuum layer reflects the behavioral

intention phase, and when it comes to intervention, the stage layer is required since it allows for stage-matched solutions—it represents the actual behavioral change [14]. These two layers support improved behavioral prediction while reflecting the mechanisms of behavior change [14].

According to Schwarzer and Luszczynska (2008), HAPA focuses on two main processes, which are (1) preintentional motivation processes (motivation phase, which is the continuum layer), and (2) postintentional volition processes (volition phase, which is the stage layer) [15]. The first phase causes an intention to change behaviors, while the second phase causes the actual health behavior. The three main predictors of intention as is shown in Figure 1 are Risk Perception, Outcome Expectancies, and Task Self-Efficacy [15]. Risk Perception reflects the threats to the environment or health. For example, "I am at higher risk of having HPV because I am not educated about this disease." Outcome Expectancies represent the consequence of a certain health behavior. For example, "If I educate myself about HPV, I will reduce the chance of having this infection, so I probably will not have cervical cancer." Knowing the pros and cons related to a behavior promotes good intentions [14]. Furthermore, Task Self-Efficacy or Action Self-Efficacy are significant determinants of performing a desired action. Task Self-Efficacy is defined as an individual's belief about his/her capability to perform an action [14; 15] (e.g., "I am able to search and learn about HPV, so I can increase my knowledge"). Thus, Task Self-Efficacy indicates that an individual has a motivation to act (change health behaviors, such as becoming educated). A person with high Task Self-Efficacy is more likely to succeed in a new health behavior. Thus, merging between the threats, consequences and positive outcomes is important in the motivation phase, in addition to the self-belief of a person's ability to accomplish a task [15]. Therefore, these three predictors are important for a person to have the intention to change health behaviors.

Having an intention does not, in itself, mean that a person will alter her/his behaviors. The intention must be transformed into guidelines about how to perform the anticipated action [15]. Hence, Action Planning and Coping Planning mediate between the intention and the actual action (the new health behavior) because Action Planning focuses on when, where and how to perform a new action (e.g., searching and learning to increase *Personal Knowledge*). Task Self-Efficacy and Maintenance Self-Efficacy are important predictors for Action Planning [15]. Maintenance Self-Efficacy represents

the hopeful beliefs about an individual's capability to deal with Barriers (e.g., lack of social support) that occur during the maintenance time [15].
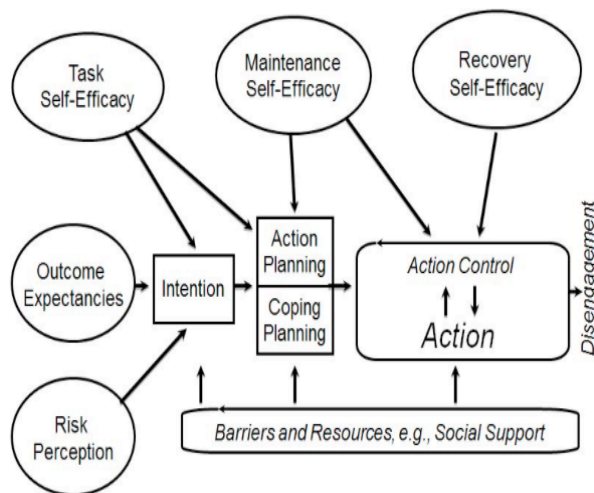

Figure 1. Health Action Process Approach (HAPA) Model

Adherence to the new health behavior could be difficult, so Action Control (Self-Regulation) is important. Self-Regulation is defined as the ability to control and monitor one's own behaviors, actions, emotions, or thoughts, changing them to match the demands of the situation [16]. According to Cook and Cook (2014), after having a strong sense of efficacy, people need to exercise control, which means they must believe that they have the ability to regulate their actions/behaviors [17]. Therefore, having high Self-Regulation is important to continue performing an action. Additionally, it is significant to note that after performing a new health behavior, the person with high Maintenance Self-Efficacy invests more effort than the person with low Maintenance Self-Efficacy. Therefore, Maintenance Self-Efficacy is considered as a predictor of a new Action. Furthermore, Recovery Self-Efficacy is considered as another predictor of the new health behavior. Recovery Self-Efficacy addresses the failure, lapses, and setbacks experienced, which means that an individual is optimistic to get back on track after being deflected. Thus, people with high Recovery Self-Efficacy trust their capability to re-control themselves to decrease harm/ health risk [15].

