



# Artificial intelligence and immediacy: Designing health communication to personally engage consumers and providers

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## ABSTRACT

**Objective:** We describe how ehealth communication programs can be improved by using artificial intelligence (AI) to increase immediacy.

**Methods:** We analyzed major deficiencies in ehealth communication programs, illustrating how programs often fail to fully engage audiences and can even have negative consequences by undermining the effective delivery of information intended to guide health decision-making and influence adoption of health-promoting behaviors. We examined the use of AI in ehealth practices to promote immediacy and provided examples from the ChronologyMD project.

**Results:** Strategic use of AI is shown to help enhance immediacy in ehealth programs by making health communication more engaging, relevant, exciting, and actionable.

**Conclusion:** AI can enhance the “immediacy” of ehealth by humanizing health promotion efforts, promoting physical and emotional closeness, increasing authenticity and enthusiasm in health promotion efforts, supporting personal involvement in communication interactions, increasing exposure to relevant messages, reducing demands on healthcare staff, improving program efficiency, and minimizing costs.

**Practice implications:** User-centered AI approaches, such as the use of personally involving verbal and nonverbal cues, natural language translation, virtual coaches, and comfortable human–computer interfaces can promote active information processing and adoption of new ideas. Immediacy can improve information access, trust, sharing, motivation, and behavior changes.

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## 1. Introduction

Communication is central to the delivery of health care and promotion of well-being. Yet, to be effective, health communication efforts have to actively capture the attention and personally engage health care participants to influence health decisions and behaviors. This is not easy to accomplish, and frankly many health communication efforts fail to accomplish their goals because they are not designed to be sufficiently involving and engaging. Decades of research show that many health communication efforts have failed because the approaches used have been overly generic, impersonal, confusing, and boring [1–5]. Health communication efforts may even have unintended negative (“boomerang”) consequences when audience members do not respond to messages as intended, often because they find the messages

to be alienating, insensitive or intimidating [6]. For example, the National Youth Anti-drug Media Campaign was designed to discourage drug abuse by emphasizing harmful effects of illegal drugs on the brain, but was perceived by at-risk youth as daring them to experiment with using illegal drugs [7]. Problematic health communication programs, like this one, fail to effectively deliver relevant health information as intended to guide informed health decisions, and do not achieve intended goals for promoting the adoption of healthy behaviors.

Fortunately, the use of artificial intelligence (AI) in e-health communication offers exceptional opportunities to increase the effectiveness of health promotion programs by enhancing immediacy and making ehealth communication engaging, relevant, involving, exciting, and actionable. Immediacy is a set of communication features that promote physical and emotional closeness, engaging and caring relationships, as well as authenticity and enthusiasm [2]. AI, which has become central to designing many ehealth programs, has been described as the science and engineering of intelligent machines [8]. AI helps to incorporate human intelligence capacities in computing, enabling the development of sophisticated ehealth communication

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features, including intuitive human–computer interfaces, congruent interaction responses, customized reminders to meet specific user needs, responsive monitors that record and adapt to users' experiences and physical/psychological states (such as movement, respiration, heartbeat, and brain waves), and engaging relational agents that can interact meaningfully with consumers as advisers, educators, and even therapists. In essence, AI can be used to make ehealth applications more human, adaptive, interactive, emotionally expressive, and can dramatically enhance immediacy.

Health communication is central to health promotion and is pervasive in most, if not all, health situations and contexts (such as hospital emergency rooms, surgical suites, medical offices, workplaces, schools, and homes) [9,10]. Designers of health communication programs must leverage the unique uses of various channels of communication with particular regard for access, preference, and utilization by key audiences in different health contexts. They must recognize that health communication situations are often fast-paced, highly charged, intense, and emotional due to many uncertainties about health risks and intervention strategies. They must design health communication program to meet the urgent needs of consumers (e.g., patients, caregivers, survivors, support group members) and providers (e.g., physicians, nurses, therapists, pharmacists, nutritionists, social workers, health educators) for relevant health information to guide complex, time-sensitive, and challenging health decisions for reducing health risks, selecting treatment options, and adopting sometimes difficult healthy lifestyle choices. However, effective health communication is not easy to accomplish. The quality of health communication programs is crucial to achieving desired health outcomes [11–13].

