Patient preferences for health information technologies: a systematic review

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Background: Advances in patient-facing health information technology (HIT) promise to improve health care delivery and patient outcomes. Low utilization of HIT suggests that the preferences of patients may not be adequately guiding the development of these technologies. This systematic review offers an assessment of published evidence regarding patient preferences for HIT.

Methods: Articles addressing preferences for HIT from patient and other end-user groups published up through 2020 were identified from PubMed, Web of Science, Scopus and via hand searching. Articles that used quantitative stated-preference methods to explore preferences for HIT were eligible for inclusion. Studies that explored attitudes towards HIT without eliciting trade-offs were excluded. Critical appraisal of study quality was conducted using the PREFS checklist and quality criteria identified by the US Food and Drug Administration including heterogeneity analysis and patient engagement in study design. We conducted thematic analysis of the main preference findings from each study to synthesize patient and end-user preferences for HIT. The review was not registered and authors received no funding to conduct the review.

Results: The search yielded 7,299 unique articles, 59 of which were ultimately included in the review. Studies explored preferences for telemedicine (n=30), patient portals (n=12), mHealth (n=9) or multiple HITs (n=8). Preference elicitation methods included direct elicitation (n=26), discrete-choice experiments (n=13), conjoint analysis (n=6), contingent valuation (n=5), and ranking exercises (n=9). Studies had a mean PREFS score of 3.51 out of 5. Forty-two studies conducted preference heterogeneity analysis and only 20 included patients in study design. Thematic meta-analysis indicated that patients prefer HIT that is convenient and lower cost, but does not sacrifice quality, and preferences varied by demographic features such as age as well as depending on the type of health information being communicated.

Conclusions: Patient and end-users have distinct preferences for the use of HIT in their medical care. It is timely that researchers and healthcare administrators consider these preferences for HIT given its rapid uptake amidst the COVID-19 pandemic. Although this literature demonstrates that patients can be engaged as participants in preference studies to identify meaningful aspects of HIT, the field was limited in its inclusion of patients in the design of such studies. Future development of HIT should be guided by high-quality preference research that integrates patients in all stages in the design and implementation of HIT.

Keywords: Telehealth; mHealth; patient preferences; end-users

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Introduction

Health information technology (HIT) has become central to the provision of healthcare (1). HIT broadly encompasses the use of electronic hardware to address the storage, retrieval, and sharing of health information to inform communication and decision making (2). The Health Information Technology for Economic and Clinical Health (HITECH) Act in 2009 created incentives for the use of HIT services such as electronic medical records, and widened the scope of privacy and security protections for electronic health data (3). As systems capable of storing, analyzing, visualizing, and communicating data to patients and providers, HIT can facilitate patient reminders, support diagnostics, gather and synthesizing important medical information, and facilitate evidence-based decision making at the point of care (4). In clinical settings, HIT applications range from simple digital charting and clinical e-mail to the integration of advanced decision support tools into virtual patient portals (5). The uptake of HIT has allowed health care providers and patients to securely share health information and more efficiently coordinate care and manage the receipt of health services (6). Data generated from HIT can also inform regulatory decision making given that the 21st Century Cures Act has prompted the inclusion of real-world evidence in product review (7).

There is general agreement that HIT has potential to improve healthcare quality and patient outcomes. A recent systematic review found that over 80% of studies integrating HIT resulted in at least one improved medical outcome among patients (8). Appropriate use of HIT has been demonstrated to reduce human and medical errors (9), improve comprehensive care coordination, monitoring and surveilling patient data over time, and improve clinical health outcomes (5). HIT also has the potential to improve outcomes for providers and health systems, such as through streamlining clinical workflow (10) and reducing health care costs (11). HIT is also thought to increase access to care (12).

Despite the promise of HIT to improve the quality of healthcare it continues to face satisfaction and implementation barriers hindering its success (13,14). A US study indicated that poor system functionalities, difficulty using, and hardware issues reduced clinician satisfaction with the use of HIT such as electronic health records (EHR) (15). A systematic review of problems with HIT spanning studies in six countries found that problems with HIT included issues with functionality, poor user interfaces, fragmented displays, and challenges in accessing the system (16). Patients and clinicians have expressed concerns that the use of technology hinders rapport-building (17), although other reports indicate that HIT can improve doctor-patient relationships by automating workflows and increasing clinician-patient time (10). A systematic review in primary care across seven countries found that neither quality of care, patient safety nor provider/patient relationships were affected by the adoption of EHR, but that implementation success was fostered by insulating features within the health system such as strong leadership, project management, standardization, and training (18). This indicates that successful implementation of HIT may depend not just on the effectiveness of the technologies themselves but on the contexts in which they are applied.

Patient-centeredness involves providing care that is concordant with patients’ needs and values and respectful of/responsive to patient preferences (19). Health informatics have the potential to facilitate patient-centered care and the field has evolved to consider technology’s role in the acquisition, storage, and usage of health care data (20). Optimized HIT may increase patient satisfaction and perceived satisfaction with and quality of care, as well as improve health outcomes HIT (7,21). Conversely HIT may also detract from the patient-centeredness of care when applied inappropriately (22). Ensuring that HIT systems are aligned with and responsive to patients’ preferences, needs and values is essential to making them patient-centered. Doing so is a priority area for the Agency for Healthcare Research and Quality (23).

Methods to measure the preferences of patients have been rigorously applied to explore the preferences of patients in diverse healthcare settings (24,25). Stated-preference methods are a well-established and rapidly growing suite of preference elicitation approaches with application in clinical, policy, and regulatory decision making (26-28). Stated-preference methods can help in identifying what attributes of a given health service individuals value most and what tradeoffs they are willing to make to achieve them. Understanding patient preferences for HIT can help in the development of HIT systems that are acceptable to patients. They can also ensure that HIT is used to support and enhance patient’s interactions with healthcare systems rather than detract from them.

