



INJURY EPIDEMIOLOGY & BACTERIOLOGIC CHARACTERISTICS OF INPATIENT BONE, JOINT & SOFT TISSUE WOUND INFECTIONS IN HANOI, VIETNAM

Chu Thanh Binh¹, Nguyen Kien Cuong¹, Ha The Tan¹, Nguyen Van Thanh¹, Pham Thi Kim Nhung¹, Nhu Manh Thu², Do Hai Linh³, Nguyen Thanh Long³, Huy C. Nguyen⁴, Robert J. Carpenter⁴, Andrew G. Letizia⁴

¹Military Institute of Preventive Medicine, Vietnam; ²Military Hospital 354, ³Military Hospital 105, ⁴U.S. Naval Medical Research Unit INDO PACIFIC



Background / Introduction

Antimicrobial resistance (AMR) is a growing global health threat, and Vietnam is recognized as a regional Southeast Asia hotspot for drug-resistant infections. Surgical site infection (SSI) rates following emergency trauma surgery most commonly due to motor vehicle accidents range from 5 - 16% in Vietnam. This study evaluate wound characteristics, microbiology, and risk factors associated with wounds and surgical infections in Vietnam to better characterize the threat they play to medical readiness.

Methods

Patients with bone, joint, or soft-tissue injuries requiring surgery at two military hospitals (MH105 and MH354) in northern Vietnam were enrolled from May–September 2025 and followed for 30 days postoperatively. Wound cultures were collected at presentation, and clinical data were recorded at enrollment and during follow-up. Patients with suspected SSI underwent repeat wound sampling.

