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Discussion

Smartphone apps and the nutrition care process: Current perspectives and future considerations

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ABSTRACT

Objective: To provide dietitians with practical guidance on incorporating smartphone applications (apps) in the nutrition care process (NCP) to optimize patient education and counseling.
Methods: The current evidence-base for mobile health (mHealth) apps was searched using PubMed and Google Scholar. Where and how apps could be implemented by dietitians across the four steps of the NCP is discussed.
Results: With functionality to automatically convert patient dietary records into nutrient components, nutrition assessment can be streamlined using nutrition apps, allowing more time for dietitians to deliver education and nutrition counseling. Dietitians could prescribe apps to provide patients with education on nutrition skills and in counseling for better adherence to behavior change. Improved patient-provider communication is also made possible through the opportunity for real-time monitoring and evaluation of patient progress via apps. A practical framework termed the 'Mobile Nutrition Care Process Grid' provides dietitians with best-practice guidance on how to use apps.
Conclusions: Including apps into dietetic practice could enhance the efficiency and quality of nutrition care and counseling delivered by dietitians.
Practice implications: Apps should be considered an adjunct to enable dietetic counseling and care, rather than to replace the expertise, social support and accountability provided by dietitians.

1. Introduction

Nutrition care delivered by registered dietitians (RDs) is a fundamental component of health promotion, and chronic disease prevention and management [1], particularly given the high prevalence of obesity, diabetes and other non-communicable diseases [2–4]. In 2012, the Dietetic Workforce Demand Study Task Force predicted only 75% of demand for RDs in the US would be met in 2020 [5]. The study also identified technology as having potential to transform how RDs deliver nutrition counseling and personalized nutrition [6].

For the delivery of more consistent and effective quality nutrition care by RDs, the Academy of Nutrition and Dietetics (the Academy) recommends their nutrition care process (NCP) [7,8]. The systematic method allows RDs to diagnose and develop treatment plans for nutrition-related problems [7]. Furthermore, having a standardized NCP framework facilitates outcomes for research to evaluate the impact of nutrition care on patient health outcomes. Subsequently, the efficacy of nutrition care can be demonstrated, enabling advocacy for the role of RDs in obesity and chronic disease treatment and prevention [7,9]. Moreover, productivity and communication between RDs and other members of the health care team have improved through diagnosis-focused documentation of the NCP [9]. There is now the opportunity for advocating the NCP further with technology.

The public market for and acceptance of mobile health (mHealth) technologies, such as smartphone applications (apps) has experienced dramatic growth, with over 259,000 mHealth apps available [10]. Fifty-eight percent of US smartphone owners have downloaded a health-related app [11], with fitness and nutrition apps most frequently downloaded [12]. The proliferation and low-cost of many nutrition apps may appear a threat to RDs services. However, if implemented appropriately, apps could support dietetic practice by increasing accuracy, efficiency and quality of clinical decision-making when applying the NCP [13], as well as improving patient access to point-of-care services and

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patient-provider communication, to ultimately improve patient outcomes [14].

Recent reports indicate the dietetic profession has adopted health apps into their practice. Eighty-three percent of US RDs were found to recommend apps [15]. In Canada, 57% of dietitians used apps in practice, and a three country study of Australian, New Zealand and British dietitians found 62% used apps in patient care and 84% recommended apps [16].

Despite the rates of app adoption by dietitians, the profession has expressed their desire for more education and training around incorporating apps into dietetic practice, especially private practice [15,16]. To support app use among RDs, the Academy has undertaken science-based reviews of nutrition apps, which are included in their *Food & Nutrition* magazine [17]. However, there has been no systematic process proposed of how to incorporate apps into the NCP. Therefore, the purpose of this paper was first to identify the areas in which an RD could practically implement health apps across the four steps of the NCP (i.e. nutrition assessment, nutrition diagnosis, nutrition intervention and nutrition monitoring and evaluation). Secondly, the medical nutrition literature (PubMed) and more general sources (Google Scholar) were searched for research on implementation of health apps to support weight loss, diabetes, healthy lifestyles, nutrition care, and dietetic practice. Finally, a framework to guide the use of apps in the NCP was constructed.

2. Nutrition assessment

During patient assessment, RDs will obtain, verify and interpret anthropometric, biochemical, medical, social and client history, as well as dietary information [8]. RDs usually conduct a diet history to estimate nutritional adequacy and meal patterns but sometimes ask patients to keep a diet record in advance of their consultation. However, paper-based dietary records are burdensome for patients and labor-intensive for RDs to analyze, thereby reducing counseling time available [18].

