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*JAMIA* 2006 13: 428-431  
doi: 10.1197/jamia.M2026

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*Brief Review* ■

# Defining Obtrusiveness in Home Telehealth Technologies: A Conceptual Framework

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**Abstract** The literature of home telehealth technology recommends that systems be designed to minimize their obtrusiveness to end users. However, this term is neither explicitly defined nor consistently used. This paper presents a definition of the concept of obtrusiveness. Within this definition, twenty-two categories of what may be perceived as obtrusive in home telehealth technology are proposed based on a review of the literature. These categories are grouped into eight dimensions. This effort represents an initial step toward developing measures of obtrusiveness associated with home telehealth technology. A validated and reliable instrument would allow for evaluation of individual applications as well as theory-building across applications.

■ *J Am Med Inform Assoc.* 2006;13:428–431. DOI 10.1197/jamia.M2026.

## Introduction

Clinical informatics is concerned with the application of methods, techniques, and theories of biomedical informatics to patient care.<sup>1</sup> Advances in information and communication technologies and rapid growth of the elderly population have led to increased informatics research on telehealth applications that monitor individuals in their homes and detect or predict health-related problems. The concepts of obtrusiveness and intrusiveness are often used in the home telehealth literature as criteria (i.e., non-obtrusive and non-intrusive) for such technologies to be successfully implemented. However, these terms are not well defined or consistently used. They are often used interchangeably, in most cases to imply generally that an application has to be user-friendly and accessible. The lack of a detailed and clear definition of these concepts is surprising given the importance placed on these attributes for home telehealth and for patient-centered technologies in general.

The specific aims of this paper are to identify and briefly describe the problem; to provide a definition with underlying dimensions and categories supported in the literature; and to discuss next steps and implications for informatics research and development.

## Background

Home telehealth technologies are defined as IT-based systems that transfer data from and to residences, whether these are disease management systems (that, for example, transfer vital signs), videophones, “smart home” applications, or other health-related monitoring and communica-

tion equipment. Numerous examples of different uses of “obtrusive” and “intrusive” can be found in the home telehealth literature. In the Suzuki et al.<sup>2</sup> exploration of the use of smart home monitoring sensors, “non-intrusive” was used to emphasize that users did not have to operate the system. In their examination of intelligent biomedical clothing, Lymberis and Olson<sup>3</sup> used the term “non-obtrusive” to refer to the miniaturization of monitoring devices and the potential for non-invasive capture of vital signs. Ling et al.<sup>4</sup> described a minimal contact oxygen delivery system as “non-obtrusive” because it did not contact the face and was odorless and comfortable to use. In their overview of smart homes, Rialle et al.<sup>5</sup> call for technology that is as “unintrusive” as possible. Miskelly<sup>6</sup> states that “unobtrusive” sensors have potential to contribute to the care of elderly in institutions and at home. Suzuki et al.<sup>7</sup> selected sensors for an automatic remote health monitoring system based on their “ease of installation and *unobtrusiveness*.” Conversely, in his review of similar telematic and personal area networks, Abascal<sup>8</sup> cautions that these technologies are “very *intrusive* and must only be used with the permission of the user.” In all of these instances, the term is not defined and a framework is lacking to determine the extent of obtrusiveness or intrusiveness.

In the conceptualization presented here, both terms (namely obtrusiveness and intrusiveness) are incorporated into a single concept of obtrusiveness, as described below.