Health information technologies (ehealth programs) are being increasingly used to support the communication demands of health care delivery and health promotion, helping both to provide consumers with relevant health information and gather information from consumers. Yet, the quality of communication with these technologies is crucial for providing consumers and providers with the accurate, timely, sensitive, and adaptive health information they need. If there is a breakdown in the ways health risks, treatment regimens, and recommended health behaviors are communicated, there will be problems with encouraging consumers to accept and incorporate health recommendations (such as following therapeutic procedures, taking prescribed medications, and adopting health promotion strategies) [14]. It is not easy to explain complex health information to lay audiences, and even more difficult to motivate consumers to faithfully follow health recommendations. It is also a challenge to elicit interprofessional cooperation between health team members to deliver coordinated care. There are many instances in the delivery of care when communication is not ideal, providers and consumers do not have access to or understanding of the best information for guiding health decisions, leading to breakdowns in the health care/promotion process [15–17]. Smart, adaptive, interactive, and immediate ehealth programs can help supplement and enhance health information sharing to achieve health goals [4].

Patients are often intimidated by the health care system, have difficulties expressing their health concerns, and feel challenged to participate fully in directing their own health care [15–19]. It is critically important to equalize the communication dynamics between consumers and providers in the delivery of care and promotion of health to encourage active exchange of information and cooperation to accomplish complex health goals. Ehealth programs are often advantageous channels to communicate with consumers, since they are often easily available wherever and whenever consumers may need to interact, are perceived by consumers as being more private and less judgmental than interacting directly with health care providers, can reduce

relational power discrepancies encouraging information sharing and participation, and have infinite patience for listening, recording, and repeating/explaining information when necessary [3,20]. Care must be taken in health promotion efforts to craft messages that are appropriate and compelling to target audiences, deliver these messages through the most effective communication channels, and reinforce adoption of healthy behaviors over time. We will describe the design and evaluation of two mobile ehealth applications – the ChronologyMD system – that enhances the immediacy of health communication by using AI to provide consumers confronting Crohn's disease with personal, engaging, and dynamic narrative-based health information to help them monitor their conditions and direct their care.

## 2. Problems with the quality of current health communication practices

Close attention needs to be paid to the quality of communication in the delivery of care and promotion of health. Health care and promotion efforts typically focus on health care procedures and technologies, and not on the communication of health information. This often results in poor quality health communication that inhibits, rather than facilitates, achievement of desired health outcomes. Several qualitative factors in the delivery of health care and promotion of health need greater attention. How engaging are health communication efforts? Do health communication efforts capture audience attention (exposure)? Do they communicate clearly (taking into account individual audience differences and levels of health literacy)? Do they communicate humanely (sensitivity)? Do they communicate persuasively? Do they adapt well to unique individuals? Do they promote immediacy (relational closeness and dynamism)? Unfortunately, the answers to these questions about the quality of health communication processes are often very disappointing.

Too often, health communication efforts are boring, unimaginative, and intimidating. Health care providers and educators often appear emotionally unattached to consumers. There is a mind-numbing amount of repetition, regulation, and bureaucracy within modern health systems. Health care personnel often have limited time to treat many different patients, which makes them rush and appear to be superficial when communicating with patients. Health promotion efforts often focus more on presenting scientific facts and directives than on connecting the information in personally engaging ways to consumers.

There is common overuse of technical medical jargon that is difficult for laypeople to understand. This can alienate consumers, creating psychological distance between health care professionals and the consumers they serve. Jargon is often overused in delivering information about health risks, diagnoses, intervention options, and health promotion recommendations. The overuse of jargon is also widespread in written health information on websites, pamphlets, handouts, and medication package inserts. The overuse of jargon leads to patient confusion and disengagement that impedes health education and informed consent for care. Medical jargon can make the entire health care system appear overly complex, bureaucratic and constraining, rather than facilitating, health promotion efforts [19]. Reductions in jargon use can help increase immediacy for consumers by enhancing understanding and personal involvement.

Sometimes, the messages sent to consumers can be disempowering, suggesting that consumers are to blame for their health problems. These messages alienate consumers and make them feel badly about themselves. The ways that questions are asked of consumers about their health behaviors and health histories can be intimidating and insulting. (Are you still smoking? How much exercise do you get? How often do you bathe? How much alcohol

do you drink? Do you eat a balanced diet? Are you following your doctor's recommendations?) Medical recommendations presented to patients often sound like directives for consumers to clean up their acts. These recommendations are often very prescriptive and limit consumer input into their health care because they do not provide consumers with many options. For all of these reasons, health communication is often not very much fun for consumers. The quality of health communication is often disempowering and alienating, discouraging patient participation and cooperation, leading to problems with understanding and following health care recommendations, and limiting informed and cooperative health care decision making. Inclusion and participation are critical communication tools for increasing immediacy and enhancing health promotion.

