Implementing the complex renal diet on a daily basis is a challenging responsibility for anyone who receives hemodialysis. In addition, some patients are asked to concurrently implement additional dietary restrictions because they have comorbid conditions, such as diabetes or heart disease. All patients, however, are encouraged to read food labels and are often provided with lists of food to avoid, alternative cooking strategies, and suggestions on how to improve food flavor.1

Sometimes patients might not possess the skills required to implement the renal diet. Providers cannot assume that patients can read food labels, measure, add intake values, and make conversions from one metric to another, such as from ounces to milliliters; these abilities might be beyond those who are educationally disadvantaged or who have limited cognitive capabilities. Furthermore, such patients can be reluctant to inform care providers of their limited skills.

Sometimes providers do offer patients effective methods to help them overcome low literacy skills. For example, many dialysis units provide graduated water pitchers to help patients reduce fluid intake. Patients are instructed to place their daily fluid allotment into the pitcher and to extract fluid from the pitcher throughout the day without refilling. The use of a water pitcher, however, may not always be realistic because it doesn’t allow for different types of drinks. It also limits the ability of patients to monitor fluid intake while engaging in normal activities of daily living, such as visiting with family and friends outside the home or even shopping in a mall.2

About three years ago our research team began thinking about developing and testing the effects of electronic self-monitoring using a personal digital assistant (PDA) to help patients overcome many of the obstacles encountered in the daily implementation of diet and fluid limitations while maximizing their ability to make personal choices. An interdisciplinary research team was formed that included individuals from biostatistics, informatics, nursing, nutrition and computer science. We were particularly interested in an application that would be easy in use, free of disease stigma, and useful for patients with low literacy skills. As we began our venture, we had numerous questions that we have started to answer. Could chronic kidney failure patients, about half of whom have a concurrent diagnosis of diabetes mellitus and/or are older adults, see icons on a PDA screen? Do they have the manual dexterity to use a stylus? Would patients interpret consumption information icons in the intended manner? Could dialysis patients navigate within the PDA without getting lost or frustrated? Could we program a PDA so patients could get
up-to-date real time feedback about their intake in relation to their individual dietary prescriptions? Could we add a Universal Product Code (UPC) scanner? Would patients use a PDA to monitor diet and fluid intake if it was available on a day-to-day basis?

To begin answering these questions, we decided to adopt a user-centered approach to developing a PDA application, which we refer to as the Dietary Intake Monitoring Application (DIMA). Our work has been conducted with adults who receive out-patient hemodialysis in an urban, inner-city dialysis unit. As we began this venture, we initially decided to integrate and merge two databases into a PDA for patient use—the U.S. Department of Agriculture (USDA) food database and an open source UPC database. The USDA database contains approximately 7,300 food items with their nutrient composition, and an open source UPC database contains 641,363 identified barcodes, of which not all are food. However, after more careful consideration, we decided to develop the fully functioning DIMA prototype with Gregg London’s combined UPC and nutrition database. We also explored the various types of hardware currently available on the market. We wanted to use a light-weight, powerefficient PDA that could display information on a large screen and accommodate patients who had poor visual acuity or manual dexterity. We initially selected Palm One’s Tungsten T3 and are in the process of changing to the HP iPAQ mx2490 Pocket PC for easier programming. We also selected a Socket In-Hand UPC scanner that fit the PDA. The UPC scanner is about the size of a quarter and allows individuals to scan any food item that contains a UPC.

Our earliest work focused on tasks specific to using a PDA. We learned that our dialysis patients could press PDA buttons, record voice messages and scan barcodes. They preferred to use large icons, but found the PDA tasks easy to complete.

We then began developing the interface—the visual and interactive part of the application. Low-fidelity interfaces were designed using picture cards (i.e., pieces of paper with interface drawings) so that we could quickly change and create new designs without having to reprogram the PDA. We’ve learned that dialysis patients organize foods in similar ways and want to use a combination of interfaces when searching for food items. Patients found it easiest to interpret consumption icons that looked most like artifacts used in their everyday life and were able to accurately interpret warning icons.

Once the interface was designed, we planned to iteratively develop the application to receive feedback from dialysis patients. For the first iteration, patients were asked to enter dietary intake using a UPC scanner or voice recorder over a three-week interval. All patients received one-on-one instruction until they could demonstrate mastery of this procedure. If a food item did not have a UPC barcode, the patients were asked to voice-record what and how much they ate. Patients and dietitians agreed that this application would be helpful for dialysis patients starting treatment.

We envision three additional areas that need to be explored to continue the development of our application. First, because we believe that continual real-time feedback is essential for dialysis patients to make informed decisions about intake on an ongoing basis, we will explore whether a voice-driven menu would be an acceptable and easy alternative for dialysis patients to enter food items. Second, we plan to explore the best way to set up the interface for navigation to enable patients to find what they are looking for in the fewest number of steps avoiding a potential source of frustration. Finally, we plan to beta test the product to discover problems we have not yet uncovered or anticipated.

After these three additional phases are completed, we plan to pilot test our product in a small group of individuals. As part of our overarching plan, we will be developing a program that will allow us to download data from the PDA onto a computer. We plan to monitor intake patterns of calories, fluid, phosphorus, potassium, protein and sodium to determine whether intake gets better or worse. Will patients consume more protein and calories if they can visually see their intake throughout the day? Will the consumption of fluid, phosphorus, potassium and sodium remain the same or approach the amount prescribed by their physician?

The use of an electronic application has an added bonus because we can monitor

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treatment fidelity. We can determine the day and time data are entered. Will patients record on an on-going basis throughout the day as we intended or will they record intake at the end of the day only? How long will recording data take? Will it be burdensome? Preliminary data using an existing product revealed that, although we may need to incorporate a reminder system into the program, data entry did not cause an undue burden. We will gather additional data as we continue development; for example, we will determine whether the frequency of electronic monitoring affects outcomes.

The PDA application, DIMA, is being designed as a tool for patients to use as they implement the complex and difficult renal diet. After initial pilot testing, we plan a well-powered clinical trial focusing on health-related quality of life outcomes that are associated with successful self-management. Future plans will also need to focus on costs for implementing DIMA into practice and considering how to integrate other aspects of self-management into a mobile application.

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