Investigating the resistance to telemedicine in Ethiopia

Yajiong Xue, Huigang Liang, Victor Mbarika, Richard Hauser, Paul Schwager, Mequanint Kassa Getahun

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Background: Telemedicine has great potential to improve health care in Africa as well as other developing areas, especially when medical expertise is urgently needed in emergency situations. Yet resistance from healthcare professionals could prevent telemedicine’s social value from being materialized.

Objective: This article intends to understand why healthcare providers resist using telemedicine from a threat-control perspective.

Method: A survey on 107 healthcare professionals in Ethiopia was conducted.

Conclusions: The resistance to telemedicine is determined by perceived threat and perceived controllability, which in turn are influenced by reduced autonomy, anxiety, and costs. Government support weakens the effect of perceived threat but strengthens the effect of perceived controllability on telemedicine resistance.

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1. Introduction

The fast-spreading epidemic Ebola in western Africa countries has drawn the world’s attention. Given the shortage of medical specialists in these countries, telemedicine could have played an important role in curbing the rampage of Ebola. Telemedicine refers to the use of telecommunication and information technologies to deliver health care services over distance. By eliminating geographical separation between health providers and recipients, telemedicine can improve access to medical services that are often difficult to provide in remote rural regions like Sub-Saharan Africa (SSA). SSA is a vast rural region that has poor healthcare conditions and is short of medical personnel and facilities. The three countries with the most widespread Ebola (Guinea, Liberia, and Sierra Leone) are in this SSA region.

Health conditions in the SSA have always been alarming. According to the World Health Organization (WHO), about 28.1 million HIV/AIDS carriers, or more than 70% of the worldwide HIV/AIDS population, are in the SSA [1]. As a matter of fact, the SSA carries 25% of the global burden of disease; yet, it only possesses 1.3% of the world’s health workforce [2]. The doctor-to-population ratios in SSA countries range from 1:5000 to 1:30,000, which is significantly lower than the average ratio of 1:1400 in other developing countries and 1:300 in

* Corresponding author. Tel.: +1 252 737 1462; fax: +1 252 328 9872.
E-mail address: huigang.liang@gmail.com (H. Liang).

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developed countries [1]. The shortage of health care professionals combined with the rampage of diseases together lead to huge health disparities between the SSA and the rest of the world. Telemedicine is a highly promising technology that could be utilized to reduce the SSA health disparities and improve medical conditions of the underserved SSA communities. Its role will be particularly salient in epidemic disaster situations like Ebola, which limits the ability of specialists to work on site.

Prior research finds that telemedicine is able to increase care accessibility, improve care quality, reduce costs, and enhance patient and provider satisfaction, and telemedicine has been routinely used in some parts of the world [3–5]. However, telemedicine’s benefits cannot be fully realized because many health care systems are still unable to employ telemedicine as a regular approach to delivering medical services [6]. Telemedicine pilot projects often suffer from economic sustainability issues after the initial seed funding is depleted [7]. Besides economic and technological impediments, a frequently cited challenge to the survival of telemedicine is that complex human and social factors hinder the diffusion of telemedicine services [6]. Given that telemedicine represents a novel service model that differs from the familiar traditional face-to-face approach, it is not uncommon for health care professionals and patients to find the idea difficult to embrace. The medical literature suggests that health care professionals have negative attitudes toward telemedicine for several reasons: fear of handling computers, anxiety that telemedicine will reduce their job security, apprehension that the return on investment for telemedicine is low, and concern that the physician–patient communications will be ineffective [8]. Physicians are also concerned that the implementation of telemedicine technologies may alter current work practices, challenge physician referral methods, or interrupt their workflow [9]. These negative perceptions and concerns tend to produce an impression that telemedicine is threatening rather than beneficial, which leads to a resistance to telemedicine adoption. Therefore, understanding why health care professionals resist telemedicine will enhance appropriate and meaningful use of telemedicine systems in Africa.

User resistance has consistently been identified as a major obstacle to the success of system implementations [10,11]. In fact, it is reported to be the number one challenge to the implementation of large-scale systems, and is widespread in the early stages of system implementation [12]. User resistance is particularly serious in healthcare settings in which healthcare professionals are characterized by high professional autonomy and a low propensity for being persuaded by people outside their profession [13–15]. Both qualitative and quantitative studies suggest that physician resistance is one of the top barriers to implementing clinical information systems [16].

