The Kidney Diet Challenge: An Experiential Educational Experience

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Key Points
- Participating in a Kidney Diet Challenge can improve your ability to educate your patients with CKD about dietary modification.
- The Kidney Diet Challenge can be recreated with freely available webinars and our supplemental document.
- Social media improved our ability to recruit more participants in the Kidney Diet Challenge and made the experience more enjoyable.

Abstract

Background Health care providers who care for patients with CKD must be able to provide effective counseling about a kidney-friendly diet. Nutrition is underemphasized in medical curricula, and the kidney diet is one of the most challenging diets. We hypothesized that participation in an experiential educational program in kidney diet would result in improved knowledge of the underlying principles behind it and provide concrete examples of how to explain this diet to patients.

Methods The first part of this study was a knowledge assessment administered to all US nephrology fellows during the 2020 National Board of Medical Examiners Nephrology In-Training Examination. We later opened the assessment to a broader, global audience via social media. Respondents included trainees, practicing nephrologists, dieticians, and other health professionals. Participants self-identified willingness to participate in the second part of the study, the Kidney Diet Challenge (KDC). The 5-day challenge included daily webinars by experts in nutrition. Daily surveys captured self-reported adherence to the diet. Social media was used to engage with participants. All participants received a follow-up knowledge assessment.

Results Among the nephrology fellows (n=317), the median pretest score was 2 out of 5 (40%) questions correct, and results did not differ by year of training (P=0.31). Of the participants (n=70) who completed the 5-day challenge and responded to the post-challenge survey, the distribution of the number of correct answers improved after the KDC (median [25th, 75th percentile]: 3 [2, 3] versus 3 [2, 4]; P<0.001). Statistics from our official hashtag for this study (#kidneydietchallenge) showed that we achieved 406,241 reaches and 1,004,799 impressions, with a total of 974 posts using this hashtag.

Conclusions The KDC is an immersive, experiential educational tool that enabled a global population to learn how to counsel their patients better about adherence to a complex kidney diet.

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Introduction

People with CKD are educated on adherence to a diet that restricts intake of phosphorus, potassium, protein, and sodium. This diet may contribute to a delay in progression of CKD and ameliorate some of its complications. Thus, dietary education has the potential to provide a significant clinical benefit (1). The kidney diet is one of the most complex, restrictive, and challenging therapeutic diets. Yet, health care providers are expected to provide advice to patients and include tips for adherence (2). People with CKD and their caregivers find the kidney diet “overwhelming, frustrating, and emotionally demanding.” To help them manage these difficult dietary changes, they need clinicians who feel comfortable providing clear explanations of the rationale behind each of the

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specific restrictions and who can guide them toward actionable and realistic change (3).

In general, nutrition is underemphasized across the spectrum of medical education (4,5-8). Within nephrology fellowship training programs, anecdotal evidence suggests that most nutrition training is lecture based. Yet, for many topics, experiential, online, or simulation educational experience may be more effective. In a recent survey of nephrology fellows, 17% indicated that one of the topics in which they would like additional training was renal nutrition (9). Among medical and dietetics students, experiential and simulation training in nutrition (including culinary skills training) may be associated with improvements in nutrition knowledge and counseling confidence (9-11). Such methods have been applied only rarely to kidney disease, and we know of no studies describing their use in nephrology fellowship programs (10,11).

We hypothesized that health care providers, including medical trainees, nephrology fellows, and practicing professionals, who attempt to adhere to a kidney diet in their personal life will better understand the complex kidney diet and gain confidence in their ability to counsel people with kidney disease. Health care professionals who care for patients with kidney disease are increasingly seeking out medical education in various online formats. We chose to improve accessibility and increase participation in our project through live discussion and recruitment on Twitter.

**Methods and Materials**

The Baylor College of Medicine Institutional Review Board approved and reviewed this study (protocol number H-45522), with a waiver of documentation of informed consent.