This systematic review characterizes how stated-preference methods have been used to explore patient and other end-user preferences for HIT. Previous research has
systematically reviewed other processes measures associated with HIT including its adaption (16,29,30), satisfaction and attitudes (7,31,32), and barriers and facilitators (33,34). In addition to providing substantial information regarding patient and other end-user preferences for HITs, we also offer methodological recommendations on how to evaluate the quality and bias in patient preference studies following good research practices, and how to synthesize substantive information about patient preferences using meta-synthesis. We present the following article in accordance with the PRISMA reporting checklist (available at http://dx.doi.org/10.21037/jhmhp-20-105).

**Methods**

**Key questions**

We conducted a systematic review and meta-synthesis to explore the use of preference-elicitation methods in evaluating HIT. The review was guided by three overarching questions: (I) In what HIT and healthcare contexts are preference studies being conducted? (II) What is the typology and quality of HIT preference studies? (III) What are patients’ and other end-users’ preference for HIT? Answers to these questions will make an important contribution to the literature by providing information that can be used to inform the development, application, and evaluation of HIT from a patient-centered perspective. This review follows protocols based on other systematic reviews of preference-elicitation methods (35,36).

**Inclusion and exclusion criteria**

Studies were eligible for inclusion if they (I) discussed HIT; (II) used a quantitative trade-off based stated-preference method, including: direct-elicitation, discrete-choice experiments, conjoint analysis, and ranking; (III) elicited the preferences of patients, caregivers, or end-users; (IV) were available in English, and (V) were full-text documents. Studies that only assessed the preferences of health care providers for HIT were excluded. Studies in which the preference-elicitation approach did not involve a trade-off, such as “select all that apply” questions or Likert-type rating, were excluded. Abstracts and purely qualitative studies were excluded. For this review HIT was defined following Brailer et al.’s description of HIT as “the application of information processing involving both computer hardware and software that deals with the storage, retrieval, sharing, and use of health care information, data, and knowledge for communication and decision making” (2). Studies describing such technologies were eligible for inclusion, prominent examples of which include EHR, patient-portals, and telehealth. Two reviewers assessed studies at the title/abstract and full-text stages to determine inclusion (BW, SH). Conflicts were addressed by a third reviewer (JB).

**Search strategy**

The search strategy included three concepts: (I) HIT, (II) stated-preference methods, (III) patients, caregivers, and end-users. We performed a preliminary search of PubMed and Web of Science in January 2020. The search strategy was amended, and run in PubMed, Web of Science, and Scopus in April 2020. The final search terms are presented in Table S1. This search was supplemented with additional hand-searching of the reference lists of all included studies, and the journals Journal of Telemedicine and e-Health, Journal of Telemicine and Telecare, Journal of American Medical Informatics, BMC Medical Informatics and Decision Making, Journal of Medical Internet Research from 2004 to 2020. These journals were selected for additional hand-searching because they had produced many relevant/nearly relevant hits in database searches.

**Data abstraction & critical appraisal**

The following categories of information were extracted: author, date, country, preference-elicitation method, sample size, HIT context (i.e., telemedicine, patient portal, mHealth, or multiple HITs), and healthcare context (i.e., receiving healthcare, managing health data, receiving health data, or multiple healthcare contexts), and key preference finding.

We assessed study quality using the PREFS checklist (35) which evaluates the quality of reporting of stated-preference studies according to five criteria: purpose of study, respondent sampling, explanation of assessment methods, findings, significance testing. Studies achieved a score of 1 for every criterion that meet PREFS standards, and a 0 otherwise. The range of possible PREFS scores is 0–5. ANOVA tests were used to explore differences in PREFS scores across preference-elicitation and HIT contexts. We also assessed study quality according to several criteria posed by the US Food and Drug Administrations for patient
preference studies, including: justification of sample size, heterogeneity considerations, relevance/comprehension to the patient population (37,38).

General data abstraction was split between two reviewers (BW, SH). PREFS scores and FDA recommended qualities were independently assigned by two reviewers (BW, SH) and discrepancies were resolved through consensus agreement between the reviewers.

**Meta-synthesis using thematic analysis**

Key preference findings abstracted from all studies were synthesized using thematic analysis. Thematic analysis is a foundational approach in qualitative analysis and is used for identifying, analyzing and characterizing repeated topics and ideas (39,40). The key preference finding was thematically analyzed by three reviewers (NC, BW, SH). The three reviewers independently identified themes, and then collectively revised and refined themes. Two reviewers conducted a final thematic categorization of the key findings from each included article (BW, SH) and a third reviewer (NC) reconciled any conflicts.

The review was not registered and authors received no funding to conduct this review. The review protocol can be accessed from authors upon reasonable request.

**Results**

**Identified studies**

The search strategy identified 9,152 results via systematic review methods and 14 results via hand searching as is visualized in the PRISMA diagram presented in Figure 1. After removing 1,867 duplicates, titles/abstracts of 7,299 papers were reviewed. A full-text review was conducted for 130 articles, 71 of which were excluded as they did not meet all inclusion criteria. In total 59 articles met all criteria and were included in the review. Several studies met many but not all criteria. For instance, some studies assessed preferences of clinicians rather than patient/caregiver end-users (41,42), and others used qualitative methods rather than quantitative trade-off techniques to describe preferences for HIT (43).