Telemedicine, as an innovative approach to delivering care enabled by IT, is new to healthcare professionals in SSA countries and will likely encounter resistance. Given that telemedicine could provide great social value to Africans, it is important to understand why healthcare professionals tend to resist the use of telemedicine. However, prior research on telemedicine use is predominantly focused on physician adoption of telemedicine [17–20], and existing knowledge about healthcare professionals’ resistance to telemedicine is scant. There is a lack of theory-driven quantitative research that delineates which antecedents lead to resistance and in what way. This research attempts to fill this gap in the literature. Our objective is to understand why Sub-African healthcare professionals resist the use of telemedicine. Based on technology threat avoidance theory (TTAT) [21], we propose that perceived threat and perceived controllability are two salient perceptions determining resistance and identify a set of antecedents that influence these two perceptions.

2. Theoretical foundation

As shown in Fig. 1, we draw on technology threat avoidance theory (TTAT) to develop a research model that explains health care providers’ resistance to telemedicine [21,22]. We suggest that users’ resistance to telemedicine is primarily determined by two cognitive appraisals: the resistance increases when the users perceive telemedicine to be a threat and decreases when they believe that telemedicine usage is controllable. Based on an extensive literature review, we propose that perceived threat arises from three major cognitive sources: reduced autonomy, anxiety, and cost, and anxiety and cost also reduce perceived controllability. In addition, given that any individual is inevitably surrounded by some social contexts, we posit that users’ cognitive perceptions and appraisals are influenced by contextual factors. Specifically, government support plays a pivotal role in alleviating telemedicine resistance by having a negative effect on reduced autonomy, anxiety, and cost, as well as by moderating the effects of perceived threat and perceived controllability on resistance. We explain in detail the theoretical rationale behind the research model as follows.

TTAT, rooted in coping theory from social psychology, posits that IT is a two-sided sword that could bring both benefits and losses to individuals. Resistance is a type of coping behavior that arises from individuals’ cognitive evaluation of the situation [21]. Specifically, when an innovative IT such as telemedicine is introduced, a stressful situation is created for the users because they need to make efforts to adapt to this new technology. To cope with the stress, users go through two processes: cognitive appraisal and coping. During cognitive appraisal, they determine whether and how telemedicine impacts their well-being [23]. This process can be further divided into primary appraisal, which decides what may be at stake, and secondary appraisal, which determines what can be done to prevent or reduce harm or improve benefits.

In the context of telemedicine, primary appraisal gives rise to perceived threat, defined as the extent to which users believe that telemedicine negatively influences their personal benefits despite its value in improving care delivery. Secondary appraisal, on the other hand, leads to perceived

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1 Rogers’ diffusion of innovation model is widely applied to explain the positive behavior of technology adoption/acceptance. However, this study is focused on resistance, which is a type of negative behavior. Therefore, Rogers’ model cannot be readily applied in this context. Resistance is a typical form of coping. That is why we chose TTAT that is based on coping theory instead of Rogers’ model.
controllability which is defined as the extent to which users believe that they have the capabilities and resources to be in control of the use of telemedicine. It should be noted that the primary appraisal could engender both perceived threat and perceived opportunity [24], because users can recognize the opportunities offered by telemedicine to improve their performance while also feeling threatened by the pressures of using telemedicine. However, recent research shows that perceived opportunity only influences adaptive coping while perceived threat only affects maladaptive coping [25]. Given that in this research we investigate resistance, which is a maladaptive behavior, we only focus on the effect of perceived threat.

Based on the outcome of appraisals, specific coping behaviors should manifest. Coping refers to the user's cognitive and behavioral efforts to manage (reduce, minimize, master, or tolerate) the stressful situation. Coping is essentially an adaptation behavior which allows users to adjust to the introduced IT in various ways. This adaptation could be adaptive or maladaptive based on whether it positively or negatively affects users’ performance [24]. Resistance is a maladaptive behavior users take to adapt to telemedicine because it is a passive approach to dealing with innovations and does not allow users to leverage telemedicine to improve their capability of delivering medical services.

3. Hypothesis development

Individuals evaluate the potential negative consequences of the target of resistance and then decide their resistant attitudes or acts [26]. When the target is a specific technology, people refuse to adopt the technology if they expect it to cause losses of control, resources, or emotional stability which can all lead to a perception of threat [21,24]. Many studies have suggested that expected losses could lead to resistance. An early study by Markus [27], for example, found that accountants’ resistance toward a new financial system was propelled by their expected loss of control over critical data and consequent loss of organizational power. The new system was perceived by accountants as a threat, which led to the eventual implementation failure. Kim and Kankanhalli [11] suggest that users prefer to maintain the status quo when facing changes and will resist using an information system if it threatens the status quo.

