Management of Chronic Health Conditions: Passive Monitoring and Anomaly Detection for Diverticulitis

Why it matters: Nearly 95% of older adults (age 65+) have at least one chronic health condition, with close to 80% having 2 or more chronic conditions.[1] Effective management of these conditions can reduce the risk of exacerbations, hospitalizations, and overall healthcare costs as well as improve outcomes and older adults' quality of life. However, obtaining an accurate assessment of the condition's impact on an older adult's functioning, determining an appropriate intervention, and evaluating the effectiveness of treatment can be challenging. The Sovrinti system's passive monitoring provides older adults, their loved ones, and medical professionals with continuous, objective data for the more-efficient management of chronic conditions.

Background: The Sovrinti system utilizes high temporal, spatial, and device use change recognition to autonomously identify and quantify activities of specific individuals in a private residence or senior living facility. The examples shown are from a completed (2020 – 2023) National Institute on Aging Phase II research study (R44AG065118) where the Sovrinti system was installed in the residences of 124 older adults to identify changes in daily activities (ADLs).

The charts below represent data from an 83-year-old female "Care Recipient" (CR) living alone in a two-bedroom, one-bathroom apartment. Her primary physical complaint related to chronic struggles with diverticulitis. The CR received 6 hours per week of assistance from a volunteer caregiver and had the Sovrinti system installed in her residence for 8 months. The caregiver (CG) also completed monthly phone surveys regarding the CR's health and ADL performance. These surveys were intended to provide comparative data for the validation of the Sovrinti system.

Example data: Figure 1 shows bathroom activity for the CR from 3/11/22 – 8/8/22. The green band represents what is considered normal (± 1 standard deviation) bathroom usage for this specific CR. The yellow and red bands represent statistical variations from the CR's norm: 1-2 standard deviations and 2+ standard deviations, respectively. The total number of daily bathroom events ranged from 6 to 25, with the CR averaging 13 bathroom events per day.

The sharp increases in toilet usage that can be seen in the data usually corresponded with the CG's report that the CR experienced a diverticulitis flare-up. During a survey on 4/15/22, the CG reported that the CR had "not been doing as much" in the past 4 weeks because of her diverticulitis. Looking at the bathroom event data, we can infer with high confidence that the CR had a flare-up on 4/4/22, with the event count at 25. The event count was also into the yellow band on nearby dates, indicating above-average bathroom usage.

Figure 2 depicts time of day data for the 4/4/22 flare-up, with the blue dots representing the day's flushes on the face of a 24-hour clock. The data reflects a higher concentration of flushes from 8-10am followed by 1-2 flushes every hour from 1-8pm. Time of day data such as this could aid in identifying diverticulitis triggers (e.g., certain foods at breakfast, lunch, or dinner), treatment impacts (e.g., how the timing of a medication impacts toileting), and sleep interruptions (i.e., how many flushes occurred during nighttime hours).

The next month, the CG shared that the CR went to the hospital on 5/6/22 where she was put on an antibiotic and liquid diet – the impact of which is likely seen in the spike in bathroom usage on 5/8/22. Also of note is the sharp increase in bathroom usage on 4/21/22. This represents a likely diverticulitis flare-up not specifically reported by the caregiver, which illustrates the utility of the Sovrinti system to pinpoint incidents and allow for better-informed, more targeted treatment.

Meanwhile, the 3 instances where the flush count is in the red band for June reflect the CR's statement during a check-in on 6/28/22 that she had been "frustrated" and "depressed" by continued struggles with diverticulitis during the previous month. While the CR's subjective reporting is valuable, the objective, quantitative data offered by the Sovrinti system bolsters her accounts of the previous months.

Summary: In these examples, individualized bathroom behavior is identified for an 83-year-old female with diverticulitis. Bathroom event data shows relatively stable toilet usage interrupted by significant increases associated with diverticulitis flare-ups. The Sovrinti system allows for alerts to be established that would notify care providers of anomalous bathroom usage that may necessitate intervention. Additionally, medical professionals can utilize the Sovrinti system's objective data to make informed decisions regarding treatment, thereby supporting older adults' aging in place.