**Characteristics of included studies**

Table 1 describes the characteristics of included studies. Most studies were conducted in the US (n=29), followed by Australia (n=9), the Netherlands (n=4), South Korea (n=3), Germany (n=3), United Kingdom (n=2), Canada (n=2 each), Italy (n=2) and Israel, Turkey, Sweden, and Japan (n=1 each). Only one study spanned multiple countries (44). The majority of studies were published from 2010 to 2020 and this growth of preference studies for HIT is visualized in Figure 2. Study sample sizes ranged from 34 to 20,882 participants. Studies using an experimental preference method (i.e., DCE, conjoint analysis, contingent valuation) had the highest average sample size (average n=1,640) followed by direct elicitation (average n=421) and ranking (average n=178). Data extracted from included studies is available from authors upon reasonable request.

**Critical appraisal of study quality**

Three studies met all five PREFS criteria (45-47), 28 studies met four criteria, and the remaining four studies met two criteria (Table 1). The average PREFS score was 3.51 out of 5 (SD 0.70). Almost all studies met criteria for stating the preference purpose (“P” in PREFS, n=58) and explaining the preference-elicitation methodology (“E”, n=56). Few studies demonstrated that responders were similar to non-responders (“R”, n=5). Three-quarters of studies appropriately included respondents in the findings (“F”, n=43) and used significance tests (“S”, n=45). Average PREFS score did not vary across preference-elicitation (ranking vs. direct elicitation vs. experimental methods; P=0.73) or by HIT context (P=0.69). Inter-rater reliability of study quality using PREFS was 0.80 before a consensus score was assigned for every study, and 1.00 after consensus.

In assessing study quality using criteria outlined by FDA we found that 71% of studies (n=42) conducted heterogeneity analysis. Preference heterogeneity was generally assessed through sub-group analysis of patient demographics, medical conditions, technology familiarity, health literacy, or some other distinguishing characteristic of the research population. About a third of the articles (n=20) engaged patients in the development of the preference elicitation tool through either a focus group, pilot study, or both. Only 15% of studies (n=9) justified their sample size.

**Preference elicitation approaches**

We segmented literature into three preference-elicitation categories based on the preference study design: (I) experimental preference methods (DCE, conjoint analysis,
contingent valuation), (II) direct elicitation, and (III) ranking exercises.

Experimental preference methods
Twenty-four studies used experimental preference elicitation approaches including DCEs (n=12) (44,46,48-56), conjoint analysis (n=7) (57-63), and contingent valuation (n=5) (64-68). Of the 19 studies that used a DCE or conjoint analysis, 14 had a choice-based design (44,46,48-50,52,56,69), three had a rank-based design (57-59), one used a value-based conjoint (60), and one used a take-it-or-leave conjoint analysis (62).

In the choice-based designs, multiple choice tasks were presented to respondents, each consisting of two or more profiles described by various attribute levels relevant to the healthcare and HIT context. Seven of the studies using choice-based designs offered an opt-out choice in which the respondent could choose none of the presented profiles (44,50,53,54,56,61,69). For example, Determann et al. included an opt-out option in their DCE that explored EHR preferences in order to make the experiment resemble the real-life situation where respondents are not obligated to have a EHR (53).

The total number of choice tasks presented to respondents in a given preference study using a choice-based design ranged from 5–22 (mean 11.36, SD 4.78). Eight of these studies used blocked-designs wherein a given respondent received a subset of the total choice tasks (44,46,48-50,52,56,69). In these studies, the total number of choice tasks ranged from 12–120. One such study was a pan European survey of online patient portal preferences that analyzed a total of 120 choice tasks through surveys that only presented five choice tasks to each respondent (44). In choice-based design studies, the number of attributes

Figure 1 PRISMA flow chart of study identification and selection
Table 1 Characteristics of included HIT preference studies