Physicians in particular have long been known for being laggards in terms of IT adoption. When studying physician resistance to clinical information systems, Lapointe and Rivard [14] find that physicians made projections about the consequences of the use of a new system and then engaged in resistance behaviors if the expected conditions were threatening. Bhattacherjee and Hikmet [15] confirm that physicians’ threat perception of health information technology is a strong predictor of their resistance to change. Based on these previous findings, we hypothesize that if healthcare professionals perceive telemedicine as a threat causing loss, they will resist using telemedicine.

H1a. Perceived threat is positively associated with resistance.

Perceived controllability is concerned with whether an individual believes that the change associated with telemedicine use is under the control of the individual. It is well recognized that perceived controllability over change plays a central role in determining humans’ self-regulated behaviors [28]. When the contingencies in the environment are interpreted to be controllable, individuals tend to respond by mobilizing necessary motivational and cognitive resources to adapt to the required changes [29]. Users with a high perception of controllability tend to view the difficulties in telemedicine use to be under their personal control and thus embrace the change confidently. On the contrary, users with a low perception of controllability will be discouraged by the difficulties and may be more inclined to resist the change.

Perceived controllability has significant conceptual similarities with other constructs such as perceived behavioral control, self-efficacy, and facilitating conditions [30]. Strong evidence has emerged from research in the theory of planned behavior to show that perceived behavioral control can make individuals more motivated to perform a target behavior [31]. It is also found that facilitating conditions, which enhances the feeling of controllability, is positively associated with physicians’ use of electronic medical records [13]. Bala and Venkatesh [25] demonstrate that perceived controllability can reduce users’ avoidance of enterprise systems. All of the above evidence suggests that the more people feel in control, the
less likely they will resist using telemedicine. Therefore, we propose that as perceived controllability increases, the level of user resistance will decrease.

**H1b.** Perceived controllability is negatively associated with resistance.

Because health care professionals possess specialized expertise and knowledge in the field, one characteristic that distinguishes them from other individuals is the high autonomy in performing their professional tasks [13,32,33]. Professional autonomy is the ability of individuals to make independent decisions concerning their work-related tasks and activities. It generally refers to professionals’ control over the conditions, processes, procedures, or content of their work according to their individual or collective judgment in the application of their knowledge and expertise [34]. For example, a physician has full authority to decide how to deliver medical care to a patient without the uninvited outside influence [35]. Physicians traditionally form a close-knit social network that views external attempts to exert control as a challenge to its autonomy [36]. Many privileges emanate from professional autonomy. First, professionals have more access to critical resources than non-professionals. Second, professionals have control over the tasks performed by supporting staff so that the staff’s work is peripheral to their professional activities [34]. In the context of telemedicine, a physician’s access to resources and control over others’ work are both constrained, because telemedicine services require fewer resources deployed on the local site and many work activities take place on the remote site which is out of the local physician’s reach. In addition, telemedicine implies that the physician would submit to his or her peer’s diagnosis and treatment decisions. These changes brought forth by telemedicine tend to reduce healthcare professionals’ autonomy and undermine their privileges. After evaluating these losses, healthcare professionals are likely to perceive telemedicine as a threat.

**H2a.** Reduced autonomy is positively associated with perceived threat.

The impact of anxiety on users’ attitude toward IT has been extensively documented in the information systems literature [37–40]. Anxiety can be categorized as trait anxiety and state anxiety. Trait anxiety reflects a chronic and generalized predisposition to be anxious and nervous, while state anxiety is triggered in a situation in which an individual is confronted with problems or challenges [39,40]. In this study, we focus on state anxiety that is invoked by the introduction of telemedicine.

Researchers have shown that computer systems can lead to anxiety that involves the apprehension or fear of an individual experiences when faced with the possibility of using an IT [38]. In our case, physicians tend to have anxious or emotional reactions (e.g. feeling fearful, nervous, or intimidated) when they are requested to use telemedicine. Physicians with high levels of anxiety will have negative attitudes toward telemedicine and are likely to engage in resistance. Venkatesh et al. suggests that anxiety does not have a direct effect on individual’s system use intention; rather its impact is indirect. Similarly, we propose that the impact of anxiety on physician’s resistance to telemedicine is also indirect. Such impact is mediated via perceived threat and perceived controllability. When users suffer from anxiety, they are scared and worry about possible harmful consequences caused by telemedicine, giving rise to a perception of threat. In addition, the feeling of anxiety makes users feel vulnerable and powerless, which reduces their self-efficacy and perception of being in control [40].