There were two parts to this study. The first part consisted of a voluntary electronic questionnaire administered to US nephrology trainees after completion of the June 2020 Nephrology In-Training Examination (Supplemental Material 1, Table 1). The survey (developed by E.B.) was designed to elicit data on fellow knowledge (five knowledge questions), dietary education during fellowship, and comfort level in counseling patients with kidney disease about implementing a kidney diet. The knowledge questions were straightforward queries that addressed protein, phosphorus, and potassium content of common foods, and a CKD patient or renal dietician would be expected to answer correctly after dietary training.

A similar electronic questionnaire was created on the REDCap platform (Supplemental Material 2), and a link to this questionnaire was posted on social media in July 2020 (Supplemental Material 2). We used Twitter and Facebook to recruit our project participants using a separate account (@dietkidney) and a specific hashtag (#kidneydietchallenge). This allowed us to build an online community interested in this topic (Table 2). Before our project began, we posted a recruitment tweet by tagging users and organizations who were likely interested in this topic within the #medtwitter and #nephtwitter community.

All participants who wished to participate in part 2 of the study, the Kidney Diet Challenge (KDC) provided their email address at the completion of the questionnaire.

Three days before the KDC, all interested participants received information about the diet and sample menu (Supplemental Material 3). The menu was prepared by the study dietician (E.B.) and incorporated practical knowledge of common questions and concerns of patients following the kidney diet. The dietician was available throughout the challenge week via email, evening webinars, and social media to answer participants’ questions and provide motivation. Participants received dietary instruction in the form of a 1-hour recorded webinar on the evening before the beginning of challenge week. Participants used the hashtag

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**Table 1.** Abridged kidney diet survey

| Question                                                                 | Possible Answers                                                                 |
|------------------------------------------------------------------------|---------------------------------------------------------------------------------|
| What is your current position—student, resident, fellow, attending, patient, other? | Student, resident, fellow, attending, patient, other                           |
| Have you received formal training on a kidney diet—yes, no, unknown?    | Yes, no, unknown                                                                 |
| Knowledge Assessment*                                                   |                                                                                  |
| 1. How much protein is in a 1/4 cup (handful) of nuts—3, 7, or 10 g?    | 3, 7, or 10 g                                                                   |
| 2. How much protein is in a 1/2 cup of yogurt—4, 5, or 8 g?             | 4, 5, or 8 g                                                                   |
| 3. Which contains the most phosphorus—1 medium egg, 1 oz. almonds, 3 oz. beef? | 1 medium egg, 1 oz. almonds, 3 oz. beef  |
| 4. Which contains the least phosphorus—1/2 cup bran flakes, 1/2 cup cheerios, 1/2 cup cornflakes? | 1/2 cup bran flakes, 1/2 cup cheerios, 1/2 cup cornflakes |
| 5. Which is considered a low-potassium fruit—nectarines, pineapple, or kiwi? | nectarines, pineapple, or kiwi |
| On a scale from 1 to 7 (with 7 being the highest), how do you rate your ability to advise and educate patients about a kidney diet? | 1, 2, 3, 4, 5, 6, 7 |
| Post-challenge only                                                      |                                                                                  |
| Now after having completed the challenge, on a scale from 1 to 7 (with 1 being the lowest and 7 being the highest), how do you now rate your ability to advise and educate patients about a kidney diet? | 1, 2, 3, 4, 5, 6, 7 |
| What is your gender identity?                                           |                                                                                  |
| What is your current position?                                          |                                                                                  |
| How difficult was it to adhere to the diet?                            |                                                                                  |
| How palatable was the food for the kidney diet?                        |                                                                                  |
| Do you have (a) personal diet restriction(s)?                          |                                                                                  |
| 1. If so, do you think your personal diet restriction(s) made it more difficult to adhere? | Yes, no |
| 2. Please indicate your dietary restriction.                           |                                                                                  |

Full versions of the In-Training Examination Survey (to nephrology fellows) and REDCap (to the online audience) are available in the Supplemental Material.

