Published in final edited form as:

Proc Int Symp Hum Factors Ergon Healthc. 2017 June ; 6(1): 37–43. doi:10.1177/2327857917061010.

Participatory Design of a Social Networking App to Support Type II Diabetes Self-Management in Low-Income Minority Communities

Wayne W Zachary, PhD¹, Georgia Michlig, MSc², Avril Kaplan, MSc², Ngoc-Tung Nguyen¹, Charlene C. Quinn, PhD, RN³, and Pamela J. Surkan, ScD²

¹Starship Health Technologies, LLC, Plymouth Meeting, PA, USA

²Johns Hopkins University Bloomberg School of Public Health, Baltimore, MD, USA

³University of Maryland, School of Medicine, Baltimore, MD USA

Abstract

Participatory design (PD) is an emerging alternative to existing methods of user-centered design (UCD), and may be a more appropriate approach for designing patient-facing products in the health care sector than conventional UCD. Type 2 Diabetes Mellitus (T2D) is a serious chronic illness that requires life-long treatment and life-long self-management of food intake, physical activity, and self-testing to avoid complications. T2D disproportionately affects low-income minority communities. Using PD, we have developed an app to help T2D patients. Called the Diabetes Networking Tool (DNT), the app is intended to help patients better self-manage by empowering their network of family and friends to better contribute and support the patient's self-management needs. PD was used to involve a low-income African American community into the process of identifying the specific problems and issues DNT needed to address. We then used multiple complementary analytical methods to condense and abstract the community inputs to yield a functional and user interface design for DNT.

INTRODUCTION

User-centered design or UCD refers to a family of system- and user-interface design methods which seek to make fundamental design decisions based on information gathered from the ultimate end-user of the system, rather than, for example, just from subject matter experts or computer systems analysts (Abrams, C., Preece, J., 2004; Norman, D., Draper, S., 1996)). UCD largely focuses on methods such as task analysis and cognitive task analysis, which observe or interview end-users (typically skilled or expert users) on how they perform activities currently (i.e. without the future system) and/or how they think about the domain that the system will address. In UCD, those indirect inputs are used by human factors specialists to develop the interface to the system under design.

Within the field of healthcare, existing UCD methods are appropriate for applications that focus on provider's interfaces and interactions with medical devices and/or information

systems, as the domain knowledge and task expertise can be elicited and brought directly to bear on the design problem. UCD can also be effectively used to develop or improve patient-facing interfaces with repetitive tasks, such as using a glucometer. There is, however, a broad range of design problems involving patients' problems in non-clinical (i.e., everyday-life) environments where UCD does not fit well. A major class of these problems include a mobile-health (mHealth) smartphone app to support patients in activities in which they struggle, such as Type 2 Diabetes Mellitus (T2D) self-management. In such problems the patients, as potential-users, do not so much have expertise in the process (of self-management) as they have an awareness of their problems, pain-points, and barriers in trying to achieve it.

For these problems, we believe that Participatory Design (PD) is a better and more appropriate front-end analysis and design approach. Participatory design (PD) is a recent variant of a PD that goes further by involving the potential users directly in the discussion and consideration of the features, functions, and look-and-feel of the system. In this paper, we present an illustrative use of PD in the design of a smart-phone app for T2D self management.

BACKGROUND

T2D is a serious and growing public health problem in the US that disproportionately affects racial and ethnic minorities (American Diabetes Association, 2017; Gaskin et al., 2014; Ross, et al, 2010). T2D requires considerable self-care and constant management of eating and other behaviors to delay disease progression and avoid complications. Low income minority populations face multiple barriers to effective self-management, including limited access to healthy food, inconsistent access to health-care and medications, and environments that inhibit physical activity (Larson, et al., 2009; Schulz, et al., 2005).

Many medical and behavioral interventions for T2D have been developed in recent decades. A systematic literature review found that most interventions were cost-effective, but most have required constant external funding for active recruitment, training of leaders/educators, and use of facilities (Li, et al., 2010). Alternative models of self-organizing interventions have used social media technology (e.g., Facebook, Twitter, Tumblr) to take advantage of real-world social relationships to pull participants into virtual networks that can organize and maintain themselves with little or very minimal ongoing external infrastructure (Greene, et al., 2011; Shrank, et al., 2011). However, a review of > 500 social media interventions for on-line weight management found very few collected any outcome data, and most focused on psychological support rather than practical day-to-day support for self-management (Chang, et al., 2013).