**H2b.** Anxiety is positively associated with perceived threat.

**H3a.** Anxiety is negatively associated with perceived controllability.

Previous research has suggested that net inequity, greater costs than benefits [27,41], and negative outcome expectations [42] are also reasons for user resistance. From the rational decision making perspective two different types of costs, transition costs and uncertainty costs, are identified in the literature as causing user resistance to a new system implementation [11]. Transition costs occur when users try to adapt to the new environment. Such costs include transient costs which occur during the change and permanent costs that are results of the change [43]. In the telemedicine context, healthcare professionals are required to spend time and efforts in learning the new system and they may face loss of work due to the implementation of telemedicine system. Meanwhile, switching to the telemedicine environment could lead to a permanent change in their work flows and a reduction in their power status. Thus, both transition and uncertainty costs could result from the use of telemedicine and contribute to a perception of personal loss. When costs are high, users tend to believe that telemedicine is detrimental, thus increasing perceived threat. In the meantime, high costs could exceed users’ capabilities and resources. As a result, users are likely to be overwhelmed by the costs and feel a diminished control over the situation.

**H2c.** Cost is positively associated with perceived threat.

**H3b.** Cost is negatively associated with perceived controllability.

The government can exert important institutional influences on adoption of innovative technologies by organizations and individuals [44]. Government support has been identified as a critical factor in the success of telemedicine [6,45,46]. The support from government includes several aspects. First, policy makers can enact laws and regulations to afford telemedicine a legal status in the practice. The legitimization of telemedicine can also lead to the acceptance from insurance companies. Once telemedicine becomes a legitimate practice, healthcare professionals’ concerns about legal disputes and return on investments will be alleviated.

Second, the government can establish infrastructures and provide various funding support and incentives to stimulate the use of telemedicine. The telecommunication services, power and other major infrastructures of most developing countries are monopolized by government agencies.
Therefore, the government has a crucial role in updating, regulating and standardizing the infrastructure and equipment needed for telemedicine. In poor developing countries, the government needs to directly fund or find international sponsors to fund telemedicine initiatives. The government could also offer financial incentives to IT adopters, as the United States did to promote meaningful use of electronic health records. This can significantly reduce healthcare professionals’ concern about the cost of adopting telemedicine.

Third, the government can provide institutional support for healthcare professionals. For example, the government can implement operational standards and protocols for telemedicine practices so that the role of telemedicine in clinical decisions is clearly defined and effective communications can be achieved between healthcare professionals in the use of telemedicine. The government can also raise healthcare professionals’ awareness of telemedicine by providing educational programs and disseminating exemplary telemedicine success stories. These governmental initiatives can help healthcare professionals gain an in-depth understanding of telemedicine which should reduce their fear of losing job autonomy. Therefore, we hypothesize that government support is able to lessen healthcare professionals’ concerns about reduced autonomy, anxiety, and perceived cost.

H4a. Government support is negatively associated with reduced autonomy.

H4b. Government support is negatively associated with anxiety.

H4c. Government support is negatively associated with perceived cost.

Government support not only directly alleviates healthcare professionals’ concerns about IT adoption, but also plays a nuanced moderating role. By enacting policies and leveraging public media, the government helps to nurture an innovation-oriented national culture in which innovative behaviors are encouraged in three ways. First, the innovation-oriented culture sends signals to individuals that their pursuit of creative ideas and new ways of accomplishing tasks is valuable and approved [47]. Second, the innovation-oriented culture suggests that innovative behaviors of using advanced IT will be rewarded and appreciated [48,49]. Third, the innovation-oriented culture assures that risk taking will be encouraged and failures and mistakes will be tolerated [50–52]. Due to various risks associated with telemedicine such as reduced autonomy, anxiety, and costs, it is rational for healthcare professionals to feel threatened and refuse to integrate telemedicine into their practices. Influenced by the innovation-oriented culture nurtured by the government, the healthcare professionals should be more likely to take risks and less worried about negative consequences of using telemedicine. Although the threat perception still induces them to resist using telemedicine, the weight of the threat perception in their decision making will be reduced. Therefore, government support can act as a moderating variable that weakens the relationship between perceived threat and resistance.