*Answers to Knowledge Assessment: 1. 7 g; 2. 4 g; 3. 3 oz. beef; 4. Corn flakes; 5. Pineapple.
#kidneydietchallenge to encourage one another during the week. During the KDC, we were active on social media using the @dietkidney Twitter account to keep the trainees engaged. We posted educational information, poll questions and pictures (from the food our trainees were preparing), and announcements regarding the upcoming webinars. Each participant was invited to a 1-hour evening webinar (Table 3). The participants also received a daily five-question survey (Supplemental Material 4), asking how difficult it was to adhere to the kidney diet for that day. At the conclusion of the study, participants completed a final survey (Supplemental Material 5, Table 1), asking if they felt the experience had subjectively improved their ability to counsel patients about a kidney diet. The final survey also repeated the same knowledge questions regarding the kidney diet that were present on the original survey, and asked about self-assessed adherence, difficulties with adherence, other dietary restrictions, and palatability. The five-question test was developed by E.B. and is similar to questions that would be administered to a dietician or patient. Both the daily survey and the final survey were developed and reviewed by R.R., E.B., and S.N. Participants received an electronic certificate for completing all surveys and webinars.

We measured social media activity by identifying total number of posts, reach, and impressions using #kidneydietchallenge per hour for 1 week. We also measured the total number of posts, active users, and influential users and quantified total reach, engagement, and impressions of the project’s main hashtag. Twitter reach is the maximum number of people who see a specific tweet on Twitter within a set period of time. Engagement is the total number of times a Twitter user interacts with a tweet, e.g., clicks anywhere on the tweet, including retweets, follows, likes, links, embedded media, etc. Impressions are how many times a specific tweet has appeared on other users’ timeline. We also identified related active hashtags used by our participants during KDC week. Social media activity during the project was incentivized by an online competition offering a cookbook (written by one of the authors) as a prize to up to the five top influential participants. Comments from the final survey (Supplemental Material 6) were organized into common themes, and those mentioned at least twice by participants are shown in table form.

Table 2. Methods of recruitment and engagement using social media

| Platform    | Mechanisms for Recruitment and Engagement | Hashtags Used | Social Media Activity Measurements |
|-------------|------------------------------------------|---------------|------------------------------------|
| Twitter*    | Initial recruitment: Tweet tagging       | Project main hashtag: #kidneydietchallenge | Using #kidneydietchallenge: Captured total number of posts, users, frequency of likes, retweets per tweet |
|             | Engagement: Achieved by retweets, likes from the project’s main Twitter account, and project leader personal accounts | Related hashtags: #medtwitter #nephtwitter #changeyourbuds #nephforward #FOAMed #foodismedicine #foodforthought #nephrology #knowthedata #giveitatry #kidney #kidneydisease | Measured reach, engagement, and impressions Identified influential users using project hashtag |
|             | Posting: Pictures/tweets of the daily meal prep by project leaders and participants |             | Total number of posts, reach, and impressions per hour Identified related hashtags used by our users during the challenge |
|             | Offered free online dietician consultation during the project |             | |
|             | Posted daily poll questions (knowledge check) by project leaders |             | |

*aTwitter was used as the main platform. The #nephtwitter community is mainly active on this platform.

Table 3. Challenge week schedule

| Time       | Event                                                                 |
|------------|------------------------------------------------------------------------|
| Pre-challenge | Reminder to participants                                                 |
|            | Sample menu and grocery shopping list                                   |
| Day 0      | Kidney Diet Challenge welcome, including teammate introduction and tips on survival |
| Day 1      | Dietician: Educating the patient with kidney disease                    |
| Day 2      | Live cooking demo and interview with patient                            |
| Day 3      | History of nutrition in treating kidney disease                         |
| Day 4      | Journal club and concluding remarks                                     |

The authors hosted a 1-hour webinar each evening at 7:00 pm Eastern time during the challenge week. Each webinar was recorded and shared with participants for future viewing or download and is available as an educational tool.
Keyhole was used for social media analytics, which uses Twitter’s official firehose application programming interface (API) to access the real-time data and metrics. Twitter API is a set of program endpoints that allows users to retrieve the following stats: followings, tweets, users, and impressions. Using the API, Keyhole tracks specific hashtags or keywords on Twitter to find out exactly how many times the hashtag has been mentioned, who the individuals are using the specific hashtag, and what they have said about it. It also can track aggregated engagement metrics such as reach and impressions.

