

The virtual home hospital septic stone discharge pathway: Results following implementation at a single Canadian centerMatthew Mancuso¹, Sabrina Pattar¹, Patrick Albers¹, Michael Jacka², Nathan Hoy¹¹Division of Urology, University of Alberta, Alberta, AB, Canada; ²Department of Critical Care Medicine, University of Alberta, AB, Canada

Cite as: Mancuso M, Pattar S, Albers P, et al. The virtual home hospital septic stone discharge pathway: Results following implementation at a single Canadian center. *Can Urol Assoc J* 2026 October 19; Epub ahead of print <http://dx.doi.org/10.5489/cuaj.9749>

Published online October 19, 2026

Corresponding author: Dr. Matthew Mancuso, Division of Urology, University of Alberta, Alberta, AB, Canada; mmancuso@ualberta.ca

ABSTRACT

Introduction: Traditionally, patients with septic stones (SS) remain hospitalized until clinically stable and culture-directed oral antibiotic therapy can be initiated, leading to a prolonged hospital stay after source control. A novel virtual home hospital (VHH) pathway was introduced to enable early discharge with physician oversight, including lab work and home-based intravenous antibiotics pending rationalization. Our primary objective was to assess length of hospital stay (LOS). Secondary objectives included representation rates and other complications.

Methods: A total of 137 SS patients were retrospectively analyzed at the University of Alberta, of which 37 were enrolled in the VHH pathway. Collected data included demographics, clinical course details, blood culture results, admission timelines, and unplanned healthcare visits.

Results: No demographic differences were noted between groups. Intensive care unit admission occurred in more non-VHH patients compared to VHH patients (17% vs. 3%, $p=0.03$). Significantly more positive blood cultures were noted in the non-VHH group (49% vs. 24%, $p=0.009$). Mean LOS was significantly shorter in the VHH group (3.8 vs. 2.3 days, $p=0.005$). Mean antibiotic duration was shorter in the VHH group (12.3 vs. 10.2 days,

KEY MESSAGES

- The virtual home hospital discharge pathway is safe.
- This pathway has led to reduced LOS and antibiotic duration.
- The patients in this pathway are generally not as clinically unwell.

$p < 0.001$). No significant differences were observed for emergency or clinic representations ($p = 0.77$, $p = 0.06$).

Conclusions: Preliminary results suggest that a novel VHH pathway is a feasible and safe approach for managing SS patients. With implementation of the VHH pathway, there was a significantly shorter LOS and antibiotic duration, which may be secondary to closer outpatient followup and antibiotic rationalization. This has the potential to free up in-patient hospital resources in a resource-limited socialized healthcare system.

INTRODUCTION

Kidney stone disease remains a common problem faced by many patients, with an estimated prevalence of up to 15% (1). From a Canadian perspective, recent work has demonstrated an increase of 4.7% in kidney stone episodes during a 5-year study period (2). Resultantly, emergency department (ED) presentations and healthcare utilization have become increasingly burdened; national US data have shown an estimated 3.6 million ED visits from 2006-2009 for upper tract stones, with an increasing incidence throughout that time (3). Reflective of this trend is the estimated \$5 billion in stone-related ED charges in the US, in 2009 alone (3).

A portion of those that present to ED with kidney stone disease, have evidence of an obstructing stone with concomitant urinary tract infection, referred to as “septic stones.” This phenotype represents an acute, emergent situation in which rapid source control and initiation of broad-spectrum IV antibiotics are necessitated. Clinical guidelines recommend urgent renal decompression via ureteric stent or nephrostomy tube, as conservative measures alone are unlikely to be successful without source control (4). These patients can rapidly deteriorate and progress to septic shock with multi-organ dysfunction, further necessitating resuscitation and ICU admission. In a large US inpatient analysis, delayed decompression (≥ 2 days) in patients with septic stones was independently associated with higher in-hospital mortality (5). Further, data have demonstrated that rates of sepsis and severe sepsis in this cohort of patients has also increased with time, over a 1999 to 2009 period (6). While local practices differ greatly in selection of nephrostomy tube versus ureteric stent insertion, patients often rapidly improve once source control is achieved. Hospital capacity constraints have underscored the importance of safely expediting patient discharge without compromising care in this setting. Oftentimes, culture-directed oral antibiotic rationalization remains the final barrier to discharge, which can take several days. Thus, a large proportion of these patients remain admitted to hospital for ongoing monitoring, while final culture sensitivities are pending.