H5a. Government support moderates the relationship between perceived threat and resistance, so that the relationship is weaker when government support is high.

When the government is committed to supporting telemedicine, using telemedicine to deliver care will become a legitimate practice. Resources such as infrastructure, training, and dedicated IT support services are likely to be allocated for facilitating telemedicine usage. With the support, healthcare professionals will be empowered to adapt to the new work context altered by telemedicine. In addition, when the government nurtures an innovation-oriented culture, knowledge sharing and open information flow regarding telemedicine use could become a norm among healthcare professionals [53,54]. By exchanging relevant knowledge and information related to telemedicine, healthcare professionals can learn from each other and become better prepared to adjust to telemedicine. Hence, government support is likely to reinforce the effect of perceived controllability of healthcare professionals so that they have a deeper understanding about their level of control over telemedicine. As a result, with government support, healthcare professionals should be more confident in their level of control and less likely to resist using telemedicine. In contrast, without government support, they could be less sure about their personal control and more likely to resist using telemedicine. Therefore, we propose that government support strengthens the effect of perceived controllability on resistance.

H5b. Government support moderates the relationship between perceived controllability and resistance, so that the relationship is stronger when government support is high.

4. Method

4.1. Research context

Ethiopia is a SSA country with an area of 1.1 million square kilometers. About 83% of its 93.8 million population live in rural areas and Ethiopians’ life expectancy at birth is 56.5 years. The present levels of health care facilities and staff are extremely low. For example, the ratio of health centers to citizens is 1:222,850 (compared to the Ministry of Health standard of 1:25,000), and the ratio of physicians to citizens is 1:38,619 (compared to the World Health Organization standard of 1:10,000) [55]. The government, foreign alliances and universities are the primary sources that contribute to improving the existing facilities and personnel. The Ethiopian government has recognized the need to strengthen national capacities of telemedicine, and has worked on policy and strategy, capacity building, and education in the health sector [55]. All stakeholders including universities, the telecommunication authority, the ministry of health, and other institutions and policy makers have been committed to supporting telemedicine implementations. Most of the existing health care institutions and other infrastructure (such as telecommunications
and electricity) are owned and controlled by the government, and their use requires the permission and co-operation of overseeing authorities.

Telemedicine was first started in Ethiopia in 2001. Thereafter, concerted efforts from various stakeholders have enabled telemedicine to expand to four teaching hospitals and six district hospitals, which provide services to more than 29 clinics or health centers. The major telemedicine services include teleradiology, teledermatology, teleophthalmology, and telepathology [56]. As a study shows, the development of telemedicine has been slow and the telemedicine system in the largest tertiary hospital in Ethiopia has only been used less than 40 times per year during the past seven years [57].

4.2. Measurement development

Except government support, all of the measurements in this study are adapted from validated scales in previous studies. Specifically, resistance was assessed with items from Bhattacherjee and Hikmet [15]. The items for perceived threat and perceived controllability were adapted from Major et al. [58]. The items for costs were obtained from Kim and Kankanahalli [11]. Anxiety was measured using a scale from Venkatesh et al. Reduced autonomy was measured by items adapted from Walter and Lopez [34]. The items for government support were self-developed because there are no existing measures available. All of the items (Appendix A) were rated by a 5-point Likert scale where 1 means “strongly disagree” and 5 means “strongly agree.” The measures were pre-tested with 10 physicians in Ethiopia to ensure face validity.

4.3. Data collection

A paper-based questionnaire was used to collect data. Data were collected from 107 healthcare professional during summer 2010 in Ethiopia. The development of telemedicine in Ethiopia has been very slow since 2010. Few new projects were initiated and the existing systems are seriously underused [57]. Therefore, we believe that the data we collected in 2010 are still relevant to test the hypotheses because the situation has not changed much. Among these respondents, 61 respondents are under 35 (57.0%); 30 are between 35 and 45 ages old (28.0%); 13 are between 46 and 55 ages old (12.2%), 3 are over 55 years old (2.8%). A total of 69 respondents are male (64.5%). Their professions include nurse (N = 45, 42.1%), health officer (N = 4, 3.7%), primary physician (N = 11, 10.3%), and specialist (N = 47, 43.9%).

