HHS Public Access

Author manuscript

J Inform Nurs. Author manuscript; available in PMC 2019 June 07.

Published in final edited form as:

J Inform Nurs. 2018 ; 3(2): 6–11.

Utilization of Mobile Applications in Collaborative Patient-Provider Monitoring of Chronic Health Conditions:

An Examination of Three Theoretical Frameworks to Guide Practice

Sara B. Donevant, **DeAnne K. Hilfinger Messias**, and **Robin Dawson Estrada**

Abstract

Mobile health (mHealth) applications may improve chronic disease management through enhanced patient-provider communication and collaboration. The aim of this review was to compare and critique the application of three theoretical frameworks to guide mHealth research and practice in patient-provider interactions.

Keywords

mHealth; mobile health; theoretical framework; chronic disease management; patient-provider communication

The use of mobile technology (i.e., smartphones, texting, secure messaging) and similar technologies in health care settings is referred to as mHealth (Aitken & Lyle, 2015). The adoption of mHealth facilitates timely access to information and has the potential to significantly change patient- provider communications related to the management of chronic health conditions (Silva, Rodrigues, de la Torre Diez, Lopez-Coronado, & Saleem, 2015). For example, the ability to track a patient's biometric values and simultaneously communicate these to a health care provider through a smartphone may potentially transform patient self-monitoring from an individual, solitary activity into an active, engaged collaboration between patient and health care provider.

Theoretical frameworks are necessary to both conceptualize and guide the implementation of mHealth technology within the context of patient self-management. The purpose of a theoretical framework is to organize the concepts (in this case, patient, provider, communication, mHealth), with the aim of answering questions that direct practice and research (Meleis, 2017). Specific questions relevant to the utilization of mHealth in patient self-monitoring include: 1) what are the roles of patient, health care provider, and the mHealth technology; and 2) how do the relationships between these concepts influence self-monitoring and patient outcomes? To further contribute to the development of research and practice in this area, the aim of this review is to examine and critique the application of specific theoretical frameworks and models within the context of chronic disease self-management through mHealth technology.

Patient Self-Management and Related Concepts

Lorig and Holman (2003) published the first concept analysis on patient self-management. One current definition of self-management is the individual's management of a chronic disease through skills and activities aimed at improving quality of life and health outcomes (Baker & Fatoye, 2017). Effective self-management involves both the individual's perceived and actual abilities (Barley & Lawson, 2016; Jones, Postges, & Brimicombe, 2016). Self-efficacy, self-care, and patient empowerment are concepts related to self-management that apply across a variety of chronic health conditions, including chronic obstructive pulmonary disease, stroke, and diabetes (Barley & Lawson, 2016; Fletcher et al., 2016; Wu, Hsieh, Lin, & Tsai, 2016). Both awareness and ability to participate actively in health-related behaviors are key elements of self-monitoring and management (Baker & Fatoye, 2017; Barley & Lawson, 2016; Hyman, Shakya, Jembere, Gucciardi, & Vissandjée, 2017; Jones et al., 2016).

Sustained patient self-management of chronic health conditions often depends on the adoption of specific behavioral change techniques, defined as "observable, replicable and irreducible component of an intervention designed to alter or redirect causal processes that regulate behavior" (Michie et al., 2013, p. 82). Michie and colleagues (2015) noted that many behavior-change techniques (i.e., goals and planning, social support techniques, feedback and monitoring, shaping knowledge) require input from external sources such as a health care provider. Jones and colleagues (2016) noted the relationship between the health care provider and patient is essential for the development of crucial self-management skills and others have examined the health care provider's role in successful self-monitoring (Baker & Fatoye, 2017; Barley & Lawson, 2016; Hyman et al., 2017; Jones et al., 2016; Wilkinson, Whitehead,& Crowe, 2016).

Within the current context of health care in the United States, patients often interact with teams of diverse providers such as physicians, nurses, nurse practitioners, pharmacists, health educators, dieticians, and physical and occupational therapists. Sustained collaborative relationships between patients and providers may enhance self-monitoring, and thus contribute to better outcomes among patients with chronic health conditions who require complex health care regimens. Von Korff and colleagues (1997) referred to *collaborative management* as the process that a patient and the health care provider engage in to improve the management of chronic health conditions. They identified the role of the health care provider in collaborative management as the provision of knowledge and expertise necessary to manage complex chronic health conditions, guide and educate the patient on the self-management process, and adjust the medication regime as necessary. A collaborative model depends on shared responsibilities between the patient and the health care provider(s) to improve the patient's health outcomes. Collaborative patient-provider self-monitoring processes include identifying common health care goals, participating in a sustained working relationship, sharing a mutual understanding of roles and responsibilities, and possessing the necessary skills for fulfilling specific roles (Von Korff et al., 1997).

