Innovative Urinals with Proteinuria Detection: A Potential Screening Tool for Diabetic Kidney Disease

SOURABH SHARMA*, HIMANSHU VERMA†, SREE BHUSHAN RAJU‡

ABSTRACT

Chronic kidney disease (CKD) poses a considerable health challenge, particularly in populations with high-risk factors such as diabetes and hypertension. This article proposes a novel and cost-effective approach to address this concern by integrating proteinuria detection technology into urinals. We suggest the installation of these innovative 'smart' urinals in homes of individuals with diabetes, offering a convenient and proactive means of monitoring kidney health. Furthermore, the deployment of such 'smart' urinals in public places could serve as accessible screening facilities, enabling early detection of CKD in a broader population. The potential cost-benefit ratio of this approach is highlighted, emphasizing the long-term economic benefits associated with early intervention. We argue that the proposed technology has the potential to revolutionize CKD screening, providing a valuable tool for individuals at risk and contributing to the global effort to mitigate the impact of CKD on public health. Further research and pilot programs are warranted to explore the feasibility and effectiveness of this innovative screening strategy.

Keywords: Chronic kidney disease, diabetes mellitus, diabetic nephropathy, urinalysis, screening tool, public health, continuous home monitoring

Chronic kidney disease (CKD) poses a significant global health challenge, with diabetic kidney disease (DKD) being a prominent contributor.[1] Early detection and intervention are crucial in managing CKD,[2] especially in high-risk populations such as individuals with diabetes.[2] In this commentary, we propose the integration of proteinuria detection technology into urinals as a novel and cost-effective approach for screening DKD, both in home and public settings.

RATIONALE

Proteinuria is an early indicator of kidney dysfunction and a common marker for DKD.[3] Current screening methods often involve laboratory tests that may not be readily accessible or convenient for routine monitoring. The implementation of urinals equipped with proteinuria detection technology could serve as an unobtrusive and efficient means of early DKD detection.

In 2020, Park et al[4] created mountable toilet systems with readily deployable hardware and software, allowing for the collection and analysis of data related to human health. This advanced 'smart' toilet, equipped with intelligent technology, assesses urine by employing a colorimetric assay that derives red-green-blue values from images of urinalysis strips. Additionally, it utilizes computer vision as a uroflowmeter to compute urine flow rate and volume, and categorizes stool based on the Bristol Stool Form Scale.[4] Figure 1 depicts the potential abilities of proteinuria detecting 'smart' urinals.

HOME INSTALLATION

For individuals with diabetes, especially those with risk factors for CKD, having proteinuria-detecting 'smart' urinals at home could offer a proactive approach to monitor kidney health. This home-based screening tool would empower individuals to take charge of their health by enabling regular, noninvasive monitoring and

