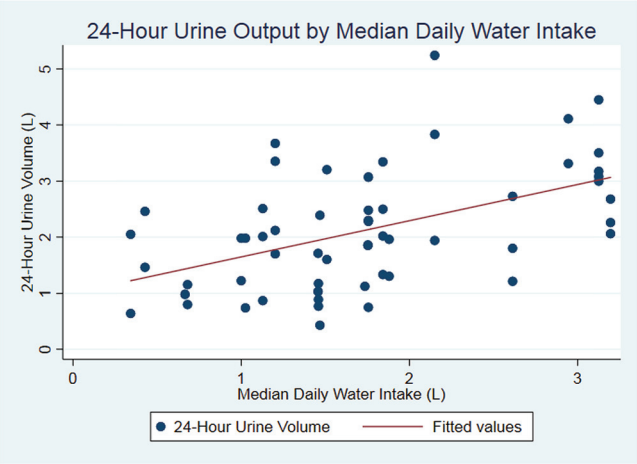
METHODS: We conducted a secondary analysis of data collected as part of the Barriers to Water Intake study, which examined daily water intake habits of 25 adolescents with nephrolithiasis. Over 7 days, participants used smart water bottles to self-monitor and record water intake. Twenty-four hour urine volumes from 12 months before and after the study period were collected via chart review for each participant. Participants' locations were obtained from mobile devices and were used to ascertain daily local wet bulb temperature for each participant during the study period. A linear regression model with a random intercept for each participant was fit to estimate the association between daily water intake and 24-hour urine volume, adjusting for age, sex, race, and daily mean wet-bulb temperature.

RESULTS: Within 12 months of the study period, 22 participants had a total of 57 24-hour urine collections obtained. Median daily water intake was 1.4 L (IQR 0.67-1.94). Median 24-hour urine volume was 2.01 L (IQR 1.20-2.73). A 1 L increase in daily water intake was associated with a 0.71 L increase in 24-hour urine output (95% CI 0.55-0.87, $p<0.001$). Applied to a hypothetical patient who needs to increase their 24-hour urine volume by 550 mL to reach a goal of 2.5 L, a clinician can recommend increasing daily water intake by 775 mL.

CONCLUSIONS: A 1 L increase in water intake increased 24-hour urine volume by 710 mL. These results can be used to develop fluid intake "prescriptions" to help adolescents with kidney stones achieve urine output goals to decrease kidney stone recurrence.



Source of Funding: K23DK106428

MP12-02

IS THERE AN APP FOR THAT? PATIENT AND PROVIDER PREFERENCES FOR PROMOTING HYDRATION WITH MOBILE PHONE APPS: A STRATEGY FOR INCREASING URINE VOLUME AND DECREASING STONE RISK

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INTRODUCTION AND OBJECTIVES: A role for mobile phone technology in healthcare is proposed. Mobile phone apps (MPAs) promoting hydration are available, but little is known about their stone-specific utility and of patient-desired features. We identified MPA features desirable for stone prevention purposes and determined patient preferences and enthusiasm for MPA technology.

METHODS: Stone clinic providers identified a reference to "fluids" (vs. only "water") and ability to individualize goals as required MPA stone prevention elements. A systematic search of the iOS App Store was then conducted between 5/2018-9/2018 using the words "fluid" and "hydration" as criteria. MPAs identified were assessed for the presence of the required stone prevention elements and then independently evaluated for characteristics related to user interface, cost, and functionality. Using an investigator-designed survey, a convenience sample of patients then rated these characteristics and overall enthusiasm for using a MPA to increase fluid intake and urine output.

RESULTS: Of 115 MPAs, 15% (n=17) were self-described as having utility for stone prevention; but only 2.6% (n=3) had the 2 elements deemed essential by providers. Surveys completed by 42 patients (18 female; 50±15/median 57y; 72% had <2.5 L urine in a recent 24-hour collection) revealed 3 important MPA functions (ranked 4-5 on a 5-point Likert scale): free download (73%), ability to set alerts (61%), and a diary function (46%), all of which were available on the 3 MPAs identified earlier. MPA features of less import to patients were: reward system (29%); smart watch adaptability (18%), pleasing graphics (17%), and a social aspect (10%). Total survey score, a surrogate measure for overall enthusiasm for MPA technology (lower score=less enthusiasm), was strongly inversely correlated with age (R= -0.52). Inverse correlations with age for a social aspect feature were also noted: strong for men (R= -0.66) and moderate for women (R= -0.53).