3. Research Objectives

There are two main aims of this research. The first aim is to understand the phenomenon by theorizing the *lack of transmission of HPV facts*—

that is, the failure of knowledge and awareness of HPV infections to become known to women who could benefit from it. The second aim is to understand the role of technology in increasing a women's awareness of HPV infections that cause cervical cancer. To make progress, it is important to ask several questions: What mechanisms are involved in transmission of knowledge about infectious diseases, such as HPV? What factors can block/promote these mechanisms? And, how can IS/IT facilitate the transmission of HPV facts and increase women's awareness of this disease?

4. Research Approach and Method

To understand the phenomenon, we assumed the following scenario: *HPV Facts* exist in the background literature, education programs, websites such as the "Centers for Disease Control and Prevention" website [7], and knowledge held by others. Women can start to search for *HPV Facts* by reading publications concerning HPV, looking at websites, attending education programs, or asking other people. During the searching phase, women may discover that this infection is linked to cervical cancer. They realize that if they do not learn they become more likely to contract the disease, which is the Risk Perception in the HAPA Model (threats). Meanwhile, women may start to think about the consequences of health behavior (e.g., "if I learn more about HPV, I may reduce the chance of having HPV, so I will not have cervical cancer"), which is the Outcome Expectancies in the HAPA Model. Balancing between the pros and cons as well as having a high Task Self-Efficacy will cause women to have a good intention to search and learn more about HPV. Having the intention to increase their *Personal Knowledge* about HPV could assist women to start their Action Planning by focusing on when, where, and how to perform a new action—searching and learning about HPV to increase their *Personal Knowledge*. Women can start to learn by trying to understand what have they read, seen, or heard, which may include definitions and descriptions of HPV infections and symptoms, as well as ways to prevent the disease—all of these activities and more being included in the Action and Action Control processes.

Maintenance Self-Efficacy and Recovery Self-Efficacy are important predictors to continue searching and learning about HPV. However, as we mentioned before, this disease is a stigmatized disease, so there is huge influence from society included in the Barriers and Resources component of

the HAPA Model. For example, if women get needed support (part of Resources) from spouses, family members, and friends to search and learn about HPV, they will continue their actions until the *HPV Facts* become *Personal Knowledge*. The lack of such support is included in the Barriers that women face. Finally, women can incorporate what they have learned into their *Personal Knowledge*. Of course, the searching and learning action with the Action Control involves as many loops as are wanted and useful to individuals, as it shown in Figure 2.
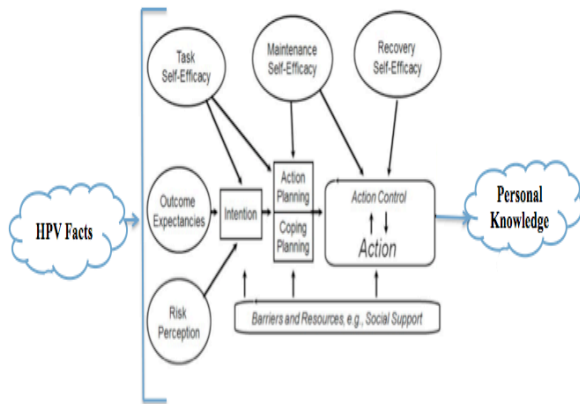