*Assistant Professor
†Professor
Dept. of Nephrology, VMMC & Safdarjung Hospital, New Delhi, India
‡Professor and Head, Dept. of Nephrology, Nizam's Institute of Medical Sciences, Hyderabad, Telangana, India
Address for correspondence
Dr Sourabh Sharma
Room No. 225, Superspeciality Block, VMMC & Safdarjung Hospital, New Delhi - 110 029, India
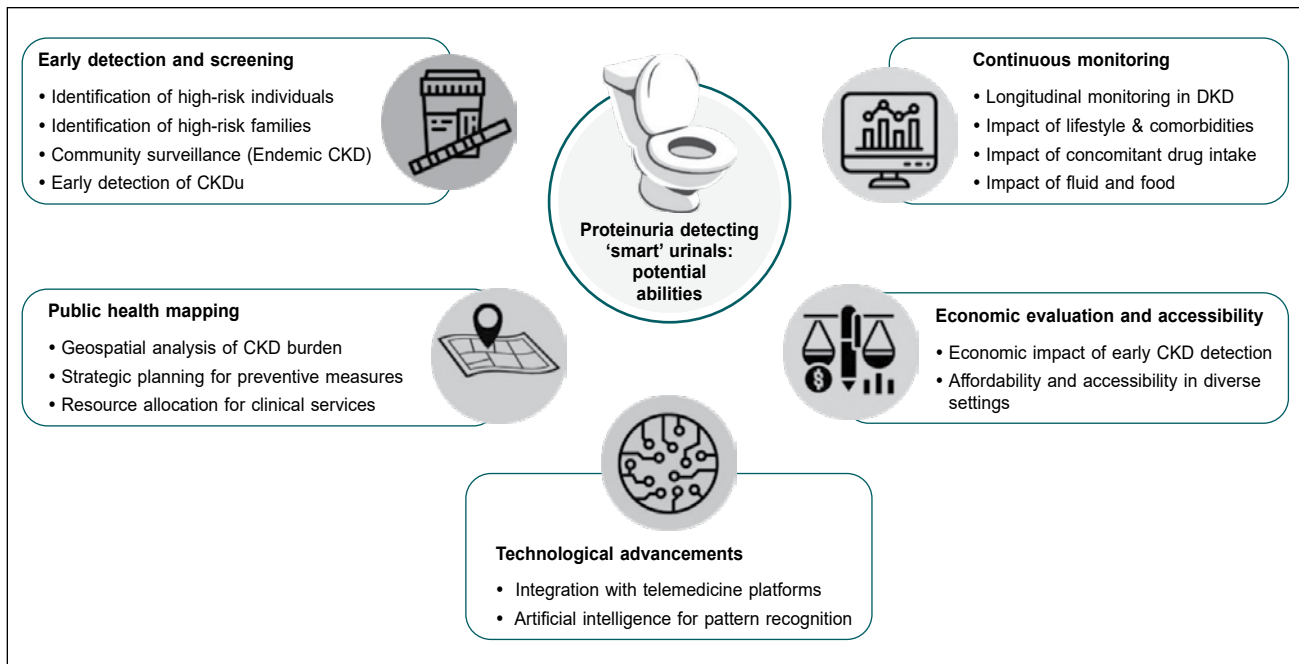E-mail: drsourabh05@gmail.com

Figure 1. Potential abilities of proteinuria detecting 'smart' urinals.

facilitating early intervention in case of abnormal results. Nonetheless, this technology can also be helpful in screening the relatives who are at higher risk of developing DKD.[5]

PUBLIC HEALTH IMPACT

Installing such urinals in public places could have a substantial impact on the early detection of CKD in the broader population. Public facilities would serve as accessible screening points, allowing individuals without prior knowledge of their CKD risk to discover potential kidney issues. Early detection may lead to timely medical intervention, reducing the overall burden of CKD and associated health care costs.[3] This is especially important for communities where CKD is endemic, i.e., endemic CKD or CKDu (CKD of unknown etiology).[6]

COST-BENEFIT RATIO

Considering the high financial burden associated with CKD treatment, the proposed proteinuria-detecting urinals offer a potentially low-cost solution for early screening and intervention. The initial investment in installing this technology could be outweighed by the long-term savings resulting from reduced CKD-related health care expenses.

CONCLUSION

In conclusion, the integration of proteinuria detection technology into urinals represents an innovative and accessible approach to screen for DKD. This proactive method has the potential to revolutionize early detection strategies, particularly for individuals with diabetes who face an elevated risk of CKD.

The implementation of such urinals at both home and public locations could contribute significantly to the global effort to mitigate the impact of CKD on public health. Further research and pilot programs are warranted to explore the feasibility and effectiveness of this novel screening approach.

Authorship Confirmation/Contribution Statement: SS and SK were involved in literature search, planning, conduct and writing the original draft of manuscript. SS, SK, SBR and HV were involved in editing of the study. All the authors have agreed with the submitted manuscript. SS is corresponding author and guarantor for all.

REFERENCES

1. Thomas MC, Brownlee M, Susztak K, Sharma K, Jandeleit-Dahm KA, Zoungas S, et al. Diabetic kidney disease. Nat Rev Dis Primers. 2015;1:15018.

2. Nagib SN, Abdelwahab S, Amin GEE, Allam MF. Screening and early detection of chronic kidney disease at primary healthcare. Clin Exp Hypertens. 2021;43(5):416-8.