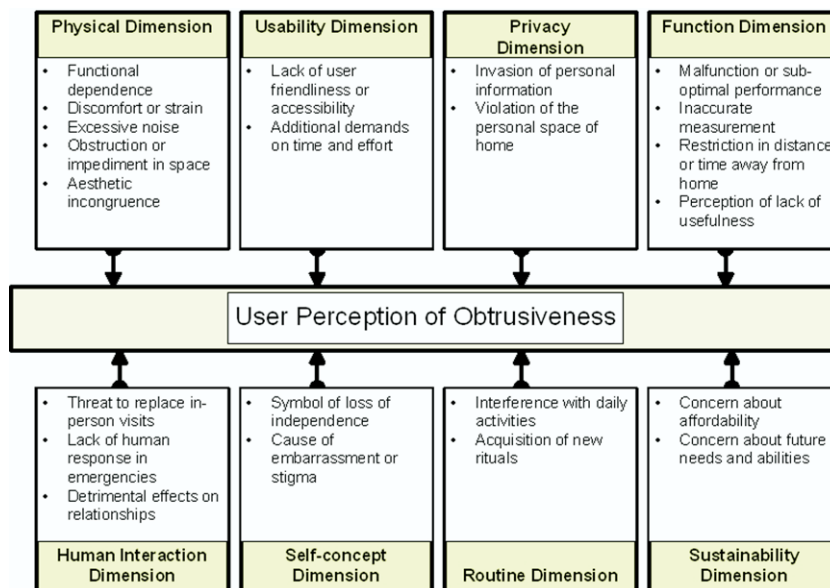
## Formulation Process

A definition of obtrusiveness as applied to home telehealth technology was not found in the literature; therefore, fundamental dictionary definitions of “obtrusive” were used to develop the definition presented below. Within this conceptual definition, categories (bullet points in [Figure 1](#)) were identified from the literature and through consideration by the research team of reasons that such technology could be perceived as obtrusive. Broader dimensions (box labels in [Figure 1](#)) were then created inductively by the research team by grouping these more specific categories. Where possible, constructs that were already defined and explicated in the

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Received for review: 11/28/05; accepted for publication: 04/06/06.



**Figure 1.**

- 1) **Physical Dimension.** This dimension captures obtrusive effects associated with physical aspects of a technology and their effects on users or the home environment. The literature raises the concern about creating functional dependency in users.<sup>8,9</sup> It also supports systems that are physically integrated into the architecture and space<sup>10</sup> and that do not clash with users' aesthetic sensibilities.<sup>11</sup>
- 2) **Usability Dimension.** The literature supports designs that maximize usability, including accessibility for users with functional impairments.<sup>12-14</sup> This dimension also includes additional demands on time and effort associated with using a technology; for example, in learning how to use it and for its maintenance. Such demands will be greater for users who are inexperienced with technology (which include some elderly).<sup>15</sup>
- 3) **Privacy Dimension.** Invasions of privacy are often cited as examples of technology-related obtrusiveness<sup>16</sup> and privacy concerns have been identified as a potential barrier to acceptance of assistive health information technologies.<sup>17-19</sup> *Informational privacy* refers to the desire to control the sharing of personal information with others<sup>20</sup> and may be violated when telehealth devices reveal more information than the user desires. *Physical privacy* is related to both the degree to which one is physically accessible to others and the accessibility of one's personal space or territory<sup>16</sup> and may be violated when telehealth technology impinges on the user's control of such access.
- 4) **Function Dimension.** This dimension captures concerns associated with how the equipment works, including its perceived reliability and effectiveness. Concerns about inaccurate measurement (of, e.g., vital signs) also fit here, which may be directly impacted by the technology, itself,<sup>21,22</sup> or by how familiar its human operators are in using it.<sup>23</sup> Additionally, functional attributes such as non-portability or limited power supply may restrict users to shortened distance or time away from home. Lastly, users may perceive that a technology is not useful in meeting needs it was expected to meet.<sup>18</sup>
- 5) **Human Interaction Dimension.** This dimension captures concerns about how a technology may negatively affect human interaction, response, or relationships. Home telehealth patients may fear technology replacing in-person interaction with their health care providers.<sup>18,19,24</sup> Family caregivers may fear that this will mean greater burden for providing care is placed on them.<sup>19</sup> Focus groups about smart home technology revealed a concern about human response or assistance, that there might be "nobody at the other end. . .to react to the information."<sup>17</sup> Finally, users may worry about a technology affecting friendships or other valued relationships.
- 6) **Self-Concept Dimension.** A technology may be perceived as obtrusive because of its effect on or meaning for self-concept: "the concept the individual has of himself as a physical, social, and spiritual or moral being."<sup>25</sup> This dimension includes the psychological aspect of dependence (as distinguished from *functional dependence*, above, which focuses on the physical aspect of dependence). Assistive technology may be viewed as "a mechanism by which to regain independent performance, or . . . as a symbol of lost function and abilities."<sup>26</sup> In addition to self-evaluation, what others may think is also important to self-concept. The literature includes examples of people with assistive devices being treated differently by others<sup>27</sup> as well as users' fears of embarrassment or stigmatization for needing such devices.<sup>9</sup>
- 7) **Routine Dimension.** The use of telehealth technology in the home may affect users' daily routines or rituals and/or require the acquisition of new ones. The issue of changes to daily routine and rituals as a result of telehealth technology has not been well described in the literature. However, the home care literature does discuss how bringing in durable medical equipment, such as hospital beds, Hoyer lifts, and bedside commodes, can affect personal routines within the home.<sup>28-31</sup> It is assumed that telehealth technology brought into the home could be perceived as obtrusive to personal routines in the same way.
- 8) **Sustainability Dimension.** This dimension includes user concerns about sustaining use of a technology. In this context, users are worried that for some reason, including affordability<sup>17,19</sup> or their own functional ability,<sup>13,32</sup> they will not be able to keep or use the technology into the future. Concerns about sustainability may be perceived as obtrusive when users believe they need to keep using a technology but are anxious that circumstances may not allow this.