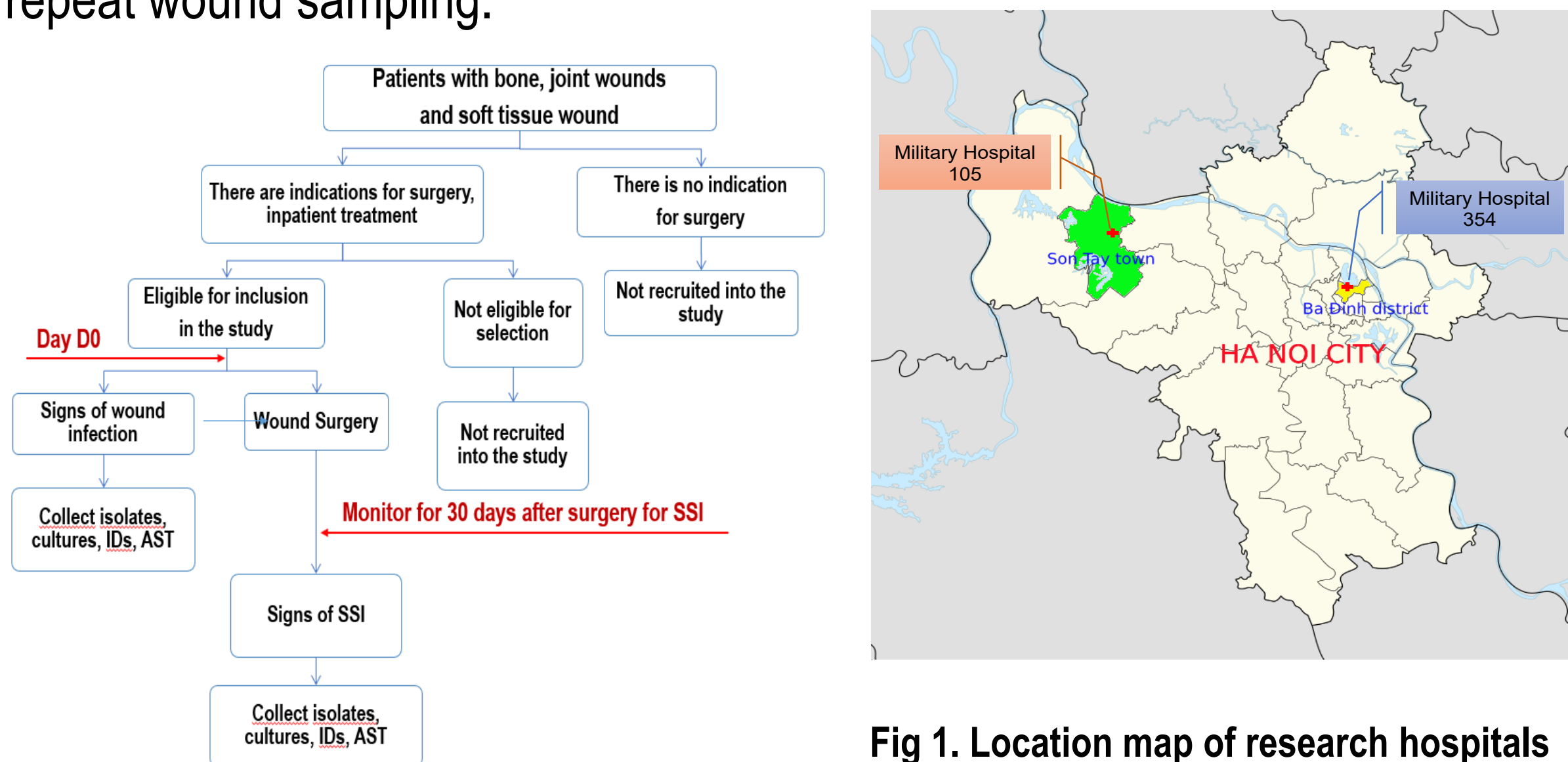


Fig 1. Location map of research hospitals

Fig 2. A flow diagram of the detailed research process

Identification (ID)

Agar plates that show visible growth will be exposed to bacteriological testing, whereas agar plates that do not show significant growth of bacteria will be re-incubated and monitored daily for up to seven days. Identification testing will be conducted on VITEK® 2 COMPACT.