3. Gorriz JL, Martinez-Castelao A. Proteinuria: detection and role in native renal disease progression. Transplant Rev (Orlando). 2012;26(1):3-13.

4. Park SM, Won DD, Lee BJ, Escobedo D, Esteva A, Aalipour A, et al. A mountable toilet system for personalized health monitoring via the analysis of excreta. Nat Biomed Eng. 2020;4(6):624-35.

5. Carpena MP, Rados DV, Sortica DA, Souza BM, Reis AF, Canani LH, et al. Genetics of diabetic nephropathy. Arq Bras Endocrinol Metabol. 2010;54(3):253-61.

6. Arambegedara D, Jayasinghe S, Udagama P. Multi-pronged research on endemic chronic kidney disease of unknown etiology in Sri Lanka: a systematic review. Environ Sci Pollut Res Int. 2022;29(4):4893-910.

■ ■ ■ ■

Childhood Atopic Dermatitis and Risk of Nonatopic Comorbid Conditions

Children and adolescents with atopic dermatitis (AD) are at high risk of developing multiple nonallergic comorbid conditions, in addition to allergic conditions, as per the findings of a study published in the *Journal of The European Academy of Dermatology & Venereology*.[1,2]

This retrospective observational cohort study utilized data of patients, aged ≤18 years, with confirmed AD from primary and specialist care registers in Sweden between 2007 and 2017 to assess their risk of developing various comorbid conditions, both allergic and nonallergic. Type 1 diabetes (T1D), endocrine and metabolic disorders, skeletal disorders, ocular disorders, infections, neurological disorders, psychiatric disorders, immunological and inflammatory disorders and malignancies were among the conditions assessed. Out of the 1,65,145 patients included in the study, 1,26,681 had mild to moderate AD, mean age 5.13 years at the time of enrollment, and 38,464 had severe AD, mean age, 6.33 years. They were matched 1:1 with an equal number of participants without AD selected randomly from the general population as controls. The study group was followed up till December 2018.

Compared to the control group, patients with AD were at a greater risk of developing comorbid conditions for all the categories of disease conditions evaluated, with the exception of T1D and skeletal disorders. Results showed that 36.6% of AD patients had developed at least one comorbid condition during the follow-up versus 28.5% in the control group. The most common comorbid conditions were hypersensitivity and allergic disorders, which occurred in 18.5% of patients in the AD group versus 10% of patients in the control group. The next most commonly occurring comorbid conditions were infections (18.35% vs. 5.29%) followed by skeletal disorders (13.2% vs. 9.65%).

Patients with AD were at least thrice more likely to develop hypersensitivity and allergic disorders versus control group with HR of 3.87. The risk for immunological and inflammatory disorders as well as malignancies was more than doubled with HRs of 2.36 and 2.53, respectively.

Additionally, patients with AD were at a higher risk of developing several comorbid conditions. Of these, 27.1% of the AD patients and 19.7% of non-AD group developed more than two comorbidities. Active AD (vs. in remission) was associated with higher risk of comorbidity onset. As the severity of AD increased, the probability of developing a comorbidity increased.

AD constitutes a significant clinical burden in the affected children. This study shows that the risk of developing multiple comorbid conditions in addition to the atopic march is significantly increased in children with AD. The atopic march starts with AD and progresses to IgE-mediated food allergy, asthma and allergic rhinitis. Additionally, these findings demonstrated a positive correlation between the escalating severity of AD and the higher chances of the onset of comorbidity. AD is being recognized as a multiorgan disease. This study further adds to the growing evidence regarding this. Hence, it should be viewed as a systemic disease. Children with AD should be evaluated for other disease conditions and managed accordingly.

References

1. von Kobyletzki L, et al. Comorbidities in childhood atopic dermatitis: a population-based study. J Eur Acad Dermatol Venereol. 2023 Oct. 12.

2. Ron Goldberg. Dated November 21, 2023. Available at: https://www.dermatologyadvisor.com/home/topics/dermatitis/children-with-atopic-dermatitis-have-an-increased-risk-for-non-atopic-comorbidities/. Accessed November 30, 2023.