### 3. Increasing immediacy to promote engaging health communication

The effectiveness of health communication processes depends upon multiple communication factors, including the accuracy, timeliness, fidelity, persuasiveness, and sensitivity of messages exchanged. One of the most important, and largely unrecognized, dimensions of effective health communication relates to how engaging the communication is, a process often referred to in the communication literature as “immediacy” [2,3]. Immediacy is a critical factor in determining whether communication processes capture attention, connect health care participants, and encourage these participants to work together to achieve important health goals. Immediacy is a relational dimension of human communication that influences physical and emotional closeness, comfort, engagement, caring, personal involvement, intensity, enthusiasm, authenticity, and enjoyment in human interactions.

There is a large and important body of research literature concerning the influences of communication immediacy on instructional outcomes. It suggests that instructors who communicate with high levels of immediacy can promote relational closeness and cooperation with their students, enhance the expression of affect, increase cognitive and affective learning, improve students' perceptions of instructor credibility, enhance motivation and participation with students, encourage active communication and feedback between students and instructors, as well as reduce student resistance and verbal aggression [21–26]. These communication outcomes in the instructional domain are just as relevant to health care delivery and health promotion as they are in the educational context [2]. Yet, there has been very limited attention to communication immediacy in health care and health promotion research. In fact, there has been limited attention given to the whole spectrum of the relational dimensions of health communication in health care and health promotion, despite the importance of relational communication in achieving desired health outcomes [16,27–29]. The instructional communication literature suggests that communication immediacy has the potential to improve health promotion outcomes, enhance consumer and provider access to relevant health information, improve the quality of health education, increase consumer acceptance and participation in health promotion efforts, and promote improved adoption of health promotion recommendations [2].

### 4. AI strategies for enhancing ehealth immediacy and engagement

Research has shown that there are a variety of relatively simple verbal and nonverbal communication strategies that can be used to enhance the immediacy of interactions in instructional contexts that can be applied very well to the design of ehealth promotion programs [3,21–26]. There are several straightforward verbal

strategies that can be used for promoting immediacy in ehealth promotion programs. For example, it is a good idea when developing health promotion interventions to use the consumer's (or providers') names or preferred nicknames when interacting with them to personalize communication. Smart interactive ehealth systems can tailor the presentation of messages to different users, incorporating preferred names and other relevant personal information into communication programs. Ehealth intervention programs can also be designed to use collective terms (such as “we” and “us”) to help enhance a sense of inclusion and cooperation with consumers [2].

Ehealth communication programs can be designed to include familiar terms and provide clear explanations of complex concepts (eschewing the use of medical jargon, and increasing the use of culturally and educationally appropriate terms and examples). Interactive health information systems can also be designed to provide opportunities for relatively casual interactions with consumers to help break the ice, reduce tension, and help to build rapport [3]. Moreover, interactive ehealth systems should be designed with the use of AI to provide specific and appropriate congruent feedback to consumers, ask for the need for clarification and elaboration, and answer any questions users may have to make sure they understand the information provided and what their different health decision options may be [30]. Ehealth information systems should be designed to ask for consumer input on health care decisions, seek consumer feedback about reactions to recommendations, and encourage consumers to express their personal preferences and concerns. These verbal communication strategies can be programmed into ehealth systems to help humanize health care interactions, encourage consumer participation, and help to build understanding, confidence, and trust [2].

There are also a number of straightforward nonverbal message strategies that have been found to enhance immediacy in instructional communication settings that can be easily adapted for use in smart ehealth programs [2]. For example, it is important for ehealth programs to communicate in ways that show appropriate concern and empathy (caring) for consumers [31]. This can be done by portraying avatars in interactive health communication programs as smiling appropriately while talking to show friendliness, gesturing in an animated way while talking to enhance the active and dramatic nature of health communication, maintaining good eye contact with program users to demonstrate personal involvement, using vocal variety when speaking to program users (avoiding the use of monotone speech), using a relaxed body posture to increase perceptions of comfort and accessibility, and using self-touching behaviors appropriately to express feelings and connect with consumers personally [32–38]. It is important to design AI interfaces to promote relational congruence and adaptation between interactive computer systems and users so the users will feel comfortable and attended to when using the information system [20].

Instructional research has also shown that the ways that teachers dress influences immediacy, with casual appearance increasing immediacy in the classroom [21]. These findings can be applied to determining the best ways that avatars can be presented in interactive ehealth systems to promote immediacy [30]. A recent hospital-based intervention project where colorful hats were created for patients, health care personnel, and family members to wear demonstrated that wearing the hats helped to enhance health communication and increase engagement between consumers and providers [36]. Furthermore, ehealth programs can use engaging design features that enhance user attention, involvement through the use of dramatic movement, color, sound, and graphic design to enhance immediacy and comfort in health communication [2].