At the University of Alberta, our practice includes urgent stenting preferentially to nephrostomy tube placement, and admission to the surgical urology inpatient service. In a publicly funded healthcare system, resource allocation is crucial. Traditionally, septic stone patients have remained admitted until clinical stabilization and cultures with sensitivities have been reported with subsequent antibiotic rationalization. The virtual home hospital (VHH) septic

stone discharge pathway was created as a means to discharge patients faster. Once discharged from hospital, patients maintain a “virtual bed”, and are remotely monitored by a physician. Emergency medical services (EMS) personnel visit these patients in their home daily, collect bloodwork, administer IV antibiotics, and record vital signs which are reviewed by the overseeing physician. Pharmacy and nursing support is also included in the pathway in a collaborative effort to address further needs. From the comfort of their own homes, patients are then rationalized to oral antibiotics, once final sensitivities are reported, and may be discharged from the program pending the physician’s discretion. The flow of patients through the VHH pathway is outlined in Figure 1, which also outlines the clinical criteria for inclusion in the pathway.

METHODS

From the VHH implementation in June 2024, to October 2025, 137 septic stone patients at the University of Alberta, were retrospectively reviewed. Institutional research ethics board approval was confirmed prior to initiation (PRO00150475). Data collected included demographics, clinical course during admission, if ICU admission was required, blood and urine culture results, means of decompression, antibiotic choice and duration, re-presentation to ED, unscheduled clinic phone calls, and any other complications. For the 37 patients within the VHH pathway, their virtual LOS was also included. Descriptive statistics, unpaired t-tests and chi squared tests were utilized where appropriate. All analyses were done within SPSS software.

RESULTS

There were no statistically significant differences in age ($p=0.93$) or gender ($p=0.45$) between the non-VHH and VHH cohorts. Similarly, no differences existed in the methods of attaining renal decompression, with 92% non-VHH and 100% VHH undergoing stent placement, compared to 8% and 0% undergoing nephrostomy tube placement ($p=0.20$). 17 (17%) non-VHH patients required ICU admission, while only 1 (3%) VHH patient did ($p=0.03$). Positive blood culture results were significantly different between groups, occurring in 49 (49%) non-VHH patients compared to 9 (24%) VHH patients ($p=0.009$). Additionally, the length of stay was significantly longer in the non-VHH compared to the VHH groups; 3.8 ± 3 days vs 2.3 ± 2.3 days respectively ($p=0.005$). Finally, total duration of antibiotics was significantly longer in the non-VHH group at 12.3 ± 2.8 days compared to 10.2 ± 3.1 days for the VHH group ($p < 0.001$). See table 1 for additional healthcare utilization features.

DISCUSSION

Nephrolithiasis remains a significant global healthcare burden. When an obstructing stone is paired with a concurrent urinary tract infection, these “septic stone” patients are urologic emergencies that require emergent decompression for source control. With variable clinical courses sometimes necessitating ICU admission, patients oftentimes convalesce well once ureteric stent or nephrostomy tube placement is achieved. A patient’s admission timeline is often dictated by culture results predicated the switch to oral antibiotics.

Hospital capacity, bed constraints, and limited resources are constant issues faced within publicly funded health care systems. In an effort to alleviate this, the virtual home hospital discharge pathway was created and implemented at our institution for septic stone patients. By reallocating resources from an inpatient to an outpatient “virtual bed”, the goal was to achieve expedited discharge safely, without increasing downstream healthcare utilization like emergency room and ambulatory clinic visits.

137 patients with septic stones from June 2024 to October 2025 were retrospectively reviewed. Of the 37 that went through the VHH pathway, we found there to be a significant reduction in LOS, antibiotic duration, and no increase in adverse outcomes or re-presentation rates. We additionally found these patients to be admitted to the ICU at a lower rate than the non-VHH counterparts, which will be discussed below.