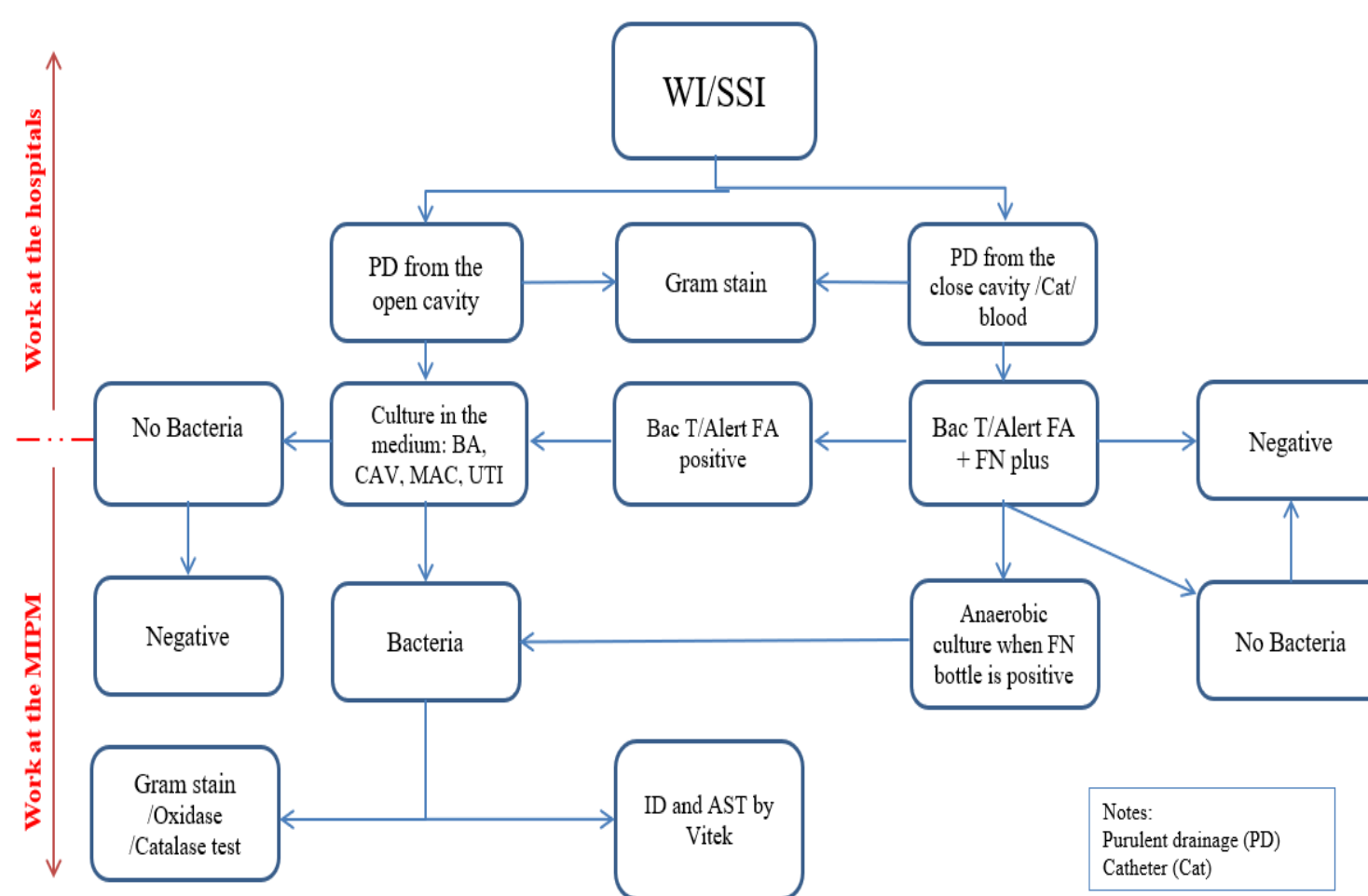
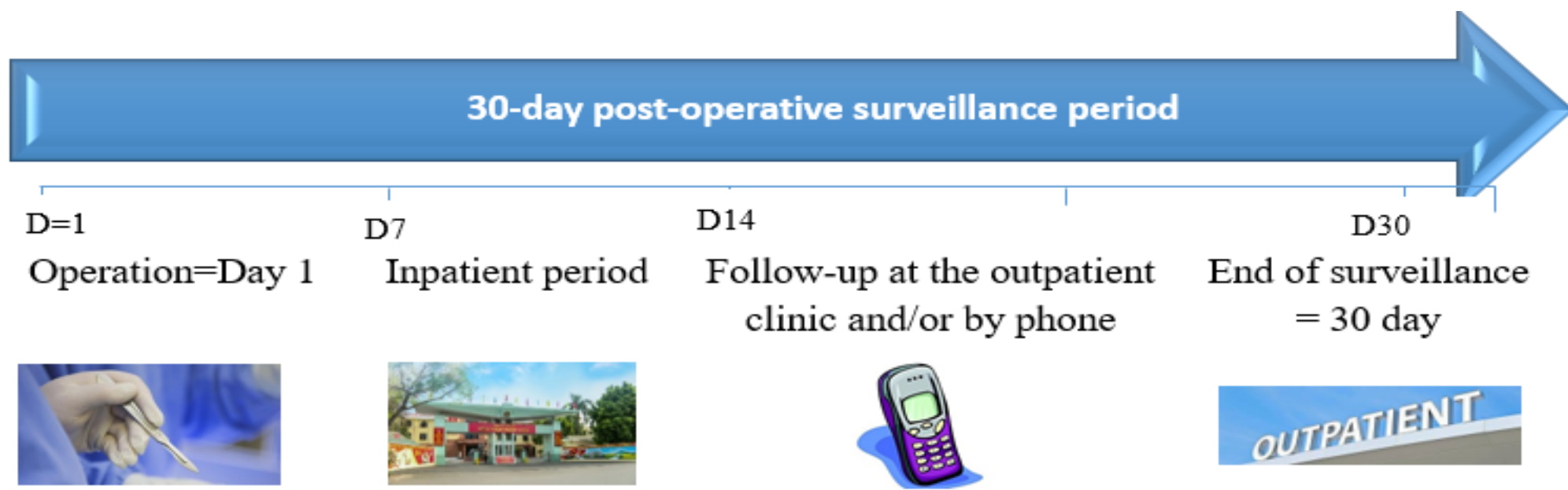