Figure 2. Simple HPV Facts Transmission Model

We believe that the mechanisms involved in HPV facts transmission are influenced by several factors. Therefore, we reviewed the literature concerning STDs— education, psychology, sociology, health behavior change, and IS/IT—to answer the research questions. We found that a number of factors seem to block/ promote the transmission of publicly known *HPV Facts* to individuals (i.e., becoming their *Personal Knowledge*). We divided these factors into two different levels, which are the *Individual Level* and the *Social Level*, based on the factors' characteristics. These factors reflect the Barriers and Resources in the HAPA Model. Based on this reasoning, we have identified the factors associated with the Barriers and Resources component of the HPV Facts Transmission Model, shown in Figure 3.
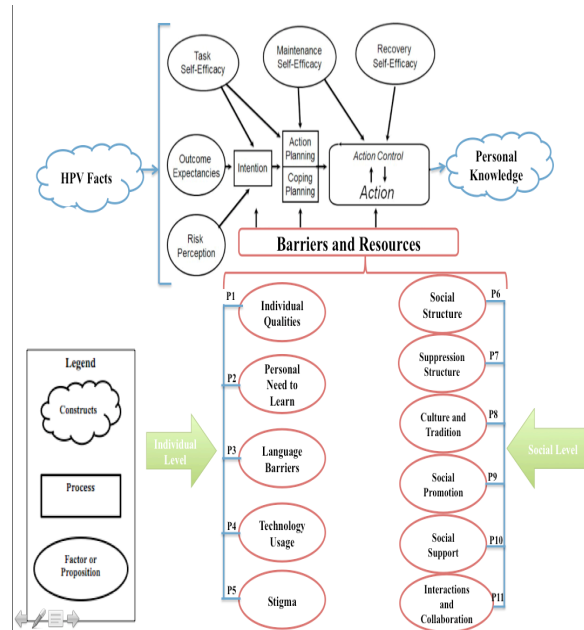

Figure 3. HPV Facts Transmission Model, Including Barriers and Resources Factors

4.1. Theorizing the problem of lack of transmission of HPV facts

As we mentioned previously, the factors that affect the *HPV Facts* Transmission are distributed into two levels *Individual* and *Social*. The *Individual Level*'s factors are:

(1) Individual Qualities

From studies of demography, population ecology, and life history evolution, *Individual Qualities* is defined as individual differences in characteristics that are linked to survival and reproduction [18]. According to Robins (2009), individuals have different capacities that directly affect their individual qualities [19].

Various characteristics make up individual qualities. Hensley (2004) noted *curiosity* and *creativity* [20]. Duggan and Banwell (2004) stated *willingness to change* [21]. Robins (2009) reported *skills*, *information*, and/or *expertise* [19]. Williams et al. (2011) added *education levels*, *ethnicity*, and *socio-economic backgrounds* [22]. These characteristics affect *knowledge acceptance* and *information dissemination* [22]. Therefore, Proposition 1 (P1) is " "INDIVIDUAL QUALITIES" AFFECTS HPV FACTS TRANSMISSION."

(2) Personal Need to Learn

Personal Need to Learn makes one more willing to accept new knowledge, which affects *information dissemination* [21]. If women realize the serious health problem that they face, they will recognize the need to educate themselves about the disease, and more willing to obtain new knowledge. Thus, Proposition 2 (P2) is " "PERSONAL NEED TO LEARN" AFFECTS HPV FACTS TRANSMISSION."

(3) Language Barriers

U.S residents who speak little English face several health care issues because of *Language Barriers* [23]. Talking with someone who speaks another language and/or reading health materials written in another language will impede *HPV Facts Transmission*. Hence, Proposition 3 (P3) is " "LANGUAGE BARRIERS" AFFECTS HPV FACTS TRANSMISSION."

(4) Technology Usage

Technology Usage may assist in searching and learning about stigmatized illnesses such as HPV. Hansen and Johnson (2012) developed a novel strategy called "veiled viral marketing" that allows individuals to interact with trusted people and information, providing *anonymity* and *access to relevant materials* [24]. In addition to these, important technology-related factors include *information-seeking style*, *receiving feedback*, and *access to experts* [21], as well as *organization of the information* [25]. Hence, Proposition 4 (P4) is " "TECHNOLOGY USAGE" AFFECTS HPV FACTS TRANSMISSION."