For further analysis: Corresponding mobility, real time location, and event (e.g., appliance and electronics usage) data is available for greater insight into bathroom habits and overall health. Additional analyses might investigate the timing of toilet usage (i.e., daytime versus nighttime) and changes in the CR's activity levels surrounding diverticulitis flare-ups.

Sources

1. National Council on Aging. Chronic Inequities: Measuring Disease Cost Burden Among Older Adults in the U.S. A Health and Retirement Study Analysis. Page 5, Figure 2. April 2022. Available at https://ncoa.org/article/the-inequities-in-the-cost-of-chronic-disease-why-it-matters-for-older-adults
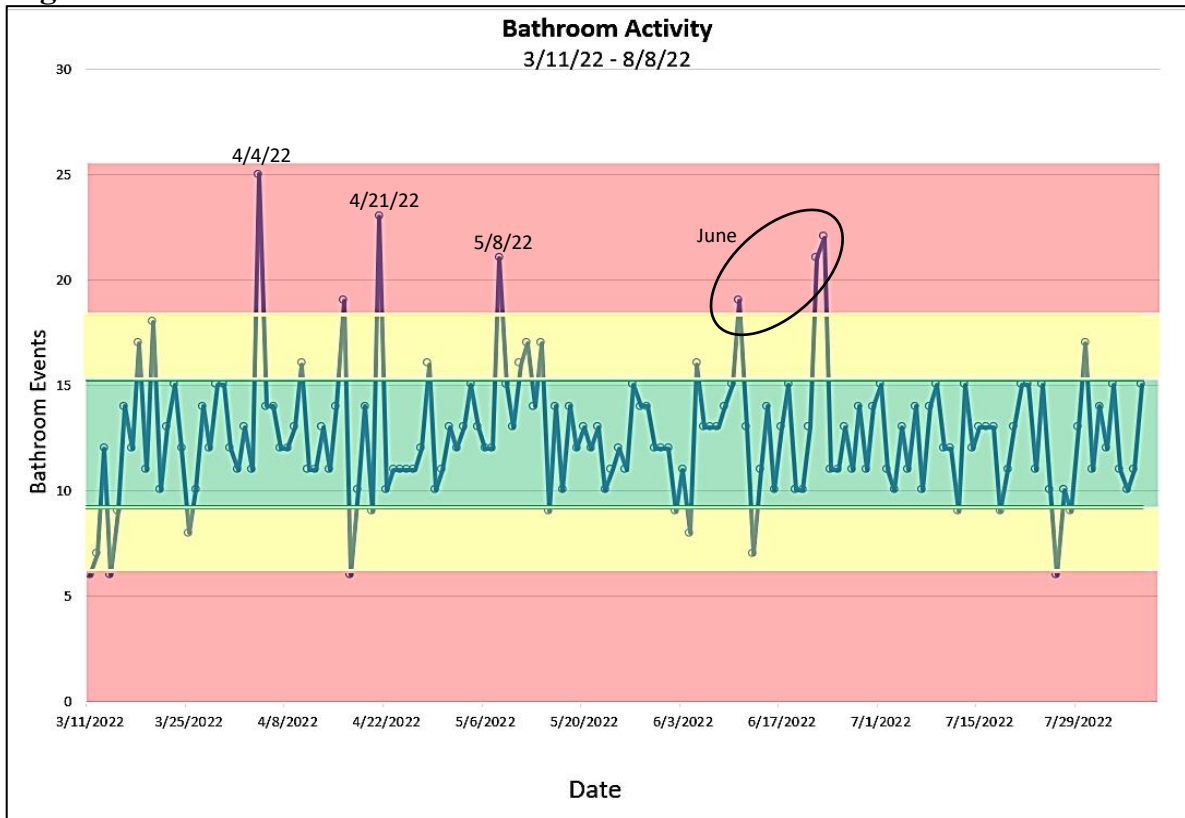
Figure 1

Bathroom Activity
3/11/22 - 8/8/22

Figure 2

Bathroom Usage time of day 4/4/2022