Participant characteristics were summarized by median with minimum and maximum value, or frequency with percentage. The change in number of correct answers and the change in self-perceived ability to educate patients on a kidney diet (post- versus pre-challenge) were graphed for each participant. The Wilcoxon signed-rank test was used to test the null hypothesis that the number of correct answers pre and post challenge was the same and that the ability for participants to educate patients on the kidney diet was the same. The exact McNemar’s test was used to compare the percentage of participants who answered all questions correctly pre- and post-challenge. A generalized estimating equation with a logit link and unstructured correlation was used to determine whether adherence to the kidney diet depended on the day of the challenge. Among fellows, the Kruskal-Wallis test was used to compare the number of correct answers pre challenge between different fellowship years.

Results

Part 1

A total of 291 fellows responded to the optional survey associated with the Nephrology In-Training Examination (response rate 35%, N=824). An additional 26 different fellows responded to the REDCap survey advertised on social media. In all, there were 134 first-year fellows, 145 second-year fellows, 10 third-/fourth-year fellows, and 28 fellows who did not report their year (N=317) who responded to the initial survey (Part 1). The median number of correct answers on the knowledge assessment (Table 1) was 2 out of 5 (40%), and performance did not differ on the basis of training year (Figure 1; P=0.31). At the conclusion of the survey, approximately 23% (n=72) of fellows indicated willingness to learn more about and participate in the KDC.

The fellows rated their ability to advise a patient about a kidney diet (on a scale from 1 to 7, with 7 being the highest ability), with a median score of 3 (interquartile range [IQR] 2). Nearly two thirds (64%) of fellows (n=200 out of 312) rated their ability as ≤3. Less than 20% of fellows (18%; n=57 out of 315) indicated that they received formal education on a kidney diet.

After the survey was advertised on social media, 265 participants (including the 72 nephrology fellows) agreed to participate in the diet challenge, and these participants were sent a confirmatory email along with a sample 5-day diet plan.

Part 2

Of the 265 participants, 70 (26%) completed the challenge and submitted the post-week challenge survey. Table 4 provides a summary of the baseline characteristics and outcomes for all participants who completed both the pre- and post-challenge survey. Figure 2 shows the change in score (out of 100%) on the five-question medical knowledge part of the survey for each individual. After the diet challenge, the number of correct answers on the five-question knowledge survey significantly improved. The median number of correct answers pre challenge was 3 (IQR 1), and the median number of correct answers post challenge was 3 (IQR 2; Wilcoxon signed-rank test, P<0.001). The percentage of participants who answered all questions correctly did not significantly differ between the pre and post survey (4% versus 13%; exact McNemar test, P=0.11).

Figure 3 shows the change in self-reported ability to educate patients on the kidney diet for each individual. The self-reported ability to educate patients significantly improved after the challenge. On a scale from 1 to 7, with 7 being the highest ability, the median ability was 2 (IQR 3) before the challenge, increasing to 5 (IQR 1) after the challenge (Wilcoxon signed-rank test, P<0.001). On each of the first 4 days of the challenge, participants indicated their level of satisfaction with the webinar educational experience. Between 77% and 89% of participants responding were satisfied or very satisfied, with the highest satisfaction percentage (89%) reported for the live cooking demonstration and patient interview.

Diet adherence did not depend on the day of the challenge (Supplemental Material 7; P=0.57). The participants indicated that dinner was the most challenging meal to prepare (46%). Only 11% reported breakfast to be the most challenging meal to prepare, with lunch and snacks being intermediate.