Recent research indicates the importance of collaboration in optimizing patient health and wellness (Levy et al., 2015; McGillicuddy et al., 2013). With the advent of mHealth

technology, there are new opportunities for enhanced collaboration between patients and providers, particularly in chronic disease monitoring. The increasing utilization of smartphones and mobile applications (apps) in patient-provider relationships can transform both the process and content of communication and information sharing. We posit collaborative patient-provider self-monitoring using mHealth has the potential to further enhance collaborative self-management.

Using mobile app technology, patients and providers can work together to identify health problems and concerns, and create goals and action plans; develop a continuum of self-monitoring training and support services; and maintain sustained interactions and follow-up (texting, secure messaging) by recording and sharing real-time biometric measurements through Bluetooth technology in user-friendly digital formats (graphs). Collaborative patient monitoring utilizing mHealth technology has the potential to improve behavioral change accessibility, acceptability, implementation, and sustainability, but must consider the unique role of each partner. With the rapid expansion of the field of mHealth, there is an urgent need to identify appropriate theoretical frameworks to guide collaborative patient-provider self-monitoring, with the aim of enhancing patient outcomes through the incorporation of mHealth. We identified three potential theoretical frameworks suitable for guiding mHealth patient-provider interventions: the Behavior Intervention Technology (BIT) model, the Interactive Behavior Change Technology (IBCT) model, and the Supportive Accountability framework. In the following sections, we present and critique each framework to determine the suitability for application to mHealth patient-provider interventions.

Behavior Intervention Technology Model

The BIT model, developed by Mohr and colleagues (2014) describes the integration of behavior science with technology to achieve health and wellness goals. BIT is divided into two sections: theoretical and instantiation. The key theoretical constructs include *why* and *how,* and the key instantiation constructs are *what, how,* and *when.* The *how* construct is incorporated twice within the model — once as a conceptual element to describe the behavior change strategies and again to explain the technical elements. These essential constructs are described in Table 1.

The technology element is clearly represented within the BIT model. The primary focus is technology features (i.e., social media, virtual reality, gaming, sensor for patient monitoring), rather than delivery mode (i.e., web-based versus mobile). As a result, the BIT model is flexible and applicable to multiple technology modalities. The roles of patient and provider are acknowledged. However, the model only nominally addresses the health care provider's role as a message recipient and does not include essential elements such as goal setting, education, feedback on biometric measurements, and medication changes. As a result, the model presents a predominantly one-sided view of self-monitoring with limited involvement, support, and guidance of the health care provider. This exclusion of the health care provider fails to establish the necessary relationships for the collaborative patient-provider self-monitoring concept.

To demonstrate how the BIT model applies to mHealth, Mohr and colleagues applied the BIT concepts to MyFitnessPal (2014). This popular fitness app tracks calories and exercise to promote weight loss and has been utilized in several weight loss trials (Jospe et al., 2017; Laing, Mangione, & Tseng, 2014). However, Laing and colleagues (2014) aptly noted that although the utilization of smartphone apps by individuals who are primed to engage in dietary self-monitoring may be useful, the mere introduction of the app is "unlikely to produce substantial weight change in most patients" (p. S11). Therefore, a more appropriate way to test the BIT model fit would be to examine mHealth apps that are more likely to result in positive health outcomes.

In summary, a positive attribute of the BIT model is the inclusion of the relevant technological interventions (i.e., videoconferencing, social media, sensors for patient monitoring). However, the model does not account for direct health care provider involvement in the health and wellness continuum. We posit that the roles of and relationships between health care providers, patient, and mHealth technology must be identified and integrated into an mHealth model.

Interactive Behavior Change Technology Model

The IBCT model, developed by Glasgow and colleagues (2004), focuses on the use of computer-based tools and devices to assist with health behavior changes. The IBCT is based upon the framework developed by the Counseling and Behavioral Interventions Work Group of the U.S. Preventive Services Task Force (Whitlock, Orleans, Pender, & Allan, 2002). This model integrates communication science and evidence-based behavior counseling interventions based on five key constructs, the 5As: *Assess, Advise, Agree, Assist,* and *Arrange* (Table 2). One strength of IBCT is the clearly defined process of these specific processes. This straightforward process guides the provider in assisting the patient using diverse forms of technology. This broad perspective model is applicable in a variety of settings.