Public health research suggests that social networks can support individuals with T2D, especially in low-income minority communities (Pollard, et al., 2014; Vassilev, et al., 2011; La Greca et al., 1995). Family and community relationships influence an individual's ability to self-manage in multiple ways, including adherence to medication, make successful diabetes-related behavior changes by providing positive reinforcement and sharing localized skills for maintaining healthy eating habits, and attaining weight loss (Garay-Sevilla, et al.,

1995; Gallant, 2003). Thus, the mobilization of these social resources offers a promising approach to improving T2D self-management in low-income minority communities.

The Diabetes Networking Tool (DNT)

DNT was conceived as a mobile health (mHealth) social-networking smart-phone app to enhance (T2D) patients' abilities to self-manage and avoid disease complications by bolstering and augmenting family, household, and community-based support mechanisms. This idea is unique in focusing on a patient's social environment, particularly family and household members who are typically closely involved in the patient's food acquisition, preparation, and consumption activities. This immediate social environment directly influences a patient's ability to make successful diabetes-related behavioral changes (Beverly, et al., 2008). In low-income communities with disproportionately high rates of T2D and complications, social networks provide free and powerful support resources for self-management.

This concept of DNT made it subtly but fundamentally different from other commercial social networking tools. The focus on the immediate social environment made the main concern hyper-local, rather than geospatially broad. Local is, after all, where the T2D patient purchases, cooks, and consumes much of her¹ food, it is also where she will engage in her daily physical activity, acquire and take her medications, and interact with her close family and friends. Moreover, food purchasing, cooking, and consumption are most often done with family and/or other household members. From this perspective, DNT was conceived of supporting small, or even micro networks of friends and family. These hyper-local and micro-net characteristics also suggested that DNT needed to be associated with specific neighborhoods.

While this established a general concept for DNT, it did not identify which specific features, functions and capabilities should be in DNT, nor did it lead to a particular user interface or user experience (UI/UX) design. Rather than rely (only) on the public health and clinical literature on T2D, we decided to turn to a community to work with us to define these with us, through a PD approach.

PARTICIPATORY DESIGN PROCESS

PD, like UCD, seeks to make fundamental design on decisions based information gathered from the ultimate end-user of the product (Davidson, J.L., Jensen, C., 2013; Menschner, et al., 2011). PD, however, goes further by involving the potential users directly in the discussion and consideration of the features, functions, and look-and-feel of the system. With regard to DNT, we felt PD was ideally suited to bring the process to communities involving everyday activities with which the participants are admittedly struggling (i.e., not expert), such as the various aspects of T2D self-management – adhering to medication and testing regimens, eating appropriately, obtaining the desired level of physical activity.

¹All gendered pronouns are presented in the feminine form.

PD was an appropriate process for DNT design because it allowed us to gain direct insight into the social processes that DNT was intended to support, and the constraints on those processes (e.g., transportation, availability of food sources, device limitations, etc.) that will directly affect the DNT design. We applied the PD process in a specific community where our research team had carried out preliminary research in social networks involvement in diet, nutrition, and T2D (Pollard, et al., 2014). The community is predominantly African American, has household income below the city median and experiences a high burden of diabetes. Our prior work in the community also showed that individuals shared information about diabetes self-management through social networks, and that mobile devices are widely used.

We operationalized PD through a series of community events, termed forums. Unlike focus groups, in which participants are asked only to reflect and comment, the forums engage participants in the creative process by asking them to make suggestions, offer ideas, and build on the ideas and suggestions of other participants. Each PD forum had the following structure:

- *Multiple participant types* – Each forum included a sample of potential end-users of DNT and a team of user-interface and mobile-health (mHealth) and public health professionals. (Potential end-user was defined as a T2D patient or close family member/friend of a T2D patient. The role of the interface designers and mHealth professionals was to keep discussion focused on what is technologically possible, and to turn end-user ideas into design-oriented products.
- *Goals and products* – Each forum had a clear goal defined by the specific product that it is trying to develop. The discussion was bounded to considerations of that goal/product pair.
- *Active moderation* – Each forum had a moderator who maintained the pace and flow of discussion, ensured that no single or small group of voices dominated, and refocused the discussion on the goal and product when it strayed.
- *Structured record keeping* – The activities of the forum were recorded in three ways: 1) an audio recording (for later transcription), 2) detailed notes, and 3) digital photographs (annotated to link them to the audio record) of each drawing, sketch, or other visual artifact created during the forum.