**Table 1**  
Immediacy characteristics and AI components in ChronologyMD.

| Immediacy characteristic  | AI component   | Results   |
|---|--|---|
| Engaging  | ChronologyMD apps and iPad and iPhone devices                                  | Visually exciting and dynamic for patients and providers  |
| Personalizes information to meet preferences; encourages users to express preferences | Patient-designed apps allow input options for individual patients              | Patients inputted data relevant to their condition; added additional data fields                              |
| Encourages interaction  | Apps require patient input; automatic reminders for patient input and actions  | Patients inputted substantial personal data; reminders prompted actions                                       |
| Enhances understanding  | Patients helped create jargon-free apps and simple data display                | Patients understood data input; patients and providers found display easy to understand                       |
| Improves accuracy of information gathered in real time                                | Withings™ scale and Fitbit™ monitor allow automatic data upload                | Devices provided accurate, immediate information about activity, sleep and weight                             |
| Provides timely feedback; aids recall   | Apps prompted daily or hourly input; display showed data over a 3-month period | Helped patients remember to take meds, input data, make appointments; helped them see multi-month data trends |
| Emotionally sensitive   | Apps allow patients to input data on pain, stress and other feelings           | Patients learned that pain and stress interact and that levels can be better managed                          |
| Promotes relational congruence  | Apps enable patient data input and display                                     | Patients showed their data to providers at clinical visits, and providers appreciated data                    |
| Improves shared decision making   | App allows patients and providers to view patient's health trend lines         | Providers saw importance of patient information and used it to make treatment changes                         |
| Motivates behavior changes  | Apps enable patients to see associations and trends for health data            | Patients saw data relationships that motivated them to get more sleep, exercise and take medications          |
| Improves quality of care and informed health decision making                          | Project AI apps plus “intelligent devices” (iPad, and smart phones)            | Patient took more control over tracking and managing health; Providers used data to make informed decisions.  |

## 5. The ChronologyMD project, AI and immediacy

Crohn's is a serious, incurable, inflammatory bowel disease that affects about 600,000 people in the US and costs an estimated \$15 billion per year [37,38]. It is highly patient-specific, and can be fatal, especially if not carefully managed. Crohn's presents significant health communication challenges that relate to issues of immediacy. Patients need to carefully track weight, medication adherence, and many symptoms, and report those data and their trends to providers accurately. Providers depend on complete and reliable patient information to help make complex treatment decisions, such as whether to do intestinal surgery. It has been difficult for patients to collect complex, precise data and for providers to have access to such information for informed decision-making.

In 2010, the Robert Wood Johnson Foundation funded the ChronologyMD pilot project as part of an ehealth effort to test the value of patient-sourced “observations of daily living” (ODLs). The project's goal was to provide computer-mediated (AI) support to patients to track their medication adherence, weight, sleep, activity, pain and other symptoms on a daily or hourly basis, and to share that information with providers for improved decision making. Project developers, patients and providers used participatory design techniques to co-create and test a system that included two main applications and several “intelligent devices”: (1) the Chronology app allowed patients to input information about the above variables into an iPad, smartphone or other familiar and easy to use mobile communication device. It sent them personalized (tailored) SMS text reminders about inputting data, taking medication, and making appointments; (2) a Withings™ electronic scale automatically uploaded the patient's weight, and a Fitbit™ monitor automatically uploaded the patient's activity and sleep patterns into the patient's iPad or other preferred device; and (3) the Crohnograph app displayed the patient's data in easy-to-see trend lines over a 3-month period so that patients and providers could view changes over time.

Thirty patients and four providers participated in a 2-year pilot study. During the first year, patients and providers engaged in intensive participatory design to define important ODLs to collect, and easy ways to enter, track and display these data. Patients and providers recommended that many components related to “immediacy” be designed into the system. Table 1 summarizes some of these features. For example, patients helped design in system AI components that allowed them to track certain key symptoms, like pain, on an hourly basis. Patients also pushed for features that would allow them to write their own health narratives (“journaling”) into the system, as desired. Patients and providers tested prototypes of the system and iteratively recommended refinements, many with immediacy-related features.

The system was formally evaluated during an 8-month period. The mixed methods evaluation included pre-post focus groups, interviews, usability testing and online surveys to assess patient and provider use of and satisfaction with the system, reported behavior changes, and changes to the quality of clinical encounters. Results showed that patients enthusiastically embraced the system, enjoyed using it, and collected a total of 28,000 ODLs. Before using the system only 40% of patients reported any tracking of their ODLs; by the end of the 8-month evaluation, over 90% of them tracked multiple ODLs. Patients reported that the AI components of the system helped them track, understand, and monitor their ODLs easily and accurately. They commented about the importance of many system communication characteristics related to immediacy. Table 1 shows selected AI components of the system, their relationship to aspects of immediacy, and to patient and provider results.