CONCLUSIONS: Patients identified free download, an alert system, and diary function as most important features of a hydration MPA. Providers identified reference to all fluids (vs. "water" only) and customizable intake goal as important. Few available MPAs met ideal elements for stone-specific hydration efforts. Despite the growing popularity of MPA technology, lower levels of enthusiasm with increasing age suggest that MPAs may not be suitable for older patients and thus do not obviate the need for other motivational methods that stimulate behavioral change.

Source of Funding: None

MP12-03

PROTOCOL TO DEVELOP A DIGITAL BIOMARKER TO DETECT DRINKING BEHAVIOR AMONG PATIENTS WITH KIDNEY STONES USING WRIST-WORN INERTIAL SENSORS

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INTRODUCTION AND OBJECTIVES: Compliance with increasing fluid intake to produce at least 2.5L of urine daily for stone prevention is commonly below 50%. We have previously shown that patients are interested in utilizing sensors to provide automated lapse detection in fluid intake to improve adherence to recommendations. Wrist-worn inertial sensors can detect drinking behavior with accelerometers and gyroscopes. The purpose of this study was to devise a protocol to test the ability of a wrist sensor to refine the detection of drinking behavior in everyday activities and to evaluate the recruitment process for future clinical trials.

METHODS: Patients with kidney stones were recruited to participate in the 70-minute lab sessions. Wrist sensors were worn bilaterally and participants were videotaped performing a variety of daily activities, including drinking from various vessels.

RESULTS: 36 patients with a history of kidney stones were enrolled to participate out of a total of 56 who were eligible. Six participants cancelled their appointment and we had a total of 30 participants (87% female, average age 33) that completed the lab study over 18 sessions. Table 1 highlights the amount of time spent performing protocol activities.

CONCLUSIONS: Sensor data can be collected in the laboratory to classify drinking gestures. The digital biomarker being developed in this protocol can be applied to automate lapse detection and trigger fluid intake for patients with kidney stones. Combining this automated lapse detection with evidence-based behavior change techniques may improve adherence to fluid intake recommendations and prevent recurrence of kidney stones.

Table 1. *Amount of time spent performing protocol activities*

Activity	Total Time (min)	Average Time per Person (min)
Taking picture with phone	3.4	0.1
Drinking	21.6	0.7
Phone conversation	23.1	0.8
Washing hands	32.9	1.1
Eating popcorn	38.6	1.3
Folding laundry	40.1	1.3
Drawing picture	47.2	1.6
Brush hair	52.8	1.8
Putting on lab coat/scrubs and removing	53.7	1.8
Eating meal	54.5	1.8
Brush teeth	55.8	1.9
Typing note on phone	58.7	2.0
Walking up and down hallway	62.3	2.1
Playing catch	86.0	2.9
Conversation about movie	91.5	3.1
Free writing	95.4	3.2
Surfing the internet	152.9	5.1

Source of Funding: The project described was supported by the National Center for Advancing Translational Sciences, National Institutes of Health, through Grant UL1 TR000127 and TR002014. The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH.

MP12-04

DILUTIONAL THERAPY USING THE VASOPRESSIN ANTAGONIST TOLVAPTAN FOR YOUNG PATIENTS WITH CYSTINURIA: A PILOT INVESTIGATION

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INTRODUCTION AND OBJECTIVES: Current treatments for cystinuria have limited effectiveness as well as short and long-term side effects. Dilutional therapy reduces recurrence, but many patients have difficulty maintaining high fluid intake. The vasopressin V2-receptor antagonist tolvaptan increases urinary excretion of free water. We sought to perform a pilot study of short-term safety, tolerability, and impact of oral tolvaptan on urinary stone risk parameters.

METHODS: We enrolled cystinuria patients age 12-25 yrs. Subjects were treated for 4 days at lower dose (0.3 mg/kg daily, up to 30 mg) and 4 days at higher dose (0.6 mg/kg daily, up to 60 mg). Subjects were closely monitored throughout the study period. 24 hour urine collections were done at baseline, at day 3-4 of the dosing period, at day 7-8 of the dosing period, and 3-6 days after washout. Primary outcome was cystine capacity (mg/L), a measure of supersaturation unaffected by concurrent treatment with sulfhydryl drugs. Target capacity is a positive value. Secondary outcomes included other urinary/serum parameters, tolerability, and thirst response. Subjects continued their home medical regimen (including tiopronin) during the study period.