We conducted four forums (total N of 38) over a three month period to explore views of desired DNT functions and the ideal user experience. In recruiting the participants, we focused heavily on building relationships with existing community organizations, but also recruited through word of mouth and flyers. The first forum was the most diverse attendance, while the second consisted exclusively of older participants while the third consisted of younger participants (all but one under 25). All participants self-identified as African-American, except for one white participant. 29 participants were women and 9 were men. We took detailed notes and audio-recorded each of the forums, after which we identified themes and challenges emerging from each forum, as well as ways in which the challenges could be addressed through DNT functionality.

Eight broad themes (medications, physician interactions, social support, general diabetes information, co-morbidities, diet, cooking, and exercise) emerged from the analysis, and led to identification of 29 specific potential DNT functions, shown below in Table 1.

From Suggested Ideas to Functionality Design

The initial forums yielded a large and rich space of potential functionality. While it was extremely positive that the forum participants saw such a broad range of functionality for DNT, it created a challenge. It created a design space that was too broad. Smartphone apps need to be focused and easy to access, and 30+ functions would create an unwieldy space of functionality for end users and an unmanageably complex situation for software development and maintenance.

Thus we treated the inputs in Table 1 as design process data and turned next to analysis of this data. Specifically, we sought to abstract and reduce functional design space that was achievable within a single app. We conducted this analysis using multiple techniques that provided us with different perspectives, from which we could triangulate a functional design solution.

Formal semantic analyses in the form of multidimensional scaling (MDS) and hierarchical clustering showed that there was no abstraction structure directly included in the functions in Table 1. That is, it was unable to show any structural reduction via underlying dimensions or hierarchical clusters, as the MDS analysis did not show any inflection point when stress was plotted against the number of dimensions, and the cluster analysis also showed a relatively linear decomposition with no predominant clusters². We took this to mean that the various functional suggestions in Table 1 were generally at the same level of abstraction.

We next analyzed the functional set directly, using ratings of the functions in Table 1, conducted by the seven members of the extended DNT team. Each rating was based on a priority for inclusion in DNT, and made on a three-point Likert scale (low-1, medium-2, high-3). The raters were also grouped into three sub-teams – two technology developers (TD), three community engagement researchers (CE, largely the public health sub-team), and two T2D clinicians (CLIN). We first separated those functions with relatively low priority from the others, by collapsing the M and H ratings into a new value of one (1), and the recoding the ratings of L as a zero (0). (Conceptually, this translated the three-point Likert scale into a two-point Guttman scale.) The binary scores were then totaled across these raters. Each function received a ‘count’ score of 0 to 7, based on how many of the seven raters were recoded to values of 1. A histogram showed no functions with a score of seven and a generally increasing in frequency as the value decreased, with eight functions having a score of zero (meaning they received only ‘low’ scores). The 15 functions with counts of four or above were selected as the first cut of DNT functionality based on commonly-perceived importance.

²The analyses were run on a similarity matrix calculated from Q-sort groupings of the functions by all members of the extended project team (Trochim, W.M., 1989).

We then took a final analysis to re-examine the rating data by perspective, specifically by looking at the combined scores of the CE and CLIN teams separately. This showed surprising differences from these two perspectives – there were several functions that one team uniformly rated as of high importance and the other as of low importance, and vice versa. This led us to re-examine the functions that were rejected by the initial rating analysis, and indicated that six received high ratings from both clinicians, though not from CE or TD sub-teams. To reflect the clinical concerns, we then added those six functions back, to get a second cut set of 21 included functions.