(5) Stigma

Stigma is a word that is strongly linked to STDs. Babic (2010) noted that stigma means to emphasize, highlight, or mark. Numerous studies have focused on the relationship between STDs and stigma [26]. Stigma results in negative feelings that affect personal and social relationships. No women would want to be marked with the stigma of an STD such as HPV. Fear of being stigmatized makes them afraid to search and learn about the disease to increase their *Personal Knowledge*. Thus, Proposition 5 (P5) is " "STIGMA" AFFECTS HPV FACTS TRANSMISSION."

The Social Level factors that could affect the *HPV Facts Transmission* are:

(1) Social Structure

Social Structure refers to social rules that people follow in a society [27]. The rules in society are constructed based on people, and their interactions and resources. As small groups interact, social rules may reconstruct. People in any society usually follow the social rules. However, *Social Structure* can deter *HPV Facts Transmission* if women think that searching and learning about HPV facts is against the rules of their society. Consequently, Proposition 6 (P6) is " "SOCIAL STRUCTURE" AFFECTS HPV FACTS TRANSMISSION."

(2) Suppression Structure

Suppression has been studied in sociology, ecology, and politics where the main aim is to examine the influence of the system of power in a group. For example, a scientist may conduct a study, and the study may be sent to a powerful group such as a government. Then, this group may stop the scientist from continuing the study. Hence, powerful groups or people may stop individuals or groups from continuing their actions or activities, which is referred to as *Suppression Structure* [28]. If powerful groups or people oppose the searching and learning of HPV facts, this will impede *HPV Facts Transmission*. Proposition 7 (P7) is " "SUPPERSSION STRUCTURE" AFFECTS HPV FACTS TRANSMISSION."

(3) Culture and Tradition

Culture and Tradition may constrain *information dissemination* [29], something that would impede mechanisms involved in the *HPV Facts Transmission*. For example, Al-Saggaf (2004) notes that, women in Saudi Arabia are shyer than men, particularly virgin women who are not married [30]. For these women, searching, discussing, talking, and becoming educated about sexual topics is not easy. Therefore, Proposition 8 (P8) is " "CULTURE AND TRADITION" AFFECTS HPV FACTS TRANSMISSION."

(4) Social Promotion

There seems to be a huge effort in many societies to promote prevention of HPV infections [31; 32]. *Social Promotion* of something can be equated with publicizing it. Researchers have studied the promotion of HPV vaccines and Pap tests to increase awareness of them [31]. Other researchers have found that HIV and STD education programs positively affected the sexual behaviors of participants [32]. Therefore, Proposition 9 (P9) is "

"SOCIAL PROMOTION" AFFECTS HPV FACTS TRANSMISSION."

(5) Social Support

Social Support refers to getting support from family, friends, etc. *Social Support* is always related to recovery from health problems. For example, recovering from health problems is faster when there is *Social Support* [33]. Similarly, women can increase their *Personal Knowledge* about HPV infections more easily when they have *Social Support*. Therefore, Proposition 10 (P10) is " "SOCIAL SUPPORT" AFFECTS HPV FACTS TRANSMISSION."

(6) Interactions and Collaboration

Interactions and Collaboration is an important factor in *HPV Facts Transmission* since it opens the opportunity to share experience, and leverage an online interactive education program [34]. Thus, Proposition 11 (P11) is " "INTERACTIONS AND COLLABORATION" AFFECTS HPV FACTS TRANSMISSION."