Table 2 shows our methods using social media recruitment/engagement and activity analytics with trending one official hashtag throughout the project. Analyzing statistics from our official hashtag for this study (#kidneydietchallenge) showed that we achieved 406,241 reach and 1,004,799 impressions, with a total of 974 posts using this hashtag from 199 different users (Figure 4). Other related
hashtags that were trending along with the KDC official hashtag were #medtwitter, #nephtwitter, #kidneytransplant, #kidneydialysis, and #changeyourbuds. Using self-identified gender information on Twitter, 41% of the accounts were self-identified as men. Within 7 days of our Twitter account activity, we reached 290 followers.

Discussion

Dietary modification is fundamental to the management of CKD. Advice on how to modify the diet to slow disease progression is often one of the first questions a patient will ask their nephrologist. The first part of this study identified that nutrition is a knowledge gap among future nephrologists. The second part highlighted a method to engage trainees and the broader nephrology community in a learning experience that was challenging, fun, and educational.

One strength of the study was the multidisciplinary workgroup. A doctorate dietician (E.B.) with more than 6 years of experience in treating patients with kidney disease created the sample diets, participated in the evening webinars, and was available on social media to answer questions live. The live cooking demonstration was led by a nephrologist and author of a cookbook for patients with CKD (B.S.). The webinar on landmark trials in Nutrition and CKD was led by a 40-year National Institutes of Health funded researcher on this subject (W.M.). A second strength is the use of social media to encourage participants, demonstrate interest in the topic, and highlight the community nature of this study, although we cannot quantify the effect of this approach. Trending related hashtags associated with our official #kidneydietchallenge (e.g., #nephtwitter, #medtwitter, #kidneytransplant, and #changeyourbuds) suggest

| Participants (N=70) |  |
|---------------------|---|
| **Sex, n (%),**     |   |
| Women               | 49 (70) |
| Men                 | 21 (30) |
| **Type of health provider (N=69), n (%),** |   |
| Medical student     | 28 (41) |
| Resident            | 1 (1) |
| Non-nephrologist physician | 1 (1) |
| Nephrologist        | 16 (23) |
| Nephrology fellow   | 15 (22) |
| Other               | 8 (12) |
| **Previous formal training on kidney diet (N=69), n (%),** |   |
| Medical student     | 28 (41) |
| Resident            | 1 (1) |
| Non-nephrologist physician | 1 (1) |
| Nephrologist        | 16 (23) |
| Nephrology fellow   | 15 (22) |
| Other               | 8 (12) |

**Self-reported estimated adherence to diet challenge, %, median (minimum, maximum)***

| Meals and snacks adhering to diet | 73 (0, 100) |
| Meals and snacks prepared by participant | 80 (0, 100) |
| Participant reporting dietary restrictions, n (%) | 21 (30) |
| Dietary restrictions made adherence more difficult (N=21), n (%) | 10 (48) |
| Adhering to diet was difficult/very difficult, n (%) | 54 (77) |
| Palatability of diet (where 1 is least palatable and 10 is most palatable), median (IQR) | 7 (1) |

IQR, interquartile range.

*Dietary restrictions reported: two gluten-free diet; two lactose intolerance; two vegan; 11 vegetarian; six other.

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Wilcoxon signed-rank test p-value < 0.001

**Figure 2.** | Change in five-item quiz answer score (out of 100%) between pre- and post-diet challenge by individual participant.

**Figure 3.** | Change in self-reported ability to counsel patients about a kidney diet between pre- and post-diet challenge by individual participant. Scale 1–7, with 1 being the lowest and 7 the highest ability.
Figure 4. Sample image of data analytics from Twitter.
that we were able to reach a broader community on social media not limited to the nephrology community. It also suggests that there is general interest in the topic and the approach.

The first limitation to this study was the timing of the challenge week in August 2020. Participants’ may have been distracted by the global pandemic and the early academic period when trainees are adjusting to a new environment. This may be ameliorated by offering the KDC more frequently or later in the academic year. A second limitation is a selection bias introduced by open recruitment of more interested participants through social media. Another limitation is that dietary adherence was self-reported on the daily survey, introducing recall bias. In addition, without a 24-hour urinary sodium measurement, a participant may have inadvertently consumed excess sodium as hidden ingredients. The survey instruments for both the knowledge assessment and self-reported ability were not formally validated before use and only reflect knowledge gained at one time point, not necessarily retention or knowledge or skills. Furthermore, the knowledge assessment utilized the same pre- and post-test questions, introducing a learning effect bias.