Finally, we turned to a technical assessment of this second pass set of functions. The tech team collectively rated each remaining function on two technical dimensions — difficulty of coding, and difficulty of obtaining/organizing the needed data. Because our project was exploratory in nature and had limited funding for development, any function that was rated as high on either criteria was discarded as impractical, at least in the initial implementation. One additional feature that emerged from this analysis was the identification of some functions that required curation, in the sense of establishing the ground truth and appropriately organizing the content for end-user access. A need for curation would add costs and complexity to the operation of the app, as well as additional costs to develop the curation functionality. Accordingly, functions requiring substantial curation were then flagged for deferred implementation. This left the final set of ten community-suggested DNT functions for inclusion in the final functional design, as follows:

- Share stories & advice w/in family and friends
- What works for me
- Exercise/meet-up for group activities
- Discussion Board for probs/complaints
- Medication testing Reminders
- Community Kitchen (recipe-collation)*
- Disseminate prevention information*
- General diabetes information*
- Check-up on each other
- Info for newly-diagnosed/borderline individuals

The items requiring non-user inputs and curation are flagged above with an asterisk.

From this final set, we then grouped the functionality into four groups. One content group focused directly on the behavior of the individual T2D patient – most notably, medication and related reminders.

A second content group focused on actions within the T2D patient's personal network of family-friends (which we termed the patient's micro-net), specifically finding family/friends to engage in group physical activities and the network of DNT users in the local community, sharing food and cooking information, and checking-up on others with T2D.

A third content group focused on information and sharing within micro-nets and the local DNT user community. It included the function of sharing stories & advice w/in family and friends, sharing what “works for me”, having a discussion board for problems, questions, and issues.

Finally, a fourth content group focused on bringing information *into* the micronets and local DNT user community. This includes access to general diabetes information, preventative information for those at risk of T2D, and information for newly-diagnosed T2D patients. The functions in this group all involved some form of curation.

Figure 1 shows this organization, supplemented with additional functions required by the app itself (e.g., personal profile) or added by the design team as integrative features (e.g., common DNT calendar).

FROM FUNCTIONALITY TO INTERFACE DESIGN

Based on the groupings in Figure 1, we designed DNT with four main user-facing functions.

1. *Remind.* DNT has multiple types of reminders for different aspects of self-management, such as taking oral medication, injecting insulin, testing blood sugar, medical appointments, and engaging in exercise. It also includes a social kind of reminder that allows a (typically nonT2D-patient) user to regularly check-in on a family member or friend. This reflected a need that we repeatedly heard in the forums.
2. *Share.* DNT is a platform for sharing information of various kinds inside the DNT community, such as personal stories, T2D related blogs or journals, and “what works for me” success stories. DNT uses mechanisms commonly used in social networking sites, including comment threads and bookmarking. However, all information within DNT stays within DNT and within the local community, keeping DNT a private and safe place where patients and family and friends can share and discuss T2D information.
3. *Active.* DNT provides a mechanism to reach out, set-up, and manage physical activity with others. We found from the forums that T2D patients were often unwilling to engage in solitary exercise especially outside the home for reasons such as embarrassment or fear for personal safety. However, they were open to forms of group activity such as walking with others. DNT uses social network techniques to allow a T2D patient to organize, schedule, and manage one-time or recurring group activities with others.
4. *Learn.* The forum participants raised many questions about T2D in general and about specific aspects of self-management that called for a clinical or nutritionist answer. To address this, DNT provides a set of the most commonly asked questions about T2D and self-management issues, coupling frequently asked questions with brief, verified answers with links to more in-depth, authoritative, sources (e.g., the American Diabetes Association website).

5. *Learn.* The forum participants raised many questions about T2D in general and about specific aspects of self-management that called for a clinical or nutritionist answer. To address this, DNT provides a set of the most commonly asked questions about T2D and self-management issues, coupling frequently asked questions with brief, verified answers with links to more in-depth, authoritative, sources (e.g., the American Diabetes Association website).

These four functions are visible in a navigation ‘tab bar’ at the bottom of the screen, via an icon and verb (shown in the list above as the initial word in each list item). This tab bar provided a simple omni-present navigation strategy for this top-level structure in DNT.

Additionally, DNT allows the user, like the user of any social networking app or site, to prepare a personal profile, to invite new members to her or his DNT ‘micro’-network, and to view a DNT calendar that provides easy access to all the reminders and group activities scheduled on any given day. These functions are available through a ‘more’ button on the bottom tab bar.