5. Results

5.1. Measurement evaluating

Partial Least Square (PLS), a second-generation Structural Equation Modeling analytic technique, was used for our data analysis [59]. We first evaluated the validity and reliability of the measures of the major constructs. Following Gefen et al. [60], validity of the measures was tested using two procedures. First, we calculated each construct’s average variance extracted (AVE) and the binary correlations between each pair of constructs. As Table 1 shows, the square root of each construct’s AVE is much greater than the construct’s correlations with any other construct, suggesting sufficient discriminant validity. Second, factor loadings and cross loadings are calculated for all of the constructs. As Appendix B shows, the loading of each item on its assigned construct is at least 0.78, suggesting sufficient convergent validity. In addition, each item’s factor loading on its assigned construct is much higher than its cross-loadings on the other constructs, confirming sufficiency of discriminant validity [61]. Reliability of the measurements was examined by computing composite reliability. As Table 1 shows, all reliability scores exceed Nunnally’s [62] recommended cut-off of 0.70.

The eight latent constructs were measured by respondents’ self-reports. Thus, common method variance (CMV) might introduce bias into our data analysis. We assessed CMV by performing the Harman’s one-factor test. An exploratory factor analysis was conducted and the factor solution was inspected [63,64]. Large common method variance is present when a single factor emerges or one general factor accounts for most of the covariance among the measures. An eight-factor solution explained 81.96% of the data variance. The largest variance explained by a factor was only 12.67% and the smallest variance explained by a factor was 7.99%, suggesting that CMV is not a serious concern.

5.2. Hypothesis testing

The results of model testing are shown in Fig. 2 and the specific hypothesis testing results are summarized in Table 2. First, about 38% of variance in resistance is explained by the model. Perceived threat ($b = 0.33$, $p < 0.01$) is positively related to

Table 1—Reliability, average variance extracted, and correlations.

<table>
<thead>
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<th></th>
<th>Mean</th>
<th>SD</th>
<th>R</th>
<th>AVE</th>
<th>GS</th>
<th>RA</th>
<th>AX</th>
<th>COS</th>
<th>TH</th>
<th>CON</th>
<th>RE</th>
<th>PU</th>
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<tbody>
<tr>
<td>GS</td>
<td>3.19</td>
<td>1.06</td>
<td>0.93</td>
<td>0.81</td>
<td>0.90</td>
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<tr>
<td>RA</td>
<td>2.46</td>
<td>1.00</td>
<td>0.94</td>
<td>0.81</td>
<td>0.01</td>
<td>0.90</td>
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<tr>
<td>AX</td>
<td>2.25</td>
<td>0.95</td>
<td>0.94</td>
<td>0.85</td>
<td>−0.28</td>
<td>0.32</td>
<td>0.92</td>
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<tr>
<td>COS</td>
<td>2.55</td>
<td>0.95</td>
<td>0.93</td>
<td>0.82</td>
<td>−0.27</td>
<td>0.02</td>
<td>0.17</td>
<td>0.91</td>
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<tr>
<td>TH</td>
<td>1.96</td>
<td>0.90</td>
<td>0.98</td>
<td>0.93</td>
<td>−0.24</td>
<td>0.37</td>
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<td>0.39</td>
<td>0.96</td>
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<tr>
<td>CON</td>
<td>3.53</td>
<td>0.99</td>
<td>0.87</td>
<td>0.69</td>
<td>0.18</td>
<td>0.15</td>
<td>−0.32</td>
<td>−0.45</td>
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<td>0.83</td>
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<tr>
<td>RE</td>
<td>2.21</td>
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<td>0.96</td>
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<tr>
<td>PU</td>
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<td>−0.32</td>
<td>0.42</td>
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Note: R = composite reliability; GS = government support; RA = reduced autonomy; AX = anxiety; COS = cost; TH = threat; CON = controllability; RE = resistance; PU = perceived usefulness. Square roots of AVE are in bold and on diagonal cells.
resistance, while perceived controllability ($b = -0.12, p < 0.05$) is negatively related. Therefore, we find support for H1a and H1b. Second, about 40% of variance in perceived threat is explained. All of the three antecedents, reduced autonomy ($b = 0.24, p < 0.01$), anxiety ($b = 0.37, p < 0.01$), and cost ($b = 0.32, p < 0.01$), have a significant positive effect on threat, which provides support to H2a–H2c. Third, about 23% of variance in perceived controllability is explained by the model. Both anxiety ($b = -0.26, p < 0.05$) and cost ($b = -0.35, p < 0.01$) are negatively associated with controllability, supporting H3a and H3b. Finally, the influence of government support is revealed. While it is shown to reduce anxiety ($b = -0.29, p < 0.05$) and cost ($b = -0.25, p < 0.01$), it has no significant effect on reduced autonomy ($b = -0.04, p > 0.05$). Thus, we find support for H4b and H4c, but not for H4a.