Nephrologists, internists, and other health care providers must feel comfortable providing dietary instruction to patients with CKD and have the knowledge to help them make sense of advice from their dieticians. This instruction should involve more than just telling patients to avoid certain foods. A comprehensive and effective strategy involves advising patients about food substitution and flavor creation, and teaching them problem-solving strategies that are unique to each individual’s dietary challenges. The interactive educational curriculum described in our study can provide the basis for training health care providers about the intricacies of the kidney diet. It can easily be tailored to ongoing dietary guidance changes and will have the downstream effect of providing meaningful benefits to people with kidney disease. Furthermore, with the landscape of education moving toward a self-paced and online style, the KDC is well suited for this direction. The KDC also provides the framework for similar educational projects that have the potential to extend beyond nephrology to include other aspects of medicine, or even further. Important lessons learned include the impact of using social media to garner interest in an educational module, the benefit of an experiential education experience, and some of the challenges that come with virtual learning. In the future, we aim to provide multiple KDC weeks throughout the year to reach a wider audience and to accommodate the schedules of those interested. The Supplemental Material and publicly available recorded webinars (https://nerdc.org) enable nephrology training programs to utilize this educational tool in their own institution. In conclusion, the KDC is an immersive, experiential educational tool that significantly improves self-assessed confidence among volunteer participants in counseling patients for adherence to a complex kidney diet. Further assessment of this educational tool is warranted in nephrology fellowship programs. Additional training in nutrition may potentially translate into better health outcomes for patients.

Disclosures
W.E. Mitch reports other interests/relationships with the American Diabetes Association, American Heart Association, American Society of Nephrology, International Society of Nephrology, and National Kidney Foundation but does not receive compensation from these organizations. K. Pivert reports current employment by the American Society of Nephrology and the Journal of Neurosurgery Publishing Group. R. Raghavan reports consultancy agreements with PriMed and honoraria from GlaxoSmithKline and Reata Pharmaceuticals. B. Shusterman reports consultancy agreements with SOMA Strategies; ownership interest with Davita, Sanderling Dialysis, The Cooking Doc, LLC, and US Renal; and partnership with the American Kidney Fund. C. Yuan reports being an administrator and member of the Nephrology Education Research and Development Consortium (https://nerdc.org). All remaining authors have nothing to disclose.

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Author Contributions
E. Bustamante, S. Norouzi, R. Raghavan, and B. Shusterman conceptualized the study; E. Bustamante, T. La, K.S. Liu, B. Shusterman, K. Staggers, and C. Yuan were responsible for project administration; E. Bustamante, S. Norouzi, and B. Shusterman provided supervision; S. Norouzi, K. Pivert, K. Staggers, and C. Yuan curated the data; W.E. Mitch, S. Norouzi, and K. Staggers were responsible for the methodology; S. Norouzi and K. Staggers were responsible for validation; T. La and K.S. Liu were responsible for the software; K.S. Liu and R. Raghavan were responsible for funding acquisition; E. Bustamante was responsible for resources; R. Raghavan was responsible for the investigation and visualization of the study; K. Staggers undertook the formal analysis; C. Yuan wrote the original draft of the manuscript; W.E. Mitch and R. Raghavan reviewed and edited the manuscript; and all authors discussed the results and contributed to writing the final manuscript.

Supplemental Material
This article contains the following supplemental material online at http://kidney360.asnjournals.org/lookup/suppl/doi:10.34067/KID.0001162021/-/DCSupplemental.
Supplemental Material 1. ITE survey.
Supplemental Material 2. REDCap questionnaire.
Supplemental Material 3. Sample menu.
Supplemental Material 4. Daily 5-question survey.
Supplemental Material 5. Final survey.
Supplemental Material 6. Table of qualitative comments from the experience.
Supplemental Material 7. Figure: Self-reported adherence to the diet challenge.

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