In the final step of the design process the organization of the DNT high-level interface into the four user-facing functions was used to design a complete UI/UX design for DNT. This portion of the design process applied state of the art but widely accepted practices, including:

- defining a set of different use-episodes for DNT, drawing on the experiences forum participants recounted about their own self-management or helping family member/friend to self-manage;
- defining a path/journey workflow and associated experience with each episode type;
- creating a navigation scheme for the app, as well as a consistent use of screen real estate, and finally
- designing and refining each screen/page, to maximize consistency, usability, and understandability.

The UI/UX design also added additional considerations for the expected user population of DNT, again based on issues raised in the various design forums. First, we expect that the user population is likely to be generally older than the target users of commercial social networking products (Greenwood, et al., 2016). While the age of onset of T2D is falling rapidly and it is no longer rare to see diagnoses on patients in their 20s, the disease and need for self-management is lifelong, and most patients are still diagnosed after 40 (Temneanu, et al., 2016). In addition to being older, many participants in the forums (particularly T2D patients) expressed having vision problems and fine motor problems, largely resulting from their T2D (Pfutzner, et al., 2012). Overall, residents of lower-income areas, minority or not, generally have lower reading levels and less education than the broader population public. Finally, the interface (as well as the app software) had to be designed to run on both Android and iOS smart phones, and to be backward compatible with earlier versions as much as possible (due to the increased prevalence of older smart phones in lower-income communities).

These issues were applied in several specific ways to the DNT design. We eschewed more compact, complex single-page layouts that required smaller text and finer-grained and more dexterous manipulations, and instead favored breaking complex operations into multi-page sequences with larger type and one key operation on each page. An example of this is in the setting of reminders for medication, blood-testing, and related activities. Unlike the Apple reminder function, which invests all interactions on a single display (with smaller text and very fine-grained manipulations), DNT breaks reminder settings across several sequential pages, using larger type and gesture interactions which are easy to do, even for someone with decreased dexterity.

Another way in which these DNT-specific design considerations were applied was in the way that general content, such as general questions on T2D were curated. We adjusted the reading level, paragraph length, and technical content to the estimated reading comprehension level of the DNT audience (Ryan, et al., 2014).

DISCUSSION AND CONCLUSIONS

DNT explicitly reflects the perspective that self-management is not a purely individual activity, but rather one that occurs in the context of a social environment, i.e., that it is socially situated. DNT thus applies social computing technology to support the use of personal social networks as practical resources for T2D self-management in low-income minority communities. It reflects a unique use of interactive technology for an often-ignored population.

We have presented the design of DNT as an example application of participatory design, itself a new method, to patient-facing healthcare. Specifically, we have sought to demonstrate how PD can be used to capture design-relevant information on unstructured but high-value processes in everyday social life. It thus has broad value for those wanting to bring human centered design to underserved communities where the community members have the most accurate perspective of how their lives and social reality works.

We have further argued that PD allowed us to address the unique human factors issues that arise in this kind of application in a way that conventional UCD methods such as cognitive task analysis (Schrage, Chipman, & Shalin, 2000; Millatelo & Hutton, 1998) or Ecological Interface Design (Vicente, 2002; Burns & Hajdukiewicz, 2004) could not. It provided us with a way of discovering the problems that potential DNT users were facing in their daily lives by directly engaging the community. This process led to suggested functions that we had not seen in the clinical or public health literatures, such as the ideas of ‘check on’ reminders or of network-based group exercise activities to ameliorate the fear and shame that prevented many users from physical activity. It also led us to appreciate the psychic toll that T2D places on patients and their family/friends, and thus to incorporate sharing functions we might otherwise have missed.

The forum data also validated our initial hypotheses that T2D self-management is socially situated. Therefore through DNT, we applied social computing technology to support the use of personal social networks as practical resources for T2D self-management, in these low-

income minority communities. It thus reflects a unique use of interactive technology for an underserved population.

Still, DNT development is on-going and exploratory. Further forums to present the design and implementation to the community are in process as of this writing, and distribution in the community as part of a controlled assessment of DNTs effect on self-management is also planned for the near future.