Government support negatively moderates the positive relationship between perceived threat and resistance so that the relationship is weaker when government support is high ($b = -0.35, p < 0.05$). It also negatively moderates the negative relationship between perceived controllability and resistance so that the relationship is stronger (i.e., the absolute value of the decreased negative coefficient is greater) when government support is high ($b = -0.20, p < 0.05$). We also calculated the effect size of each moderation effect. The effect size is medium for the first moderation ($f^2 = 0.13$) and small for the second moderation ($f^2 = 0.03$) [65].

In addition, the effects of perceived usefulness, age, and gender on resistance are controlled. Perceived usefulness is found to have a significant influence on resistance ($b = -0.19, p < 0.05$), whereas age and gender do not have significant relationships with resistance. Overall, our statistical tests provide strong empirical evidence for the research model. Except H4a, all of the hypotheses are supported.

### 6. Discussion

This research finds that resistance to telemedicine among Ethiopian healthcare professionals can be explained by their perceived threat and controllability over telemedicine use. When health care professionals believe that telemedicine causes negative consequences and harms their autonomy, their threat perception will be heightened and resistance will likely occur. In contrast, a sense of controllability will reduce the possibility of user resistance. When users have sufficient capabilities and resources to cope with telemedicine use and its consequences, they are less likely to engage in resistance behaviors. These findings have implications for both research and practice.

This paper makes several contributions to research. First, it demonstrates that user resistance can be satisfactorily explained from a threat control perspective suggested by TTAT. We tested a baseline model with resistance being predicted by only perceived threat and perceived controllability, and it explained 44% of the variance. This suggests a concise yet powerful theoretical model for explaining user resistance. This corroborates previous research that the threat perception increases while the controllability perception mitigates user resistance [15,25]. Second, it demonstrates that TTAT can be adapted to explain technology induced threats outside of the IT security context. Although TTAT was originally developed to account for users’ avoidance of IT security threats such as malware and cybercrimes, we find that its basic theoretical underpinnings rooted in coping theory are also applicable in contexts involving threats induced by IT intended to improve user performance. Third, we identify three constructs as cognitive sources of resistance, namely reduced autonomy, anxiety, and costs. We embed them in a

### Table 2 – Hypothesis testing results.

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Coefficient</th>
<th>Supported?</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1a: threat → resistance</td>
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</tr>
<tr>
<td>H1b: controllability → resistance</td>
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<td>Yes</td>
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<tr>
<td>H2a: reduced autonomy → threat</td>
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<tr>
<td>H2b: anxiety → threat</td>
<td>0.37</td>
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<tr>
<td>H2c: cost → threat</td>
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<tr>
<td>H3a: anxiety → controllability</td>
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<td>H3b: cost → controllability</td>
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<tr>
<td>H4a: government support → reduced autonomy</td>
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<td>H4b: government support → anxiety</td>
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<td>H4c: government support → cost</td>
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<td>H5a: government support × threat → resistance</td>
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<tr>
<td>H5b: government support × controllability → resistance</td>
<td>-0.20</td>
<td>Yes</td>
</tr>
</tbody>
</table>

** $p < 0.01$.
* $p < 0.05$. 

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Fig. 2 – PLS test results.
new theoretical framework and empirically show how they influence resistance by increasing perceived threat and reducing perceived controllability. Our findings are consistent with prior research which shows that these constructs negatively affect IT adoption or usage [22,27,38,41]. Fourth, we studied a new construct, government support, which has particular importance in African countries that lack social resources. We find that government support not only directly reduces anxiety and costs, but also play significant moderating roles. It weakens the positive effect of perceived threat, while it strengthens the negative effect of perceived controllability on resistance. These moderation effects provide a more nuanced understanding of how government can facilitate the implementation of IT. Although the role of governments has been identified as critical in promoting telemedicine by many scholars [6,45,46], few studies have empirically examined the mechanisms through which governments exert their influences. Our paper is the first to fill this void in the literature.