<table>
<thead>
<tr>
<th>1st author, year</th>
<th>Country</th>
<th>Method</th>
<th>N</th>
<th>HIT context</th>
<th>Healthcare context</th>
<th>PREFS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brick, 1997</td>
<td>USA</td>
<td>DE</td>
<td>461</td>
<td>Telemedicine</td>
<td>Telemedicine services for rural populations&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3 EFS</td>
</tr>
<tr>
<td>Lowitt, 1998</td>
<td>USA</td>
<td>DE</td>
<td>131</td>
<td>Telemedicine</td>
<td>Teledermatology examination of veterans&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2 EF</td>
</tr>
<tr>
<td>Tsuji, 2003</td>
<td>JAP</td>
<td>CV</td>
<td>291</td>
<td>Telemedicine</td>
<td>WTP for telemedicine services&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3 PES</td>
</tr>
<tr>
<td>Dick, 2004</td>
<td>CAN</td>
<td>VAS</td>
<td>57</td>
<td>Telemedicine</td>
<td>Care support following hospital discharge&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3 PES</td>
</tr>
<tr>
<td>Hassol, 2004</td>
<td>USA</td>
<td>DE</td>
<td>1,421</td>
<td>EHR</td>
<td>EHR web-based communication&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3 PEF</td>
</tr>
<tr>
<td>Bradford, 2004</td>
<td>USA</td>
<td>CV</td>
<td>126</td>
<td>Telemedicine</td>
<td>WTP for CHF telemedicine services&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4 PEFS</td>
</tr>
<tr>
<td>Bradford, 2005</td>
<td>USA</td>
<td>CV</td>
<td>366</td>
<td>Telemedicine</td>
<td>WTP for CHF and hypertension telemedicine services&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3 PES</td>
</tr>
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<td>Qureshi, 2007</td>
<td>USA</td>
<td>CV</td>
<td>92</td>
<td>Telemedicine</td>
<td>WTP for telemedicine services&lt;sup&gt;a&lt;/sup&gt;</td>
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</tr>
<tr>
<td>Mofid, 2007</td>
<td>USA</td>
<td>DE</td>
<td>98</td>
<td>Telemedicine</td>
<td>Teledermatology vs face-to-face consultation&lt;sup&gt;a&lt;/sup&gt;</td>
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</tr>
<tr>
<td>Basoglu, 2010</td>
<td>TUR</td>
<td>CA</td>
<td>161</td>
<td>Telemedicine</td>
<td>Remote clinical service&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3 PEF</td>
</tr>
<tr>
<td>Park, 2011</td>
<td>SKR</td>
<td>CA</td>
<td>118</td>
<td>Telemedicine</td>
<td>Diabetes Management Service&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3 PES</td>
</tr>
<tr>
<td>Basu, 2011</td>
<td>USA</td>
<td>DE</td>
<td>129</td>
<td>mHealth</td>
<td>Receiving imaging results&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4 PEFS</td>
</tr>
<tr>
<td>Vandelanotte, 2011</td>
<td>AUS</td>
<td>DE</td>
<td>803</td>
<td>Telemedicine</td>
<td>Physical activity intervention&lt;sup&gt;a&lt;/sup&gt;</td>
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</tr>
<tr>
<td>Johnson, 2012</td>
<td>USA</td>
<td>DE</td>
<td>53</td>
<td>OPP</td>
<td>Receiving radiological reports&lt;sup&gt;a&lt;/sup&gt;</td>
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<td>Ranney, 2012</td>
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<td>General telemedicine services&lt;sup&gt;a&lt;/sup&gt;</td>
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<td>Grande, 2013</td>
<td>USA</td>
<td>CA</td>
<td>3,064</td>
<td>OPP</td>
<td>Secondary uses of health data&lt;sup&gt;b&lt;/sup&gt;</td>
<td>4 PRES</td>
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<tr>
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<td>CA</td>
<td>400</td>
<td>Telemedicine</td>
<td>General telemedicine services&lt;sup&gt;a&lt;/sup&gt;</td>
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<td>DE</td>
<td>474</td>
<td>PCEHR</td>
<td>Health record storage system&lt;sup&gt;b&lt;/sup&gt;</td>
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<tr>
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<td>DE</td>
<td>277</td>
<td>mHealth</td>
<td>Messaging for behavioral interventions&lt;sup&gt;a,b&lt;/sup&gt;</td>
<td>3 PES</td>
</tr>
<tr>
<td>Stephen, 2014</td>
<td>UK</td>
<td>CV</td>
<td>34</td>
<td>Telemedicine</td>
<td>WTP for dementia telecare services&lt;sup&gt;a&lt;/sup&gt;</td>
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<tr>
<td>Stypulkowski, 2015</td>
<td>USA</td>
<td>DE</td>
<td>346</td>
<td>Telemedicine</td>
<td>Surgery postoperative follow-up&lt;sup&gt;a&lt;/sup&gt;</td>
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<td>Lal, 2015</td>
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<td>DE</td>
<td>67</td>
<td>Telemedicine</td>
<td>Receiving mental health services and information&lt;sup&gt;a&lt;/sup&gt;</td>
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<td>Choudhry, 2015</td>
<td>USA</td>
<td>RE</td>
<td>301</td>
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<td>Receiving skin biopsy results&lt;sup&gt;a&lt;/sup&gt;</td>
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<td>DE</td>
<td>617</td>
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<td>Kaambwa, 2016</td>
<td>AUS</td>
<td>DCE</td>
<td>330</td>
<td>Telemedicine</td>
<td>Health care services for older people&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4 PEFS</td>
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<tr>
<td>Wallin, 2016</td>
<td>SWE</td>
<td>DE</td>
<td>343</td>
<td>Telemedicine</td>
<td>Internet based psychological Interventions&lt;sup&gt;a&lt;/sup&gt;</td>
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<td>Determann, 2016</td>
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<td>DCE</td>
<td>1,443</td>
<td>PHR</td>
<td>Managing health data access, sharing, and storage&lt;sup&gt;b&lt;/sup&gt;</td>
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<td>Patil, 2016</td>
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<td>20,882</td>
<td>OPP</td>
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<td>White, 2016</td>
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<td>RE</td>
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<td>EHR</td>
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<td>439</td>
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<td>Receiving ED discharge information&lt;sup&gt;c&lt;/sup&gt;</td>
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<td>DCE</td>
<td>35</td>
<td>Telemedicine</td>
<td>Teledermoscopy for melanoma screening</td>
<td>4 PEFS</td>
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presented per tasks ranged from three to eight (mean 5.43, SD 1.45).

Rank-based conjoint analysis involved respondents ranking multiple profiles described by various attribute levels from most preferred to least preferred. Only three studies used this approach (57-59). Five studies used a

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Table 1 (continued)