Further development is also envisioned, as the user needs and functional opportunities obtained from the PD process substantially outran the scope and available resources of this exploratory research project. There was much more suggested that DNT could do to improve self- management than we were able to incorporate into the design and implement. In fact, our choice of the four core function areas was made in part to provide an interface and software foundation for more advanced and sophisticated features that we hope to build in future versions. An example of this can be found in the Remind function. Initially, DNT allows a patient to set a reminder for, say, taking oral and injected medications and monitoring blood sugar. DNT then provides active notification to the user within and outside of DNT to help the user adhere to this aspect of self-management. While providing an initial and useful form of support, we envision several additional layers of functionality building on this foundation. Logging of medications taken (and timing) could be a routine immediate follow-up to the notification, as could the recording of glucometer results. Such logs could then be made available to providers as part of periodic T2D routine care. Even further, gamification features (Cugelman, 2013) could be built on top of the logging, allowing DNT users to challenge each other or compete to achieve the best results, and/or to receive virtual rewards (such as online badges).

ACKNOWLEDGEMENTS

The research reported in this publication was supported by the National Institute on Nursing Research of the National Institutes of Health, under award number R21NR015577. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

REFERENCES CITED

- Abras C, and, Preece J (2004) User-Centered Design In Bainbridge W. Ed., Berkshire Encyclopedia of Human-Computer Interaction. Gt Barrington, MA: Berkshire Press.
- American Diabetes Association. Statistics About Diabetes. <http://www.diabetes.org/diabetesbasics/statistics/?referrer=https://www.google.com/>. Published December 12, 2016 Accessed April 2, 2017.
- Beverly EA, Miller CK, Wray LA. Spousal support and food-related behavior change in middle-aged and older adults living with type 2 diabetes. *Health Educ Behav*. 2008 10;35(5):707–20. [PubMed: 17456857]
- Burns CM, & Hajdukiewicz J (2004). Ecological interface design. CRC Press.
- Chang T, Chopra V, Zhang C, and Woolford J (2013) The Role of Social Media in Online Weight Management: Systematic Review. *J Med Internet Res* 2013 15(11):e262 [PubMed: 24287455]
- Cugelman B (2013) Gamification: What It Is and Why It Matters to Digital Health Behavior Change Developers. *Journal of Medical Internet Research (JMIR) Serious Games*. 2013;1(1):e3. doi: 10.2196/games.3139