4.2. Technology utilization

Technology can play an important role in transferring *HPV Facts* to *Personal Knowledge*. To understand this role, we examined several studies in IS/IT and Public Health. We found that technology may assist in the following: (1) enhancing Task Self-Efficacy, (2) maintaining Self-Efficacy, (3) recovering Self-Efficacy, (4) increasing Self-Regulation (Action Control), and (5) performing the Actions, which is the searching and learning to increase *Personal Knowledge*, as shown in Figure 4.
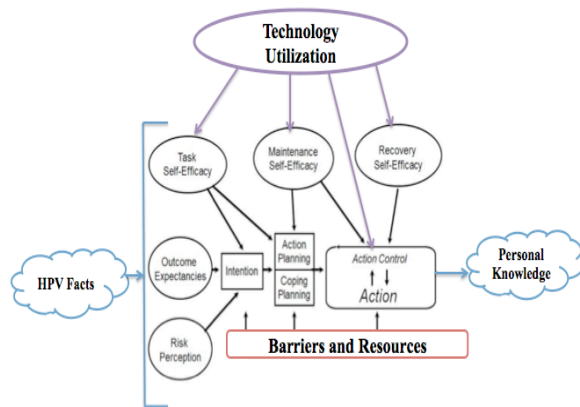

Figure 4. Technology Utilization In the HPV Facts Transmission Model

Technology offers several features, such as being anonymous while searching and learning about *HPV Facts*. As noted by Hansen and Johnson (2012), there are many elements that are required in designing IT artifacts for learning about stigmatized illnesses such as HPV. The authors developed a novel strategy called "veiled viral marketing" on Facebook. The main elements in this strategy are the possibility to interact with a trusted person and information and get access to relevant materials [24]. Therefore, *being anonymous*, *interacting with trusted person and information*, and *getting access to relevant materials* are some important design features that must be considered.

Additionally, according to Gabarron et al. (2013), a *gamification strategy* is a very important feature that should be applied to youth prevention of STDs [35]. The authors developed a gamified web application, "sjekkdeg.no," that focused on sexual health. Gamification techniques, such as achievement-based gifts, avatars, and social network sharing buttons, were implemented on educational content regarding an STD symptom checker and sexual health. The results showed that the game-style web application could be beneficial to inspire users to learn more about STDs and sexual health [35]. Therefore, applying *gamification strategy* assists users in changing their risky behaviors and preventing STDs.

Another feature is *narrative communication*. As stated by Hinyard and Kreuter (2007), the fundamental way to acquire knowledge and interact is narrative [36]. Essentially, narrative is the fundamental tool that has been used to motivate and support any behavior change. Health communication developers turned to narrative communication to achieve health objectives [36]. Using *narrative communication* to gain knowledge may involve personal experience, other people's experience, good stories, religion and faith. Thus, this way of learning could be useful especially when the context is more related to religion, personal values (not marked with stigma), and complex social relationships [36]. Entertainment-education and storytelling are some approaches of this strategy. According to Moyer-Gusé (2008), entertainment-education is more effective than persuasive messages since it encounters less resistance [37]. The author stated that entertainment-education is defined as "a popular strategy for incorporating health and other educational messages into popular entertainment media with the goal of positively influencing awareness, knowledge, attitudes, and/or behaviors" (p. 407). Narrative persuasion is the entertainment-education strategy that the author refers to, which

includes narrative messages and characters that share risky behavior, prosocial behavior, and/or health promotion features [37].

Other features that Technology can offer in addition to *anonymity*, *gamification, and narrative communication* are *access to experts* [21], *privacy with convenience* [38], and *personalization* [16]. Thus, as an initial model, we link the technology features with the predictors in HAPA, as shown in Figure 5.
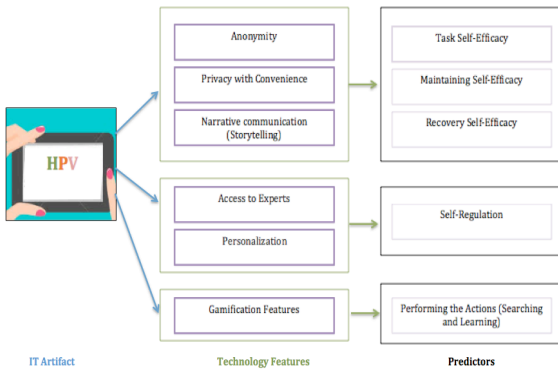

Figure 5. HPV Facts Transmission's with Technology Features

Additionally, developing an IT artifact with the previous features can assist in minimizing or removing the effect of the Barriers and Resources factors. The reason is that these factors affect the preintentional motivation processes (which include Intention), and postintentional volition processes (which include Action Planning, Coping Planning, Action and Action Control) as shown in Figure 4. Therefore, technology can assist in transferring *HPV Facts* to *Personal Knowledge*.