This study also has practical implications for implementing technology such as telemedicine in developing countries. In particular, it highlights the importance of careful planning and control in the implementation of IT of high social value. When a technology provides more value to the broad society than the users, users may miss the big picture and feel that the technology threatens them personally in some way. In this situation, governments should actively provide resources, develop infrastructures, establish policies, and develop educational programs to eliminate sources of perceived threat and barriers to perceived controllability. For example, to reduce physicians’ threat perception of telemedicine, the government could take advantage of emergency public health events like the ongoing Ebola crisis to highlight the huge benefits that could be brought forward by telemedicine. On the other hand, we also found that government support cannot alleviate the concern of reduced autonomy. This suggests that government support alone is not likely to address all sources of user resistance. If the threat perception stems from professional autonomy deeply rooted in healthcare providers’ norms and beliefs, it will probably require early exposure to information technologies during medical students’ college education. The government could also play a facilitating role in reforming the higher education for medicine and other health professions by organizing national level expert committees or task forces and establishing relevant guidelines for better integrating health informatics courses into medical schools’ curricula.

Several limitations of this study should be noted. First, we only studied three inhibiting factors as sources of perceived threat. The selection of these factors was based on interviews with Ethiopian physicians. We attempted to identify the most salient factors rather than include a complete list of all possible influencing factors. Future research should look into other factors and examine how they can explain additional variance in perceived threat and perceived controllability. Second, this study was conducted in Ethiopia and the findings could be constrained by the national context. Caution should be taken when generalizing the findings to other SSA countries. Finally, our survey data is cross-sectional and collected from a single source. Common method bias is a concern. Future research can apply a longitudinal design or collect data from multiple sources to validate our findings.

### Summary points

**What was known before the study**

- Cognitive factors such as perceptions of usefulness and ease of use can enhance physicians’ adoption of telemedicine.
- Physicians are likely to resist the use of advanced IT in their clinical practices.
- Little is known about how healthcare professionals resist the use of telemedicine.

**What this study has added to the body of knowledge**

- Healthcare professionals’ telemedicine resistance is influenced by their perceived threat and controllability.
- Perceived threat is determined by reduced autonomy, anxiety, and costs associated with telemedicine use.
- Perceived controllability is affected by anxiety and costs associated with telemedicine use.
- Government support can reduce anxiety and costs. Moreover, it can reduce the effect of perceived threat and strengthen the effect of perceived controllability on resistance.

### Author contributions

Yajiong Xue performed research design, survey development and manuscript writing. Huigang Liang contributed to research design, survey development, data analysis and manuscript writing. Victor Mbarika performed research design, data collection. Richard Hauser and Paul Schwager revised the manuscript. Mequanint Kassa Getahun collected data.

### Conflict of interest

None.

### Appendix A. Survey instrument

**Government support**

1. The local government allocated adequate funding to support telemedicine.
2. The local government encourages the use of telemedicine.
3. The local government enacted policies to approve the use of telemedicine.
4. Telemedicine is a legitimate medical practice in my region.

**Reduced autonomy**

1. Using telemedicine may decrease my control over clinical decisions.
2. Using telemedicine may decrease my professional discretion over patient care decisions.
3. Using telemedicine can decrease my control over each step of the patient care process.
4. Using telemedicine may increase monitoring of my diagnostic and therapeutic decisions by non-providers.

Perceived threat

1. I am worried that using telemedicine will negatively affect me.
2. I am scared that telemedicine will have harmful (or bad) consequences for me.
3. I feel stressed about using telemedicine.

Perceived controllability

1. I will be able to overcome any problems I might have from using telemedicine.
2. I will be able to cope well with the use of telemedicine.
3. I have the resources I need to successfully use telemedicine.

Anxiety

1. I feel apprehensive about using telemedicine.
2. I hesitate to use telemedicine for fear of liability issues.
3. Telemedicine is somewhat intimidating to me.

Cost

1. It takes a lot of time and effort to use telemedicine.
2. Using telemedicine could result in unexpected hassles.
3. I would lose a lot in my work to use telemedicine.

Resistance

1. I don’t want telemedicine to change the way I make clinical decisions.
2. I don’t want telemedicine to change the way I interact with other people on my job.
3. Overall, I don’t want telemedicine to change the way I currently work.

Perceived usefulness

1. Using telemedicine can improve my patient care.
2. Using telemedicine can enhance my effectiveness in patient care.
3. Telemedicine makes it easier to diagnose difficult cases.
4. I find telemedicine useful in my job.

### Appendix B. Loadings and cross-loadings.

<table>
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<th></th>
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<th>RA</th>
<th>AX</th>
<th>COS</th>
<th>TH</th>
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Note: GS = government support; RA = reduced autonomy; AX = anxiety; COS = cost; TH = threat; CON = controllability; RE = resistance; PU = perceived usefulness.
REFERENCES