<table>
<thead>
<tr>
<th>1st author, year</th>
<th>Country</th>
<th>Method</th>
<th>N</th>
<th>HIT context</th>
<th>Healthcare context</th>
<th>PREFS</th>
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<td>1,865</td>
<td>mhealth</td>
<td>mhealth intervention &amp; info. delivery&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4 PEFS</td>
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<td>USA</td>
<td>RE</td>
<td>125</td>
<td>mhealth, OPP</td>
<td>Breast biopsy result notification&lt;sup&gt;c&lt;/sup&gt;</td>
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<td>5,921</td>
<td>Telemedicine</td>
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<td>RE</td>
<td>201</td>
<td>Telemedicine</td>
<td>Teledermatology examination methods&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3 PES</td>
</tr>
<tr>
<td>Andino, 2017</td>
<td>USA</td>
<td>VAS</td>
<td>108</td>
<td>Telemedicine</td>
<td>Video visits at outpatient urology clinic&lt;sup&gt;c&lt;/sup&gt;</td>
<td>2 PE</td>
</tr>
<tr>
<td>Boyde, 2018</td>
<td>AUS</td>
<td>DCE</td>
<td>200</td>
<td>mHealth, Telemed</td>
<td>Delivering cardiac rehabilitation services&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4 PEFS</td>
</tr>
<tr>
<td>Deiddda, 2018</td>
<td>IT</td>
<td>DCE</td>
<td>2,000</td>
<td>Telemedicine</td>
<td>Cardiology services&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3 PES</td>
</tr>
<tr>
<td>Snoswell, 2018</td>
<td>AUS</td>
<td>DCE</td>
<td>113</td>
<td>Telemedicine</td>
<td>Teledermoscopy for skin cancer screening&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4 PEFS</td>
</tr>
<tr>
<td>Saraswathula, 2018</td>
<td>USA</td>
<td>DE</td>
<td>107</td>
<td>OPP</td>
<td>Communication of biopsy results&lt;sup&gt;c&lt;/sup&gt;</td>
<td>4 PEFS</td>
</tr>
<tr>
<td>Nayyar, 2018</td>
<td>USA</td>
<td>CA</td>
<td>774</td>
<td>mHealth</td>
<td>Aesthetic surgery information&lt;sup&gt;c&lt;/sup&gt;</td>
<td>3 PES</td>
</tr>
<tr>
<td>Wildenbos, 2018</td>
<td>NET</td>
<td>DCE</td>
<td>1,294</td>
<td>OPP</td>
<td>Patient portal functionalities&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3 PES</td>
</tr>
<tr>
<td>Russell, 2018</td>
<td>USA</td>
<td>RE</td>
<td>46</td>
<td>mHealth</td>
<td>Medication self-management app features&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2 PF</td>
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<tr>
<td>Apolinario-Hagen, 2018</td>
<td>GER</td>
<td>DE</td>
<td>646</td>
<td>mHealth, Telemed</td>
<td>Internet based therapies&lt;sup&gt;a,b&lt;/sup&gt;</td>
<td>2 PE</td>
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<tr>
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<td>USA</td>
<td>DE</td>
<td>480</td>
<td>OPP</td>
<td>Online PROMIS health assessment dashboard&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3 EFS</td>
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<tr>
<td>Offermann-van Heek, 2019</td>
<td>GER</td>
<td>CA</td>
<td>140</td>
<td>mHealth, Telemed</td>
<td>Ambient Assisted Living (ALL) technologies&lt;sup&gt;c&lt;/sup&gt;</td>
<td>2 PE</td>
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<tr>
<td>Chudner, 2019</td>
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<td>Telemedicine</td>
<td>Video consultations in primary care&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4 PEFS</td>
</tr>
<tr>
<td>Nagao, 2019</td>
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<td>DE</td>
<td>40</td>
<td>Telemedicine</td>
<td>Audiometry telehealth services&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4 PEFS</td>
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<tr>
<td>Morland, 2019</td>
<td>USA</td>
<td>RE</td>
<td>180</td>
<td>Telemedicine</td>
<td>PTSD treatment preferences&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4 PEFS</td>
</tr>
<tr>
<td>Woolen, 2019</td>
<td>USA</td>
<td>DCE</td>
<td>418</td>
<td>OPP</td>
<td>Releasing cancer radiological test results&lt;sup&gt;c&lt;/sup&gt;</td>
<td>4 PEFS</td>
</tr>
<tr>
<td>Plinsinga, 2019</td>
<td>AUS</td>
<td>DE</td>
<td>259</td>
<td>mHealth</td>
<td>Osteoarthritis self-management support groups&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3 PEF</td>
</tr>
<tr>
<td>Edwards, 2020</td>
<td>USA</td>
<td>DE</td>
<td>112</td>
<td>mHealth, OPP</td>
<td>Communication of pediatric radiology results&lt;sup&gt;c&lt;/sup&gt;</td>
<td>4 PEFS</td>
</tr>
<tr>
<td>Slightam, 2020</td>
<td>USA</td>
<td>DE</td>
<td>764</td>
<td>Telemedicine</td>
<td>Clinical services for veterans with access barriers&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5 PREFS</td>
</tr>
<tr>
<td>Lim, 2020</td>
<td>AUS</td>
<td>CA</td>
<td>547</td>
<td>mHealth</td>
<td>Digital health administration&lt;sup&gt;b&lt;/sup&gt;</td>
<td>4 PEFS</td>
</tr>
<tr>
<td>Nguyen, 2020</td>
<td>GER</td>
<td>DE</td>
<td>65</td>
<td>mHealth</td>
<td>Reporting adverse events following immunization&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3 PEF</td>
</tr>
<tr>
<td>Barsom, 2020</td>
<td>NET</td>
<td>DE</td>
<td>50</td>
<td>Telemedicine</td>
<td>Video follow-up consultations for colorectal cancer&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4 PEFS</td>
</tr>
</tbody>
</table>

Healthcare Context Groups: <sup>a</sup>, receiving healthcare; <sup>b</sup>, managing health data and healthcare; <sup>c</sup>, receiving health data. USA, United States; UK, United Kingdom; CAN, Canada; SKR, South Korea; EU, European Union; AUS, Australia; SWE, Sweden; IT, Italy; GER, Germany; NET, Netherlands; IL, Israel; DE, direct elicitation; CV, contingent valuation; VAS, visual analogue scale to facilitate a ranking exercise; EHR, electronic health record; CA, conjoint analysis; OPP, online patient portal; RE, ranking exercise; PHR, personal health record; PCEHR, personally controlled electronic health record; WTP, willingness to pay; DCE, discrete-choice experiment; ED, emergency department; CHF, chronic heart failure.
contingent valuation approach, including those using open-ended (64,67), bounded (65,66), and both open-ended and bounded (68) methodologies. These five studies all explored willingness to pay for access to telemedicine services.