RESULTS: 2 females (17, 23 yrs) and 2 males (13, 24 yrs) were enrolled. Cystine capacity respectively went from baseline of -312, -82, -353 and -628 mg/L to 97, 111, 75 and -3 mg/L on high dose (Figure 1). 24-hour volume went from 1.96, 3.0, 2.1 and 0.91 L to 11.74, 6.5, 9.9 and 2.8 L on high dose (Figure 2). There were no abnormalities in serum electrolytes or liver enzymes during the treatment period. Subjects did experience severe thirst, with thirst rated 9/10 on a visual analog scale, but all completed treatment and none terminated or reduced dose.

CONCLUSIONS: Dilutional therapy with tolvaptan increased both cystine capacity and urinary volumes. This treatment approach has the potential to reduce recurrence of stones in this population. Further investigation should study longer term effects and safety, and determine optimal dosing to improve tolerability.

Figure 1. Cystine capacity for four study subjects at baseline, on lower-dose tolvaptan, on higher-dose tolvaptan, and after washout.

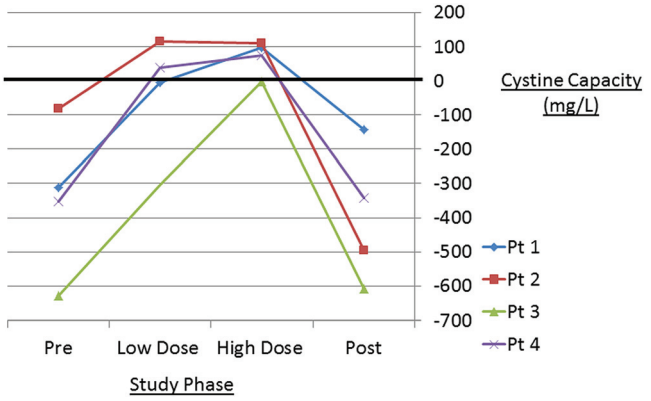
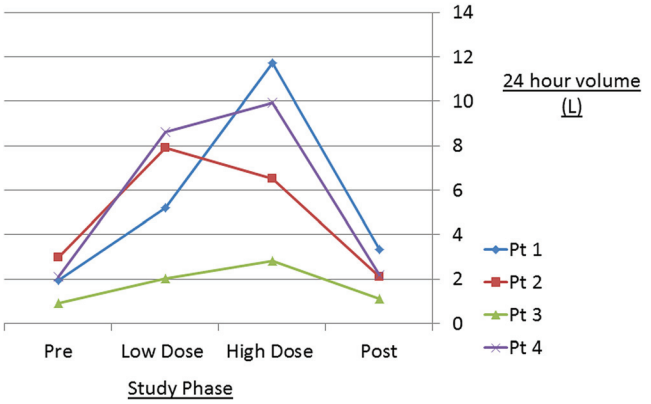


Figure 1. 24-hour urine volume for three study subjects at baseline, on lower-dose tolvaptan, on higher-dose tolvaptan, and after washout.



Source of Funding: Otsuka Pharmaceuticals provided the study drug at no cost. The authors otherwise have no financial or other interest in Otsuka or in the study medication.

MP12-05

UTILIZATION OF A SMART WATER BOTTLE TO INCREASE FLUID INTAKE IN STONE FORMERS

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INTRODUCTION AND OBJECTIVES: High dietary fluid intake is a cornerstone of kidney stone prevention; yet, is challenging to achieve. There is interest in using smart water bottles for this purpose but sparse data exists as to whether such technology leads to better outcomes relative to standard counseling. We sought to assess whether the addition of a smart water bottle to standard dietary fluid recommendations leads to improved urine volume.

METHODS: IRB approval was obtained to offer voluntary enrollment into a prospective randomized controlled trial comparing the effect of standard dietary fluid recommendations (DR) to standard DR with addition of a smart water bottle (SB) on 24 hour urine (24 hr U) volume. Eligible participants included those over age 18 with a history of nephrolithiasis and low urine volume (<1.5L) in the past 6 months. All subjects received a handout with strategies to achieve a goal urine output of 2.5 L/day. The intervention arm also received a smart water bottle (HidrateSpark, Minneapolis MN) with a sensor that recorded daily fluid intake, synced to the user's smartphone, and provided periodic reminders to drink. All patients completed a baseline survey to assess