- Davidson JL, Jensen C (2013). Participatory design with older adults: an analysis of creativity in the design of mobile healthcare applications. In *Proceedings of the 9th ACM Conference on Creativity & Cognition* (pp. 114–123). ACM.
- Gallant MP. The influence of social support on chronic illness self-management: a review and directions for research. *Health Educ Behav.* 2003 4;30(2):170–95. [PubMed: 12693522]
- Garay-Sevilla ME, Nava LE, Malacara JM, Huerta R, Díaz de León J, Mena A, Fajardo ME. Adherence to treatment and social support in patients with non-insulin dependent diabetes mellitus. *J Diabetes Complications.* 1995 Apr Jun;9(2):81–6. [PubMed: 7599352]
- Gaskin DJ, Thorpe RJ Jr, McGinty EE, Bower K, Rohde C, Young JH, LaVeist TA, Dubay L. Disparities in diabetes: the nexus of race, poverty, and place. *Am J Public Health.* 2014 Nov; 104(11):2147–55. [PubMed: 24228660]
- Greene JA, Choudhry NK, Kilabuk E, Shrank WH. Online Social Networking by Patients with Diabetes: A Qualitative Evaluation of Communication with Facebook. *J Gen Intern Med.* 2011 3; 26(3): 287–292. [PubMed: 20945113]
- Greenwood S, Perrin A, & Duggan M (2016). Social media update 2016: Facebook usage and engagement is on the rise, while adoption of other platforms holds steady.
- La Greca AM, Auslander WF, Greco P, Spetter D, Fisher EB, Santiago JV. I get by with a little help from my family and friends: adolescents' support for diabetes care. *J Pediatr Psychol* 1995;20(4): 449–76. [PubMed: 7666288]
- Larson NI, Story MT, Nelson MC. Neighborhood environments: disparities in access to healthy foods in the U.S. *Am J Prev Med.* 2009 1;36(1):74–81. [PubMed: 18977112]
- Li R, Zhang P, Barker L, Chowdhury F, and Zhang X (2010) Cost-effectiveness of Interventions of Prevent and Control Diabetes Mellitus: A Systematic Review. *Diabetes Care* 33:1873–1894.
- Menschner P; Prinz A; Koene P; Köbler F; Altmann M; Krcmar H & Leimeister JM (2011): Reaching into patients' homes - participatory designed AAL services. In: *Electronic Markets, Ausgabe/Number: 1, Vol. 21, Erscheinungsjahr/Year: 2011. Seiten/Pages: 63–76.*
- Militello LG, & Hutton RJ (1998). *Applied cognitive task analysis (ACTA)*:
- Norman D and Draper S (1986) *User Centered System Design; New Perspectives in Human Computer Interaction.* Hillsdale, NJ: LEA.
- Pfützner A, Musholt PB, Schipper C, Niemeyer M, Qvist M, Schorsch A, & Forst T (2012). Self-assessment and objective determination of dexterity in patients with type 1 or type 2 diabetes mellitus. *Current medical research and opinion*, 28(1), 15–21. [PubMed: 22087736]
- Pollard SL, Zachary DA, Wingert K, Booker SS, Surkan PJ. Family and Community Influences on Diabetes-Related Dietary Change in a Low-Income Urban Neighborhood. *Diabetes Educ.* 2014 7;40(4):462–469. [PubMed: 24685841]
- Ross NA, Gilmour H, Dasgupta K. 14-year diabetes incidence: the role of socio-economic status. *Health Rep.* 2010;21(3):19–28.
- Schulz AJ, Zenk S, Odoms-Young A, et al. Healthy eating and exercising to reduce diabetes: exploring the potential of social determinants of health frameworks within the context of community-based participatory diabetes prevention. *Am J Public Health.* 2005;95(4):645–651. [PubMed: 15798125]
- Ryan L, Logsdon MC, McGill S, Stikes R, Senior B, Helinger B, & Davis DW (2014). Evaluation of printed health education materials for use by Low-Education families. *Journal of Nursing Scholars*
- Schraagen JM, Chipman SF, & Shalin VL (Eds.).(2000). *Cognitive task analysis.* Psychology Press.
- Shrank WH, Choudhry NK, Swanton K, Jain S, Greene JA, Harlam B, et al. Variations in structure and content of online social networks for patients with diabetes. *Arch Intern Med* 2011 9 26;171(17): 1589–1591. [PubMed: 21949173]
- Temneanu OR, Trandafir LM, & Purcarea MR (2016). Type 2 diabetes mellitus in children and adolescents: a relatively new clinical problem within pediatric practice. *Journal of Medicine and Life*, 9(3), 235. [PubMed: 27974926]
- Trochim WM (1989). An introduction to concept mapping for planning and evaluation. *Evaluation and program planning*, 12(1), 1–16.
- Vassilev II, Rogers A, Sanders C, Kennedy A, Blickem C, Protheroe J, Bower P, Kirk S, Chew-Graham C, Morris R. Social networks, social capital and chronic illness self-management: a realist review. *Chronic Illn.* 2011 3;7(1):60–86. [PubMed: 20921033]

Vicente KJ (2002). Ecological interface design: Progress and challenges. *Human Factors: The Journal of the Human Factors and Ergonomics Society*,44(1), 62–78.

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Figure 1.
DNT Functionality Organized into Content Groups

Table 1.**Suggested DNT Functions from Forums**

Way to share stories, advice w/family
“what works for me...”
verbal Q&A general re diabetes e.g. Regarding drug interactions
Seek free/low cost access to testing/meds/screening
Dealing with co-morbidities
Exercise meet up/plan groups activities
Seek/get free/low cost exercise equipment for home
Seek/meet up diabetic exercise friendly class
Discussion board for problem/gripes
Where to find healthy/affordable foods
Where/who to distribute T2D friendly foods
Support & education for non-diabetic others/family (Seek and/or push)
Emotional Support
How do I (do x, e.g. use Y brand of glucometer)?
Emergency Button
Share daily testing information
Community kitchen (virtual)
Disseminate Prevention info
Diabetes and budget (SNAP & WIC)
Doctor-Patient Network
Link to Patient EHR
Medication and testing reminders
Education for young(er) family members
General Diabetes info
Check up on each other
Provider/ratings
Newly-diagnosed/borderline information/distribution
Food log/portion planning?
Coupons