Direct elicitation
A total of 26 studies including (45,47) and (70-93) used direct elicitation approaches to identify HIT preferences. The direct elicitation methodologies involved questions in which respondents chose between multiple options related to the HIT context. Twelve studies included an opt-out option wherein participants could choose neither offered option. Examples of direct elicitation type questions included: “What is your preferred platform for delivery of personalized health information?” (87) and “In case of emotional problems, which of the described interventions would you most likely personally use?” (93). Most direct elicitation studies (n=18) used one or two questions to address a particular HIT healthcare context, but eight studies utilized three or more questions. Only one study asked more than seven preference elicitation questions (86).

Ranking exercises
Nine studies used ranking methods to identify preferences for HIT (94-102). The ranking exercises involved questions or tasks in which respondents ranked HIT attributes, such as modalities for receiving biopsy results (101,102) or electronic health records/personal health record functions (98,99), from most important to least important. In three studies, a ranking exercise was paired with another research task (95,97,100). Two studies utilized a visual analogue scale to perform a ranking task (94,96).

HIT and healthcare context
The most studied HIT context was telemedicine (n=30) followed by patient portals including electronic health records (n=12), mHealth (n=9) and multiple HITs (n=8). A matrix visualizing HIT context and the preference-elicitation approaches used to evaluate them is presented in Table 2.

In comparing across healthcare contexts, we found that studies fell into one of three groups including measuring preferences for: (I) receiving health data, (II) receiving healthcare, and (III) managing health data and healthcare. Ten studies were categorized as regarding the receipt of health data (Table 1). This included studies assessing receipt of clinical information such as biopsy results or radiological reports. Thirty-three studies described preferences for clinical interventions, therapies, or rehabilitation. Clinical areas
of study in this category included diabetes management (58), mental health/psychological interventions (76,77), cardiology services (51), skin cancer screening with teledermatology (49,50,71,72,95), pain rehabilitation (69), and cardiac rehabilitation (56). Sixteen studies examined preferences for managing health data and healthcare (Table 1). These studies described preferences for EHR management and self-management of healthcare. Most studies in this area were process-oriented rather than clinically focused, although two studies did focus specifically on managing healthcare with regards to osteoarthritis (89), and adverse event reporting following immunization (90).

**Themes from key preference findings**

Thematic analysis of the key preference results from all 59 studies (Table S2) resulted in the identification of 6 substantive themes regarding patient and end-user preferences for HIT. First, that preference for HIT vary
based on patient characteristics. Second, communication modality preferences depend on the type of exchange. Third, HIT is preferred when it facilitates expediency and convenience. Fourth, patients are concerned with their data being used outside of direct clinical encounters. Fifth, patients care about the cost of HIT. Sixth, HIT should not sacrifice quality of care.

Preferences for HIT vary based on patient characteristics
Sub-group and heterogeneity analysis conducted in many studies revealed that demographic characteristics such as age (47,54,62,65,66,70,71,74,78,86,87,97,101), race (60,102), gender (51,62,86,97), education (62,86,87,101), income (46,70) and proximity to care (46,79) were associated with patient preferences for HIT. Younger patients and higher income patients generally placed higher utility on HIT services.

Communication modality preferences depend on the type of exchange
Patients in many studies preferred that new, sensitive, complex, or urgent health concerns be communicated through conversation with a provider rather than electronically (47,69,70,72,77,80,82,85,101,102). In one study, patients’ preferred direct physician communication particularly for the return of abnormal biopsy results (85) though other studies reported participant indifference to communication method (81,101) and one study reported preference for return of biopsy results via the telephone rather than in-person (102). As waiting time for in-person care increased, patients became more willing to accept electronic communication regarding health information (54,55,70,85). Patients also expressed preferences for different modalities and functionalities of HIT based on the information being communicated (e.g., preference for text message vs. email) (87,98-100).

HIT is preferred when it facilitates expediency and convenience
Several studies demonstrated that using HIT was preferred relative to a traditional, in-person appointment when it was less burdensome to patients. Participants in one study indicated that the ideal circumstance for HIT was one wherein the patient lived far away from the clinic and would save money by using HIT (48). Visits that were outside of work hours (57) or located near other normal activities were preferred (49).

Patients are concerned with data use outside of clinical encounters
Patients expressed preferences for sharing their healthcare data with their health care team to inform medical decision making and improve care quality (44,63). However, patients also expressed concerns regarding the use of their data to inform non-clinical encounters. Patients generally opposed the use of their health data for marketing purposes (60) and for pharmaceutical and academic research (44). In one study younger patients had more liberal preferences for the storage and use of sensitive information than older patients (44). Data storage was among the most important concern of people reluctant to use electronic medical record systems (53).

Patients care about the cost of HIT
Patients expressed concern for the cost of HIT services in several studies. Cost was the most important service attribute regarding telemedicine (58) and the most decisive attribute for those who refused the use of electronic health records (53). Respondents in several studies expressed that telemedicine should be of lower cost than in-person care (48,51). Recurring service fees for HIT was more important to patients than single-time costs associated with devices needed to facilitate visits (59). Numerous studies investigated WTP for diverse HIT services (46,49,50,58,59,64-68,96). Several of these studies found that increasing age was associated with decreased WTP for HIT (65,66).