Our primary finding of decreased LOS logically makes sense; an expedited discharge equates to a reduced length of hospital stay. We accounted for LOS based on the calendar date, regardless of time of day. The most significant contributor to this decreased LOS is patients are no longer having to wait in hospital for final cultures and sensitivities. They can be discharged home on IV antibiotics and then be stepped down to oral antibiotics as an outpatient. Another factor contributing to the decreased LOS is the ability to discharge patients home with vital sign monitoring as an outpatient. VHH has EMS personnel check on the patient daily and can give IV antibiotics and fluids. Though not as intensive as the monitoring that occurs in hospital, the vast majority of patients who get through the most acute phase of urosepsis with a septic stone do well with this level of care. Given the significant difference of 3.8 ± 3 days vs 2.3 ± 2.3 , we hope to strengthen the robustness of this program and increase stakeholder buy-in from administration with objective data, highlighting real change. As the pathway demonstrates success, we aim to increase the number of patients enrolled in the VHH and make this part of the standard practice. With emergency rooms full and wait times exacerbated by bed shortages, patient care is oftentimes delayed. The VHH program is utilized by other services within our centre, including medicine, nephrology, general surgery and more. While the septic stone pathway was the first partnership with our urology service, its success may yield future pathways for other clinical scenarios.

There remains a large knowledge gap in terms of antibiotic duration post septic stone decompression; no guideline or recommendations exist, and there are currently no available randomized or high-quality trials prospectively examining antibiotic duration. Within the available literature, one study examined sepsis in the post-operative period following definitive stone surgery, and noted the incidence was higher for those receiving less than 14 days (7). A similar retrospective review found that of 215 septic stone patients included, the median antibiotic duration was 13 days, however duration did not impact post stone-surgery urosepsis rates (8). Finally, a retrospective observational study from a Canadian centre, could also provide no insight into antibiotic duration following septic stone decompression (9). We believe that given these patients remained in a monitored “virtual bed”, with ongoing daily labs, vitals, and assessment by medical professionals, antibiotic discontinuation could be done more confidently,

and earlier. Given the global implications of rising resistance patterns, antimicrobial stewardship should be emphasized and sought whenever possible. We feel as though this pathway does in fact enable stringent antibiotic use and has the potential to aid in local resistance patterns.

While the VHH pathway aimed to expedite discharge, its safety profile and prevention of subsequent healthcare utilization downstream were secondary objectives. We feel as though the VHH pathway has proven to be a safe option, given no major complications were faced by any of the 37 patients enrolled. We reviewed for any >2 Clavien-Dindo complications, of which there were none, providing evidence it is a safe means of virtually monitoring patients. Further, rates of ED visits, and clinic presentations were not statistically different between groups. This further bolsters the VHH pathway as a prudent way to reallocate healthcare utilization without causing an uptick in downstream consequences. Future directions of the VHH pathway will include cost analysis to assess for potential monetary savings that could be used in other patient care domains. Additionally, a prospective randomized trial comparing the VHH pathway to the standard inpatient management pathway would be the next step in assessing the outcomes from this initiative.

Our study is not without limitations. First, the retrospective nature of our study is a limitation of itself. Second, after the implementation of the VHH pathway, we were slow to initiate enrollment, resulting in lower than expected numbers. This may be in part to buy-in from all urologists at our centre, in addition to the mere fact of any systems change requiring time for implementation. Further, patients who were enrolled in the VHH pathway were admitted to the ICU at a significantly lower rate and had a lower rate of bacteremia which would indicate a less sick population overall. This may introduce an element of bias in our results, however for those who required the ICU, their antimicrobial rationalization was likely reported by the time they were transferred to the ward or ready for discharge, precluding their need for VHH.

CONCLUSIONS

This study provides early data that a VHH pathway is likely a safe means for expedited discharge for septic stone patients that have achieved renal decompression. Given the significant reduction in antibiotic duration, the VHH pathway is a tenable means of antimicrobial stewardship. While hospital LOS was significantly less in our VHH cohort, these patients likely represent a phenotype that is not as clinically unwell, given their reduced rates of positive blood cultures and ICU admission. In a resource limited environment, we have demonstrated that a VHH pathway can free up valuable inpatient bed resources.