Another strength of the IBCT model is the inclusion of the health care provider, the patient, and technology techniques, while providing examples how each entity may function within the framework. A potential limitation is the reliance on the actions of the health care provider to advance self-monitoring, not the relationships between each entity. The 5As predominately describe the provider's actions — obtain data, recommend changes, set goals collaboratively, identify barriers, and provide follow-up. in contrast, the patient and mHealth technology are represented as passive participants in a process that involves limited patient-provider collaboration. The distinct roles of the patient and technology are not clearly defined, inhibiting the development of the relationships. In summary, the weaknesses of the IBCT model lie in the missing relationships between the constructs - patient, health care provider, and mHealth technology.

Supportive Accountability Framework

The third potential theoretical framework, Supportive Accountability Framework, offers a model that enhances patient adherence to the medical regime through human support and

interaction (Mohr, Cuijpers, & Lehman, 2011). The key constructs included in the Supportive Accountability Framework are similar to those in the BIT and IBCT. However, the Supportive Accountability Framework highlights the importance of the relationship between the patient and the health care provider in the self-monitoring process, an aspect not addressed in the other models (Mohr et al., 2011). In this model, Mohr and colleagues focused on the interaction between the patient and health care provider to change health behaviors and improve health outcomes. Five constructs synergistically influence the patient's adherence: (1) bond between the patient and health care provider, (2) accountability of patient's actions, (3) legitimacy of health care provider, (4) patient motivation, and (5) multiple modes of communication or bandwidth (see Figure 1). A strength of the model is the inclusion of an established relationship between the patient and health care provider.

At the center of the Supportive Accountability Framework is patient accountability, which is directly influenced by the bond and legitimacy of the patient-provider relationship. Accountability is represented as a linear path to adherence that is enhanced by the health care provider's support through motivation and bandwidth. The inclusion of essential characteristics of collaborative patient-provider monitoring via mHealth is a major strength of the Supportive Accountability Framework. However, the model does not adequately represent the organizational flow of how the patient and health care provider must meet the five elements within the framework. For example, the health care provider must have both intrinsic and external motivation to participate in the process along with the patient. If only the patient is motivated, the process will fail. With several modifications, the Supportive Accountability Framework could better suit the collaborative patient-provider monitoring via mHealth concept.

Proposed Modifications to the Supportive Accountability Framework

To address the collaborative nature of mHealth-enhanced patient-provider monitoring, we propose a re-structuring of the Supportive Accountability Framework (Figure 2) to represent the shared responsibility between the patient and the provider.

In this proposed revised model, the concepts and constructs are simplified and rearranged to reflect the balanced collaboration between the patient and the health care provider required within the phenomenon. Each construct (i.e. bond/legitimacy, accountability, communication, and motivation) is applicable to both patient and health care provider. For example, if the patient sends a text message to the health care provider but does not receive a response, communication is ineffective and impedes collaboration. Further, because legitimacy and bond are inherently connected, they are combined into a single concept. Mohr and colleagues (2011) described legitimacy as the patient perceiving the health care provider as an expert who acts in a truthful and kind manner. This perception is the foundation of the bond between the patient and the health care provider and serves as a catalyst for improving the self-management dialogue (Hyman et al., 2017; Jones et al., 2016; Wilkinson et al., 2016). Without legitimacy, no bond exists. In this revised model, communication reflects participation by both patient and health care provider, and is influenced by the bond/legitimacy, accountability, and motivation of both parties. In addition, the mHealth technology concept is incorporated in each construct to establish its

relationship with both patient and health care provider. These minor modifications reflect the shared, collaborative responsibility for monitoring and management between patient and health care provider, with the goal of improved adherence and improved outcomes.

Implications for the Informatics Nurse

The proposed modifications to the Supportive Accountability Framework are based on a conceptualization of collaborative patient monitoring; and can guide informatics nurses in the future development and advancement of mHealth apps by clearly identifying the actions of the patient, provider, and the mHealth app, and the subsequent relationships (i.e., interactions, feedback, etc.). During the mHealth development process, informatics nurses can ensure mHealth apps incorporate elements to enhance communication, motivation, bond/ legitimacy, and accountability between the patient and the provider via the mHealth app. For example, informatics nurses would want to include communication options that encourage and enhance the communication between the patient and provider. These options include two-way communication methods (i.e., texting, e-mail) which correlate with positive patient outcomes (Hall, Cole-Lewis, & Bernhardt, 2015; Orr & King, 2015; Poorman, Gazmararian, Parker, Yang, & Eton, 2015). This modified framework explains how informatics nurses may promote positive patient outcomes using mHealth apps.