Patients reported many positive outcomes related to tracking their ODLs. The system helped them to remember to take their medications, something they had found difficult before using the system. They said the text reminders helped them schedule medical procedures and avoid disease flare-ups. Patients appreciated having automatic uploads of accurate weight, activity and



sleep data – information they were not able to obtain before using the system. Because the system enabled them to input very granular personalized information and to view multiple kinds of data together over time, they were able to make important discoveries about their health that motivated them to change behaviors. For example, some patients reported that they noticed that when they got more sleep and exercise, their pain and stress were reduced and they could decrease narcotic medications. One patient commented:

*"I have never met anyone else who had Crohn's disease. No one in my family, my neighborhood, or at work had ever heard of it when I was diagnosed. Knowing that there are other people out there, who are my age, who are managing their disease and living productive lives has made it so much easier for me. Once I started collecting data, I realized how much of an impact my sleep and exercise had on my pain levels. Once I started sleeping more and exercising every day, I could stretch out the time between my pain meds – which made me feel so much better, and I could do more in my day – including spending more time in the park with my son. Without this technology, I would never have been able to see the interactions of all the things that impact my pain and my disease. Also, if I get enough sleep and exercise, my stress goes down, and my day goes much better."*

Providers also appreciated the system and having detailed, timely information from their patients. They reported that patients were much better prepared during clinical visits to discuss changes in weight, sleep, activity, pain and other specific information. Before using the system, patients often presented vague and rambling narratives and struggled to remember health changes over the preceding months. Having patients as more engaged partners who provided more accurate, real-time information, improved the providers' ability to make more informed decisions about treatments. Providers recommended ways to add AI algorithms to the system apps that would calculate standardized Crohn's index scores, and that could be included in the patient's electronic medical record to enhance shared decision making. One provider commented that the ChronologyMD system could "change the standard of care" for Crohn's patients.

## 6. Discussion and conclusion

### 6.1. Discussion

Immediacy is a critically important feature of effective ehealth communication programs. Ehealth programs that attract user attention and involvement can enhance health education and influence relevant health behaviors. AI applications are well-suited to enhancing the immediacy of ehealth programs by humanizing health communication and making these programs engaging, relevant, exciting, and actionable. The ChronologyMD ehealth program exemplifies the effective use of AI to promote consumer involvement, attention, participation, and improve relevant health outcomes.

### 6.2. Conclusion

Paying attention to the quality of communication in the design of ehealth systems for health promotion to enhance immediacy can help increase consumer engagement and enhance health outcomes [2,3]. The use of AI can help guide the design of smart interactive ehealth systems that can engage users and build meaningful healthy relationships with them over time. The immediacy of communication appears to be a particularly important aspect of effective ehealth communication. High

quality ehealth communication programs depend more on the appropriateness and dynamism of the messages exchanged than merely on the digital channels used for communicating. Immediacy depends on programming dynamic, exciting ehealth systems that promote physical and emotional closeness, and communicate clearly, humanely and persuasively. Ehealth programs that promote immediacy are likely to be enjoyable to use. They will combine both sizzle and substance – as we learned from the enthusiasm and appreciation of the ChronologyMD participants. The strategic use of relationally and culturally sensitive verbal and nonverbal communication are essential for increasing immediacy in ehealth programs. This can enhance the energy, excitement, and salience of ehealth communication activities across multiple channels and health settings so participants are likely to be fully engaged, involved, and motivated to promote health and well-being. The ChronologyMD project illustrates how incorporating immediacy characteristics into AI ehealth communication provides tangible benefits to patients and providers managing a serious, complex disease.

### 6.3. Practice implications

AI can be used strategically to design smart interactive message systems that promote immediacy to enhance health education and health promotion outcomes. The best smart ehealth communication programs will be crafted to interact with users in ways that can promote immediacy by:

- Capturing and maintaining user attention,
- Adapting to unique consumer interests,
- Providing congruent and responsive messages,
- Mirroring user emotions appropriately,
- Providing messages that are interesting, relevant, and easy to understand,
- Providing opportunities for feedback and extended interaction,
- Using engaging verbal and nonverbal message systems,
- Promoting user participation and cooperation,
- Demonstrating empathy, caring, and concern,
- Providing consumers with many communication options,
- Providing motivational and reinforcing information and suggestions.

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## Conflict of interest

None of the authors of the manuscript has a conflict of interest that would inappropriately influence, or be perceived to inappropriately influence their work.

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