REFERENCES

1. Pearle MS, Lotan Y. Urinary lithiasis: Etiology, epidemiology, and pathogenesis. In: Campbell-Walsh Urology. 2012:1363-92.

2. Ordon M, Powers AL, Chew BH, et al. Incidence and trends in the treatment of kidney stones in Canada: A population-based cohort study. *Can Urol Assoc J* 2024;18:158. <https://doi.org/10.5489/cuaj.8596>
3. Ghani KR, Roghmann F, Sammon JD, et al. Emergency department visits in the United States for upper urinary tract stones: Trends in hospitalization and charges. *J Urol* 2014;191:90-6. <https://doi.org/10.1016/j.juro.2013.07.098>
4. Pearle MS, Matlaga BR, Antonelli JA, et al. Surgical management of kidney and ureteral stones: AUA guideline (2026) part I: Evaluation and treatment of patients with kidney and/or ureteral stones. *J Urol* 2023.
5. Haas CR, Li G, Hyams ES, et al. Delayed decompression of obstructing stones with urinary tract infection is associated with increased odds of death. *J Urol* 2020;204:1256-62. <https://doi.org/10.1097/JU.0000000000001182>
6. Sammon JD, Ghani KR, Karakiewicz PI, et al. Temporal trends, practice patterns, and treatment outcomes for infected upper urinary tract stones in the United States. *Eur Urol* 2013;64:85-92. <https://doi.org/10.1016/j.eururo.2012.09.035>
7. Yoo JW, Lee KS, Chung BH, et al. Optimal duration of preoperative antibiotic treatment prior to ureteroscopic lithotripsy to prevent postoperative systemic inflammatory response syndrome in patients presenting with urolithiasis-induced obstructive acute pyelonephritis. *Investig Clin Urol* 2021;62:681. <https://doi.org/10.4111/icu.20210160>
8. Orr A, Awad M, Johnson N, et al. Obstructing ureteral calculi and presumed infection: Impact of antimicrobial duration and time from decompression to stone treatment in developing urosepsis. *Urology* 2023;172:55-60. <https://doi.org/10.1016/j.urology.2022.10.010>
9. Béïque L, Witherspoon L, Zvonar R, et al. Duration of antibiotic therapy in sepsis secondary to urinary stones: A retrospective observational study. *Can J Hosp Pharm* 2018;72:331. <https://doi.org/10.4212/cjhp.v72i4.2921>

FIGURES AND TABLES

Figure 1. VHH septic stone pathway (EZVHH= Edmonton zone virtual home hospital). Having been implemented in 2024, this retrospective review aims to analyze and critically appraise this pathway as a means of quality improvement. With the potential to change local practices and thereby impact a larger systems-based issue, we hoped to provide evidence on the safety and efficacy of this pathway, without compromising patient care or experience. The primary objective was to discern whether the VHH pathway had a significant impact on inpatient LOS, while secondary objectives included re-presentation to ED, unscheduled clinic phone calls/appointments, and further complications.