HIT should not sacrifice quality of care
There was concern among patients that HIT offered lower quality care as compared to in-person visits (49). Among a group of patients who expressed preferences for in-person care over telehealth, care quality was rated as the most important attribute of healthcare (52). Comprehensiveness of care was a highly prioritized attribute (58) and patients were more likely to prefer video-based care if they believed all of their concerns could be addressed during the appointment (45). In two separate studies patients were indifferent to in-person vs. HIT-facilitated healthcare as long as the provider was a specialist rather a general practitioner (50,61).

Discussion
The uptake of HIT over the past twenty years has altered the process of both providing and receiving medical care (103).
The current review demonstrates that patients have distinct preferences regarding both their own use and their care team’s use of HIT, namely that HIT is more appropriate in some settings than others, and that it ought to be convenient, low-cost, and high quality. This review contributes to calls to use and evaluate technologies from the perspective of patients by characterizing preferences for both the context and modality of HIT.

Despite technological advances there continues to be low satisfaction and uptake of HIT. Holistic understanding of patient and other end-user preferences for HIT can inform patient-centered development and application of HIT which should improve uptake (104). Doing so has the potential to improve patient engagement in health and self-management of health conditions (105,106). In addition to improving uptake of HIT more broadly, preference research can also help identify how preferences might vary across sub-groups of patient populations. The current review identified that preferences for HIT vary based on characteristics such as age, income, and education. Optimizing use of HIT might require tailoring it to meet the needs of unique individuals or groups of patients.

Thematic analysis of primary preference outcomes from included studies revealed that patients are reluctant for their personal health data to be used for drug development research. This is an important finding in light of the 21st Century Cures Act which encourages the use of real-world data such as that from patient medical records (7). To be patient-centered means to act in ways that are consistent with patients’ preferences and values (19). There is a tension in how to be patient-centered in this context; patients may not want to share data but also may enjoy the benefit of more expedient access to treatments facilitated by the sharing of their health data. This concern warrants further consideration from informatic, regulatory and bioethical perspectives and research. Preference research itself may be a useful tool to parse out acceptable tradeoffs between data sharing, data privacy, and development of new drugs.

In addition to being an area that can be informed by patient preferences, HIT might also facilitate the collection of patient preference information. There is a growing call to systematically and routinely collect patient preference information (23). Almost all stated-preference research is conducted cross-sectionally and as a result it is unknown whether preferences change over time or in response to medical events. Integrating preference-elicitation tasks into medical data, much in the way that patient-reported outcomes are currently captured now, is a potential area for new research. Knowing patient preferences at the point-of-care—for many aspects of that care, not just for HIT specifically—could improve medical decision making in clinical settings.

It is important to note that not all preference studies need be complex and experimentally designed in order to provide meaningful information about what patients want, be it with regards to HIT or elsewhere. While there has been a surge in the use of experimental methods such as DCEs in many aspects of health (107), other approaches can also be fit-for-purpose and appropriate to gauge preferences. For instance, direct elicitation approaches, wherein the researcher directly asks the respondent about what they do or do not want, composed half of studies in the current review.

This review has several limitations. First, we opted to include only quantitative preference elicitation methods that required participants to make trade-offs. Other preference elicitation methods including qualitative approaches can also speak to patient and end-user preferences for HIT (26). Another limitation is that of HIT’s conceptual ambiguity and identifying what was and was not HIT. While we conducted a systematic search, it is possible that not all articles on the topic of HIT preferences were captured. One reason for this is the conceptual ambiguity surrounding HIT. Our search followed a very broad definition of HIT (2), as specific descriptions of what does and does not constitute HIT are somewhat lacking. Such conceptual ambiguity creates difficulty in defining appropriate search terms. While our search strategy was based on our selected definition, choosing a different definition of HIT may have modified the returned set of studies and altered findings. The current review primarily captured preferences for HIT related to telemedicine, EMR, patient portals, and mHealth. Today’s rapidly-evolving technological and informatics environment means that there continue to be changes in electronic delivery of health information. On the horizon we anticipate that more HIT literature will address wearables, wireless medical devices, and personalized care (108), as well as HIT in a peri-COVID-19 world.

The current review used thematic analysis to synthesize findings from the primary preference results. Standard considerations of both meta-synthesis and qualitative analysis apply here, including that there are methodological challenges in combing results across multiple studies and that the reviewers are instruments of the research processes (109,110).

The growth of HIT in wake of the COVID-19 pandemic
strengthens the imperative of this work. COVID has acted as a push-strategy forcing the rapid rollout of HIT, rather than fostering a strategic rollout purposefully aligned with patient preferences. As HIT systems become ubiquitous in everyday medical care it is important that they be built with patient preferences in mind. As the digital era evolves it is important to consider not only whether people have access to and are able to adequately operate electronic health care services but also whether electronically-acquired information can be translated into positive health outcomes (107,111,112).

To further consider the preferences of patients in the construction of HIT systems, health information developers and health care administrators should seek to collect input from patient/caregiver end-users to identify and implement user-friendly systems that are responsive to patient need. However, healthcare administrators, rather than patients, are often primary stakeholders when examining organizational factors of patient-centeredness (113). As patients may have different ideal uses for HIT than other groups it would make sense to include patients in the identification of organizational outcomes for intervention. Failing to consider the wants of patients in the development of HIT systems may exacerbate health care disparities (114).