Conclusion

With the rapid expansion and transformation of the mHealth field, the existing theoretical frameworks available to guide the research and future advancement are still in development (Meleis, 2017). This analysis and critique of the existing models and proposed adaptations to the Supportive Accountability Framework illustrate the applicability of existing theoretical frameworks to guide the implementation and assessment of collaborative patient-provider self-monitoring via mHealth. Future initiatives are needed to test the proposed mHealth framework to assess its ability to accurately identify the entities and explain the relationships between these entities. The Supportive Accountability Framework holds the potential to guide future research and application of the technology to improving patient-provider communication and, ultimately, patient outcomes.

Biography

Sara B. Donevant, PhD, RN, CCRN, is a nurse researcher with case management, medical-surgical, and adult ICU experience. Her current research focuses on the utilization of mobile health apps to enhance patient outcomes. She may be contacted at Donevant@email.sc.edu

DeAnne K. Hilfinger Messias, PhD, RN, FAAN, is the Emily Myrtle Smith Professor of Community Nursing and director of the PhD program at the College of Nursing, with a joint appointment with the Women’s and Gender Studies Program, College of Arts and Sciences, University of South Carolina. Her research focuses on access to health care among vulnerable population groups.

Robin Dawson Estrada, PhD, RN, CPNP-PC, is an assistant professor at College of Nursing University of South Carolina and the Director of the Honors College Smart Start Nursing Program. She is a board-certified pediatric primary care nurse practitioner. Her research focuses on rural health disparities and communication processes within health care encounters.

References

Aitken M, & Lyle J (2015). Patient adoption of mHealth: Use, evidence and remaining barriers to mainstream acceptance. Parsippany, NJ: IMS Institute for Health care Informatics.

Baker E, & Fatoye F (2017). Clinical and cost effectiveness of nurse-led self-management interventions for patients with COPD in primary care: A systematic review. international Journal of Nursing Studies 71, 125–138. doi:10.1016/j.ijnurstu.2017.03.010 [PubMed: 28399427]

Barley E, & Lawson V (2016). Health psychology: Supporting the self-management of long-term conditions. British Journal of Nursing. 25(20), 1102–1107. doi:10.12968/bjon.2016.25.20.1102 [PubMed: 27834519]

Fletcher BR, Hinton L, Hartmann-Boyce J, Roberts NW, Bobrovitz N, & McManus RJ (2016). Self-monitoring blood pressure in hypertension, patient and provider perspectives: A systematic review and thematic synthesis, Patient Education and Counseling, 99(2), 210–219. doi:10.1016/j.pec.2015.08.026 [PubMed: 26341941]

Glasgow RE, Bull SS, Piette JD, & Steiner JF, (2004). Interactive behavior change technology: A partial solution to the competing demands of primary care. American Journal of Preventive Medicine, 27(2), 80–87. doi:10.1016/j.amepre.2004.04.026 [PubMed: 15275676]

Hall AK, Cole-Lewis H, & Bernhardt JM (2015). Mobile text messaging for health: A systematic review of reviews. Annual Review of Public Health, 36, 393. doi:10.H46/annurev-publhealth-031914-122855

Hyman I, Shakya Y, Jembere N, Gucciardi E, & Vissandjée B (2017). Provider- and patient-related determinants of diabetes self-management among recent immigrants: Implications for systemic change. Canadian Family Physician, 63(2), e137–e144. [PubMed: 28209706]

Jones F, Postges H, & Brimicombe L (2016). Building Bridges between health care professionals, patients and families: A coproduced and integrated approach to self-management support in stroke. NeuroRehabilitation, 39(4), 471–480. doi:10.3233/nre-161379 [PubMed: 27689607]

Jospe MR, Roy M, Brown RC, Williams SM, Osborne HR, Meredith-Jones KA, … Taylor RW (2017), The effect of different types of monitoring strategies on weight loss: A randomized controlled trial. Obesity, 25(9), 1490–1498. doi:10.1002/oby.21898 [PubMed: 28703448]

Laing BY, Mangione CM, & Tseng CH (2014). Effectiveness of a smartphone application for weight loss compared to usual care in overweight primary care patients: A randomized controlled trial. Annals of Internal Medicine, 22(1). doi:10.7326/M13-3005