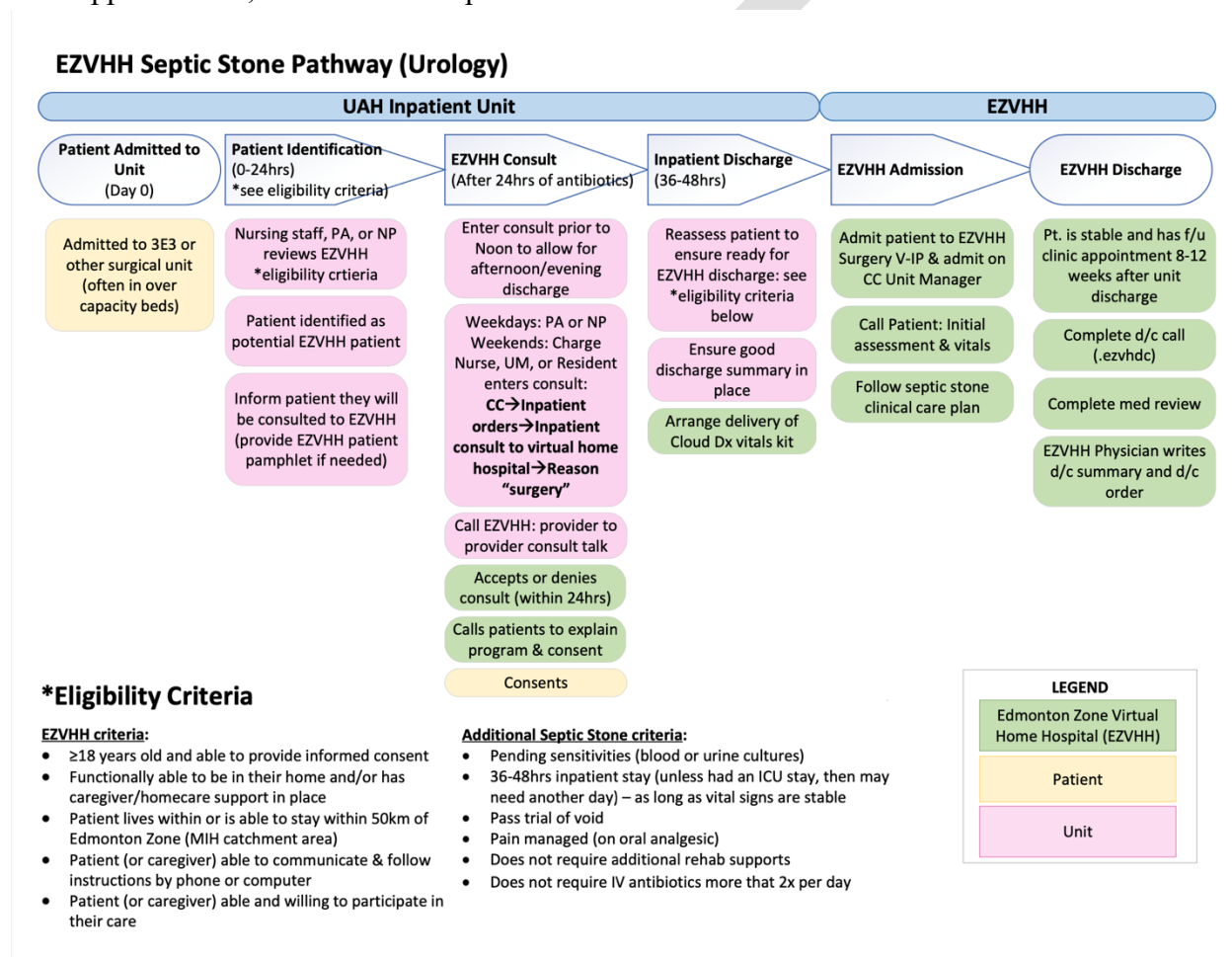


Table 1. Demographics, clinical course, and healthcare utilization characteristics

	Non-VHH (n=100)	VHH (n=37)	p
Age, mean (SD)	58.9 (16.1)	58.6 (15.7)	0.93
Gender (male), (%)	31 (31)	14 (38)	0.45
Method of drainage, (%)			0.20
OR	70 (70)	26 (70)	
Cystoscopy	22 (22)	11 (30)	
Nephrostomy Tube	8 (8)	0 (0)	
ICU stay, (%)	17 (17)	1 (3)	0.03
Laterality, (%)			<0.001
Left	48 (48)	7 (19)	
Right	46 (46)	21 (57)	
Bilateral	6 (6)	9 (24)	
Positive blood culture, n(%)	49 (49)	9 (24)	0.009
Length of hospital stay (days), mean (SD)	3.8 (3.0)	2.3 (2.3)	0.005
Time to surgery (days), mean (SD)	35.3 (22.3)	28.7 (12.1)	0.10
Length of Abx (days), mean (SD)	12.3 (2.8)	10.2 (3.1)	<0.001
Re-presentation prior to URS, n (%)	13 (13)	4 (11)	0.77
Clinic phone call prior to URS, n (%)	21 (21)	13 (38)	0.06
Other complication, n (%)	8 (8)	1 (3)	0.28

Bolded values indicate statistical significance. Abx: antibiotics; ICU: intensive care unit; OR: operating room; SD: standard deviation; URS: ureteroscopy; VH: Virtual Home Hospital.