literature, such as usability and privacy, were chosen as dimensions.

### Description of Conceptual Model

The term “obtrusive” is defined in dictionaries as “undesirably prominent”<sup>33</sup> or “undesirably noticeable.”<sup>34</sup> (“Prominent” is preferred to “noticeable” because it connotes a greater degree of perceived importance or effect.) Something may be undesirably prominent or obtrusive either physically or psychologically—or both. For example, a programmable medication dispenser may be perceived as physically obtrusive by being prominently in the way and taking up limited counter space. It may also be psychologically obtrusive as a prominent, or top of mind, symbol or reminder of growing dependence. Physical obtrusiveness is physically experienced, such as with wearable technology that may be perceived as uncomfortable by its user. Psychological obtrusiveness manifests itself in feelings such as anxiety, worry, or frustration that are associated with the technology.

What is perceived as undesirably prominent is context specific. Within the single context of the home, what is obtrusive may be thought of as something perceived as both undesirable *and* prominent. Of course, something may be undesirable to a user but be so minor or unimportant (physically or psychologically) to him or her that it is not prominent, and thus is not perceived as obtrusive.

The term “intrusive” is defined in dictionaries as “characterized by coming or entering in an encroaching manner, without invitation or welcome”<sup>35</sup> and as “tending to intrude (especially upon privacy).”<sup>36</sup> We incorporate the characteristics or effects of intrusiveness of a home telehealth technology within our broader, inclusive definition of obtrusiveness, through the dimension of *privacy* in particular.

This paper defines obtrusiveness in home telehealth technology as a summary evaluation by the user based on characteristics or effects associated with the technology that are perceived as undesirable and physically and/or psychologically prominent. Within this definition, there are four underlying assumptions. First, obtrusiveness is a summary evaluation that may be based on the cumulative obtrusiveness of a number of characteristics or effects associated with the technology or on one characteristic or effect that is especially important or prominent to the user. Second, the obtrusiveness of a given technology is subjectively assigned by each user. Technology that one person perceives as obtrusive may not be perceived as such by another. Third, “user” refers to not only the patient, but also any other resident in the home. Fourth, we are concerned with telehealth applications used in the home. As a person’s private, personal space, there is a different psychological dynamic operating in the home environment than in an institutional facility. The concept’s dimensions and categories are summarized in Figure 1.

### Discussion

Consumer health informatics applications are often designed and evaluated in terms of usability. Within the concept of obtrusiveness, the typology presented recognizes that other factors, in addition to usability, affect the adoption and sustained use of telehealth applications in the consumer-patient’s home setting. The categories of obtrusiveness range from what

some may see as inconveniences (e.g., interference with daily activities) to potentially deeper concerns (e.g., symbol of loss of independence). Determining which categories or dimensions are more important to users requires that this conceptual framework be developed into a valid and reliable instrument: the ultimate goal in making this work most useful to research and practice. Next steps include testing the validity of the categories, dimensions, and overall construct, to be followed by development of an instrument that is then tested for reliability. Validated categories and dimensions would be operationalized in instrument questions for each category measuring degree of obtrusiveness as perceived by users along a continuous scale.

### Conclusion

Measurement of an abstract construct such as obtrusiveness must begin with an explicit conceptualization. The conceptual framework presented represents this first step in instrument development. Such an instrument would contribute to research in allowing identification of generalized factors that users find obtrusive across patient-centered technologies. Knowledge of the relationship of these attributes to performance and outcomes responds to the call for a structured approach to theory building in health informatics.<sup>37</sup> Implications for practice include technological design and evaluation informed by such research.

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