Levy N, Moynihan V, Nilo A, Singer K, Bernik LS, Etiebet M-A,… Natarajan S (2015). The mobile insulin titration intervention (MITI) for insulin adjustment in an urban, low-income population: Randomized controlled trial. Journal of Medical Internet Research, 17(7), e180. doi:10.2196/jmir.4716 [PubMed: 26187303]

Lorig KR, & Holman HR (2003). Self-management education: History, definition, outcomes, and mechanisms. Annals of Behavioral Medicine, 26(1), 1–7. doi:10.1207/S15324796ABM2601_01 [PubMed: 12867348]

McGilliajddy JW, Gregoski MJ, Weiland AK, Rock RA, Brunner-Jackson BM, Patel SK, . . . Batiga PK (2013). Mobile health medication adherence and blood pressure control in renal transplant recipients: A proof-of-concept randomized controlled trial. Journal of Medical Internet Research, 2(2), e30. doi:10.2196/resprot.2633

Meleis AI (2017). Theoretical nursing: Development and progress (6th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Michie S, Richardson M, Johnston M, Abraham C, Francis J, Hardeman W,… Wood CE (2013). The behavior change technique taxonomy (vl) of 93 hierarchically clustered techniques: Building an

international consensus for the reporting of behavior change interventions. Annals of Behavioral Medicine, 46(1), 81–95. doi: 10.1007/S12160-013-9486-6 [PubMed: 23512568]

Michie S, Wood CE, Johnston M, Abraham C, Francis JJ, & Hardeman W (2015). Behaviour change techniques: The development and evaluation of a taxonomic method for reporting and describing behaviour change interventions (A suite of five studies involving consensus methods, randomised controlled trials and analysis of qualitative data). Health Technology Assessment, 79(99), 1–188. doi:10.3310/hta19990

Mohr DC, Cuijpers P, & Lehman K (2011). Supportive accountability: A model for providing human support to enhance adherence to eHealth interventions. Journal of Medical Internet Research, 13(1), e30. doi:10.2196/jmir.1602 [PubMed: 21393123]

Mohr DC, Schueller SM, Montague E, Burns MN, & Rashidi P (2014). The behavioral intervention technology model: An integrated conceptual and technological framework for eHealth and mHealth interventions. Journal of Medical Internet Research, 16(6), e146. doi:10.2196/jmir.3077 [PubMed: 24905070]

MyFitnessPal Inc. (2014). MyFitnessPal (Version 3.3.5–4x APK to 3.6.J APK) (Mobile application software). Retrieved from http://itunes.apple.com or https://ptay.google.com/store

Orr JA, & King RJ (2015). Mobile phone SMS messages can enhance healthy behaviour: A meta-analysis of randomised controlled trials. Health Psychology Review, 9(4), 397–416. doi: 10.1080/17437199.2015.1022847 [PubMed: 25739668]

Poorman E, Gazmararian J, Parker RM, Yang B, & Elon L (2015). Use of text messaging for maternal and infant health: A systematic review of the literature. Maternal and Child Health Journal, 19(5), 969–989. doi:10.1007/s10995-014-1595-8 [PubMed: 25081242]

Silva BM, Rodrigues JJ, de la Torre Diez I, Lopez-Coronado M, & Saleem K (2015). Mobile-health: A review of current state in 2015. Journal of Biomedical Informatics, 56, 265–272. doi:10.1016/j.jbi.2015.06.003 [PubMed: 26071682]

Von Korff M, Gruman J, Schaefer J, Curry S,J, & Wagner EH (1997). Collaborative management of chronic Illness. Annals of Internal Medicine, 127(12), 1097–1102. doi: 10.7326/0003-48l9-127-12-199712150-00008 [PubMed: 9412313]

Whitlock EP, Orleans CT, Pender N, & Allan J (2002). Evaluating primary care behavioral counseling interventions: An evidence-based approach. American Journal of Preventive Medicine, 22(4), 267–284. doi:10.1016/S0749-3797(02)00415-4 [PubMed: 11988383]

Wilkinson M, Whitehead L, & Crowe M (2016). Nurses perspectives on long-term condition self-management: A qualitative study. Journal of Clinical Nursing, 25(1–2), 240–246. doi:10.1111/jocn.13072 [PubMed: 26769211]