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Footnote

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doi: 10.21037/jhmhp-20-105

### Table S1: Search terms

#### PubMed


AND


AND

("patient preference"[MeSH] OR "consumer behavior"[MeSH]) OR ("patients"[MeSH] OR "caregivers"[Mesh] OR "end-user"[All Fields] OR "end user"[All Fields] OR "consumer"[All Fields])

#### Web of Science

("HIT" OR "health information technology" OR "health it" OR "EHR" OR "electronic health record" OR "EMR" OR "electronic medical record" OR "patient portal" OR Epic AND "mychart") OR (Cerner AND "HealthLife") OR "Microsoft Health" OR "Google Health" OR "GE Healthcare" OR ("mobile application" AND "health") OR ("health portal" AND "web") OR "personal health record" OR "PHR" OR "ehealth" OR "electronic health" OR "telecare" OR "telemedicine" OR "telehealth" OR "mobile health technology" OR "mobile health application" OR "m-health" OR "mhealth" OR "consumer health information" OR "social media" OR "instagram" OR "facebook" OR "twitter" OR "snapchat")

AND

("Patient Preference" OR "Consumer Behavior" OR "preference" OR "perception" OR "priority" OR "Health Priorities" OR "stated preference" OR "stated choice" OR "rating" OR "ranking" OR "perspective" OR "preference-based approach" OR "preference-based method" OR "tradeoff" OR "trade-off" OR "TTO" OR "BWS" OR "best worst scaling" OR "best worst scaling" OR "maximum differential" OR "maxdiff" OR "max diff" OR "discrete choice experiment" OR "DCE" OR "discrete choice" OR "Conjoint analysis" OR "ngen" OR "conjoint.ly" OR "sawtooth" OR "Point allocation" OR "magnitude estimation" OR "pairwise comparison" OR "budget allocation" OR "self explicated method" OR "self-explicated method" OR "direct assessment" OR "direct elicitation")

AND

("patient" OR "caregiver" OR "enduser" OR "end user" OR "end-user" OR "Consumer")

#### SCOPUS

(TITLE-ABS ("HIT" OR "health information technology" OR "health it" OR "electronic health record" OR "ehr" OR "electronic medical record" OR "emr" OR "personal health record" OR "health record, personal" OR ("epic" AND "mychart") OR ("cerner" AND "patient portal") OR "microsoft health" OR "google health" OR "gehealthcare" OR "telemedicine" OR "telecare" OR "consumer health information" OR ("mobile application" AND "health")))

AND

(TITLE-ABS ("patient" OR "caregiver" OR "enduser" OR "end user" OR "end-user" OR "consumer"))

AND

(TITLE-ABS ("patient preference" OR "preference" OR "stated-preference" OR "stated preference" OR "preference based approach" OR "preference-based approach" OR "preference based method" OR "preference-based method" OR "consumer behavior" OR "perception" OR "perspective" OR "priority" OR "health priority" OR "health priorities" OR "stated choice" OR "rating" OR "ranking" OR "tradeoff" OR "trade-off" OR "TTO" OR "BWS" OR "best worst scaling" OR "best worst scaling" OR "maximum differential" OR "maxdiff" OR "max diff" OR "discrete choice experiment" OR "DCE" OR "discrete choice" OR "conjoint analysis" OR "ngen" OR "conjoint.ly" OR "sawtooth" OR "point allocation" OR "magnitude estimation" OR "pairwise comparison" OR "self explicated method" OR "self-explicated method" OR "direct assessment" OR "direct elicitation")) AND (LIMIT-TO (DOCTYPE, "ar") ) AND (LIMIT-TO (LANGUAGE, "English"))
Key findings

- 73% of patients with a history of psoriasis or melanoma chose telemedicine over in-person care when it offered faster service.
- Only 19% of the cohort preferred telemedicine when time for service was the same, with 58% WTP for the service ($10-$125).
- The estimated household WTP for telehealth was $4.39 USD per month. This value was higher for households living more than 20 miles from their medical provider ($5.85) and with higher income ($5.85).
- Most participants preferred a cardiac rehabilitation program with a short length (4 weeks), a program time that was more than 6 weeks, and with frequent exercise (4 weeks).
- Preferences for the delivery of imaging results differed depending on whether results were normal or abnormal, with more respondents preferring normal results through email (22% normal, 8% abnormal) while the opposite was true for abnormal results.
- Preferences for the industry with the highest median income was telemedicine services (65% normal, 35% abnormal), followed by facetime (40% normal, 60% abnormal), and email (25% normal, 75% abnormal).
- The most important factor in determining user’s willingness to share EHR data was “use of data” (64.3%), followed by “data use” (31.6%) and “data sensitivity” (3.1%).
- Most patients prefer communication of biopsy results over the telephone (51%), followed by provider in person (31%), and written report (18%).
- The most preferred delivery modality for general intervention information was a Desktop Computer (38%), followed by email (11.5%), and smartphone (10.2%).
- For personalized info, they preferred None of the options (20.6%) followed by written report (18.2%) and facetime (17.8%).
- The most important finding was that technology-based interventions were the first choice for 75% of patients, followed by faceto-face interventions (10%), and then email (5%).
- The most preferred type of EHR data access was for patient portals (64.3%), followed by independent organizations (12.6%), and care providers (12.6%).
- Most veteran’s ranked home-based telehealth (HBT, 42.8%) as their first choice followed by in-person-in-home (31.7%) and face-to-face (25.5%).
- Most veteran’s were WTP $20 USD for access to telemedicine but only 19% were WTP $40 USD. Age had a marginally significant negative effect on WTP, suggesting older patients may have lower WTP for access to telemedicine.