5. Discussion, Conclusion and Future Work

There seem to be quite a few factors that might block or promote the mechanisms involved in the diffusion of *HPV Facts*. We divided the factors into *individual* and *social* levels. *Individual Qualities, Personal Need to Learn, Language Barriers, Technology Usage,* and *Stigma* are the *Individual Level* factors. These factors impact the process taking into account that each woman has different characteristics that distinguish her from others. These characteristics can increase or decrease a woman's searching and learning about *HPV Facts*. The more *Personal Need to Learn* a woman has, the more searching and learning she is likely to pursue, impacting *HPV Facts Transmission*. Different written

materials may not be written in the language that a woman knows, which will also affect *HPV Facts Transmission*. All of these can affect the way she lives and thinks, which also will affect the acceptance of the information and facts. Using IT may assist in *HPV Facts Transmission* for a variety of reasons, perhaps especially because the learner can be anonymous. In fear of being stigmatized, women may avoid many of the noticeable actions associated with searching and learning; therefore, *Stigma* affects *HPV Facts Transmission*.

The *Social Level* factors are *Social Structure, Suppression Structure, Culture and Tradition, Social Promotion, Social Support,* and *Interactions and Collaboration*. These factors impact *HPV Facts Transmission* as follows: there are some rules that construct the *Social Structure*, which are usually followed by society and may influence *HPV Facts Transmission* positively or negatively. A powerful individual or group may stop or support the searching and learning to increase *Personal Knowledge*, which is the meaning of *Suppression Structure*. Moreover, women live in different countries and/or share different cultures or traditions that may lead to some consequences if women do not follow them; women might stop becoming learned about HPV because they do not want to face these consequences from the society or group. Education programs and marketing are important elements in *Social Promotion* that may advance *HPV Facts Transmission*. *Social Support* refers to any friend, coworker, or family member that may support women to continue searching and learning about *HPV Facts*. Finally, *Interactions and Collaboration* with others enhances searching and learning activities for individuals. This is because meeting others and discussing topics with them can improve the personal learning experience and leverage *Personal Knowledge*.

A good understanding of these factors can help IS researchers to understand the *lack of transmission of HPV facts* problem. Analyzing *HPV Facts Transmission* through the HAPA model assisted in understanding the phenomenon, and the model could be used as a theoretical foundation for developing the IT artifact.

Technology Utilization can assist in solving the problem of *lack of transmission of HPV facts*. Therefore, developing a persuasive technology with some of the gamification strategies and other features that technology offers will assist in solving this problem. Using technology will aid in enhancing Self-Efficacy, maintaining Self-Efficacy, recovering Self-Efficacy, increasing Self-Regulation, and performing the Actions to increase women's knowledge regarding HPV. Additionally, having a

suitable technology will assist in reducing or eliminating the effect of the Barriers and Resources factors on "HPV Facts Transmission Model."

To this end, we theorized the problem of *lack of transmission of HPV facts* by identifying the "HPV Facts Transmission Model. This model includes Barriers and Resources Factors," and proposes what the effects of these factors should be. In future research, we will attempt to assess the factors, as well as develop indicators for the various model constructs. To assess the model, we will start with a qualitative method such as a semi-structured interview, where the subjects will be mainly women from the public. Additionally, after finalizing the model, we will try to test the model by applying several case studies or any appropriate data. Moreover, we will create an IT artifact that in practice that will address the answer to the following question "How can IS/IT facilitate HPV Facts Transmission and increase women's awareness of HPV?" Therefore, we will eventually create a theory of the solution, an integral part of creating an IT artifact to help solve a problem.

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