Wu SFV, Hsieh NC, Lin LJ, & Tsai JM (2016). Prediction of self care behaviour on the basis of knowledge about chronic kidney disease using self efficacy as a mediator. Journal of Clinical Nursing, 25(17–18), 2609–2618. doi:10.1111/jocn.13305 [PubMed: 27364760]

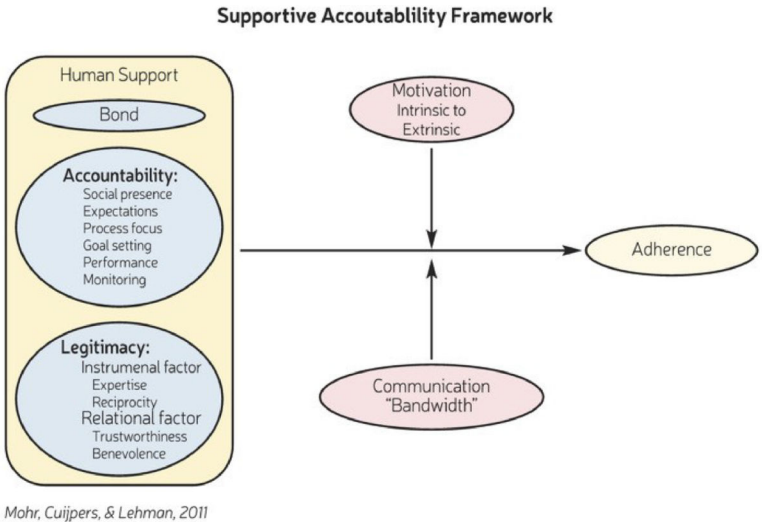

Figure 1.
Supportive Accoutablility Framework

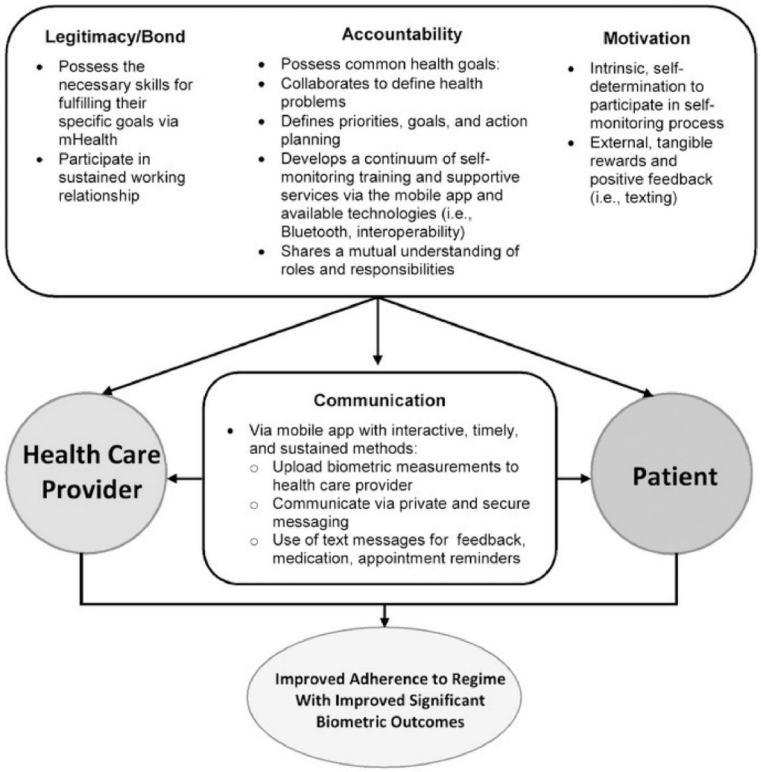

Figure 2.
Revised Supportive Accoutablility Framework

Table 1.

Behavior Intervention Technology Constructs and Description

Construct	Description
Theoretical	
Why	Clinical and usage aims to achieve the goal
How (conceptual)	Methods to achieve the dincal and usage aims
Instantiation	
What	Specific components of BIT to achieve the behavior change strategy
How (technical)	Modalities to deliver the specific components of BIT
When	Timing and sequence of the intervention

Mohr, Schueller, Montague, Burns, & Rashidi, 2014

Table 2.

Interactive Behavior Change Technology Constructs and Description

Construct	Description
Assess	Provider obtains data
Advise	Provider recommends changes based up biometric measurements
Agree	Patient and provider collaboratively set goals
Assist	Provider assists patient identify barriers; develop action plan
Arrange follow-up	Provider gives ongoing support

Glasgow, Bull. Piette, & Steiner, 2004