Ninety-three percent of US adults use their smartphone while eating [19]. Apps provide a convenient means to record data in near real-time during eating occasions and have demonstrated greater acceptability than paper-based food diaries [20–22]. Dietitians and health care providers also show acceptance towards technology-assisted dietary assessment [16,23]. Most nutrition apps convert the food intakes into nutrients and provide valid estimates of energy and nutrient intake comparable to traditional dietary assessments [24–26]. An evaluation of variance across 23 commercial weight loss apps revealed that 17 of 23 apps assessed were within ±100 kcal of weighed food records [27].

Some commercial apps also include image logs to complement the digital dietary record and assist with prompting memory when reviewing records or by dietitians for qualitative assessment [27,28]. Sole image-based dietary record apps show promise in lowering the burden of logging, though challenges remain for automated computer vision approaches to reliably assess the vast array of foods [29].

Collection of anthropometric measurements and monitoring could also be enhanced. Apps and wireless scales provide a popular and simple method to assess, monitor and visualize weight history [27]. The Academy's *NutriCare Tools* app contains a compilation of evidence-based tools, including calculators that assess energy and fluid requirements and a range of anthropometric tools [30]. Fitness and exercise wearables, such as Fitbit or smart watches, can also support the passive assessment of physical activity, including valid estimates of step counts and energy expenditure [31,32].

Apps for diabetes management enable patients to log blood glucose levels, track insulin injections and oral medication and record exercise, carbohydrate and other dietary intake [33]. These 'all-in-one' apps are convenient for patients, and allow RDs to pinpoint certain foods, carbohydrate intake patterns or physical activity sessions influencing patients' blood glucose. Some diabetes apps also allow patients to synchronize blood glucose measurements from glucometers for simplified recording and visualization of trends [34–36]. Certain diabetes apps have been approved by the US Food and Drug Administration [33,37].

3. Nutrition diagnosis

From data gathered in nutrition assessment, RDs can identify the etiology, signs and symptoms of nutrition problems, which can then be targeted through a treatment or nutrition intervention [8]. With many complex terminology references in this step, the former *IDNT app*, now integrated into the *Kalix* software [38,39], is a useful tool for guiding RDs on the selection of relevant and appropriate nutrition diagnoses. Nutrition diagnostic domains most likely to be established by health apps include the intake domain for energy, nutrients and fluids; clinical domain diagnoses, such as weight loss or weight gain and behavioral-environmental aspects, such as knowledge and beliefs and physical activity [8].

Identifying the etiology of a nutrition problem is necessary for subsequent implementation of nutrition interventions. Etiologies related to the behavior category of the Nutrition Diagnosis Etiology matrix (e.g. disordered eating pattern, excessive or inadequate energy intake, excessive physical activity) [8] are readily identified by health apps. With continued recording, dietary patterns and anomalies can be detected, albeit dependent on patient input of the data. Therefore, examining patient-generated health data (PGHD) via app records may also allow RDs to uncover additional information about other etiological categories, such as beliefs-attitudes, cultural or knowledge, that may be contributing to the nutrition problem.

4. Nutrition intervention

To address the etiology or signs and symptoms of the nutrition diagnosis, RDs plan individualized interventions and provide nutrition education and counseling [8]. Dietitian-specific tools, such as *NutriGuides*, an app developed by the Academy, contains an accessible compilation of the Evidence Analysis Library to help RDs determine best-practice treatment [40].

Emerging evidence provides some support for using apps in lifestyle change [41,42], and weight [42,43] and chronic disease management [44–46]. However, apps appear to be more effective when complemented with counseling sessions, education or other mHealth technologies (e.g. text messaging) in multi-component interventions rather than with standalone use [41,47,48]. The importance of dietitians in providing coaching [48,49] is affirmed by the lack of success when nurses or physicians provided such care [50–52]. It should be noted, most effective interventions involved younger adults, who typically engage with apps more successfully than older participants. Thus, RDs must assess the appropriateness of prescribing apps in nutrition interventions based on individual patient demographics and motivations.

Nutrition education is a NCP intervention strategy [8], and using apps to deliver information is likely to be acceptable to patients, given 63% of US smartphone users access information about health conditions via smartphones [53]. Calorie or nutrient information provided by apps are reported to be a useful resource in patient nutrition care [16]. Educational information on diabetes, including managing blood glucose and diabetes-related treatments are also accessible in some diabetes apps [33,54]. However, there is opportunity for more personalized patient education, particularly apps centered around dietary and clinical guidelines [27,33,54–56]. *Nutricare Tools* app provides education on reading food labels [30].

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