Fig 3. A flowchart of microbiological testing procedure

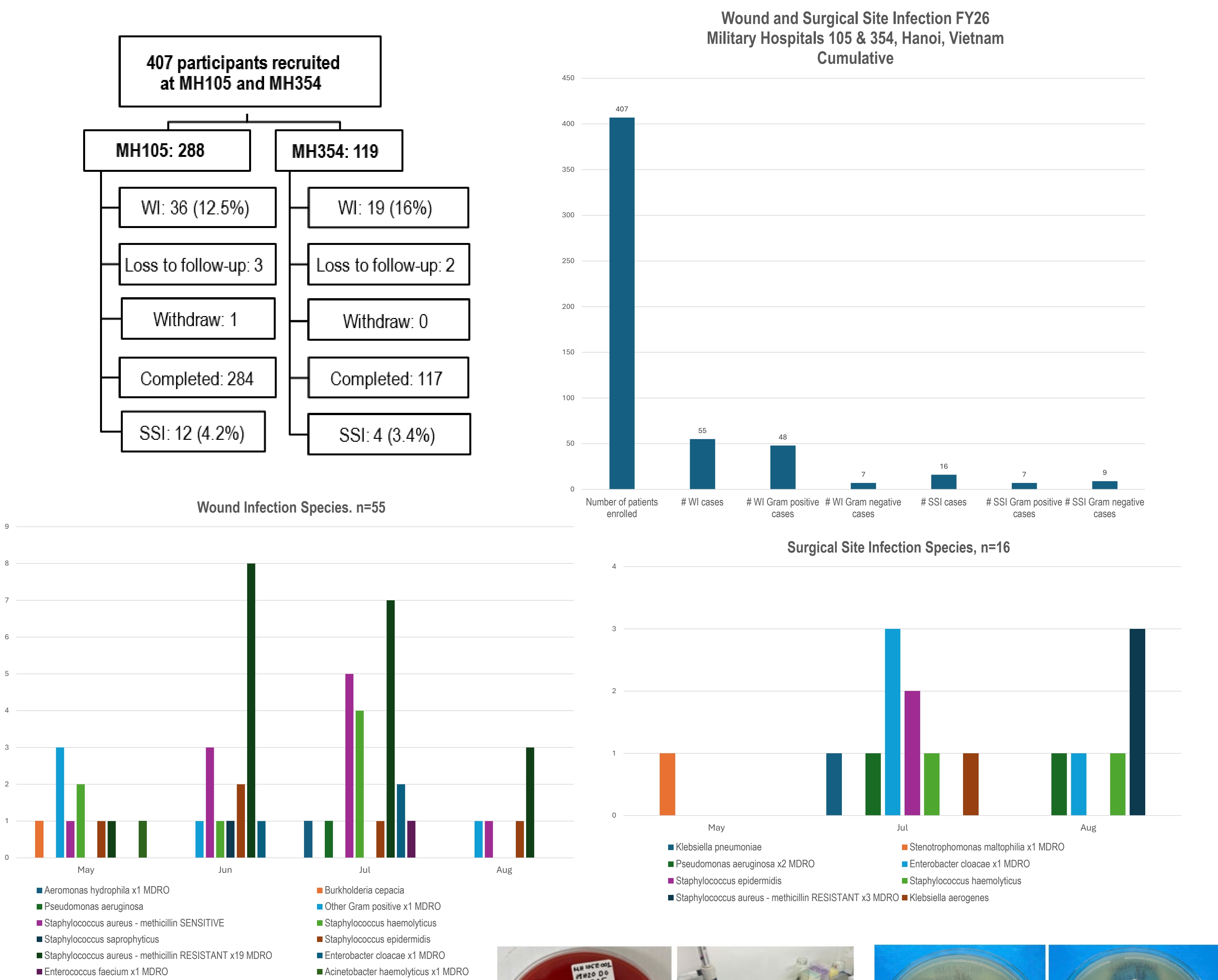


Antibiotics by disk diffusion technique: The disc diffusion technique (Kirby-Bauer method) according to CLSI M100, 35th

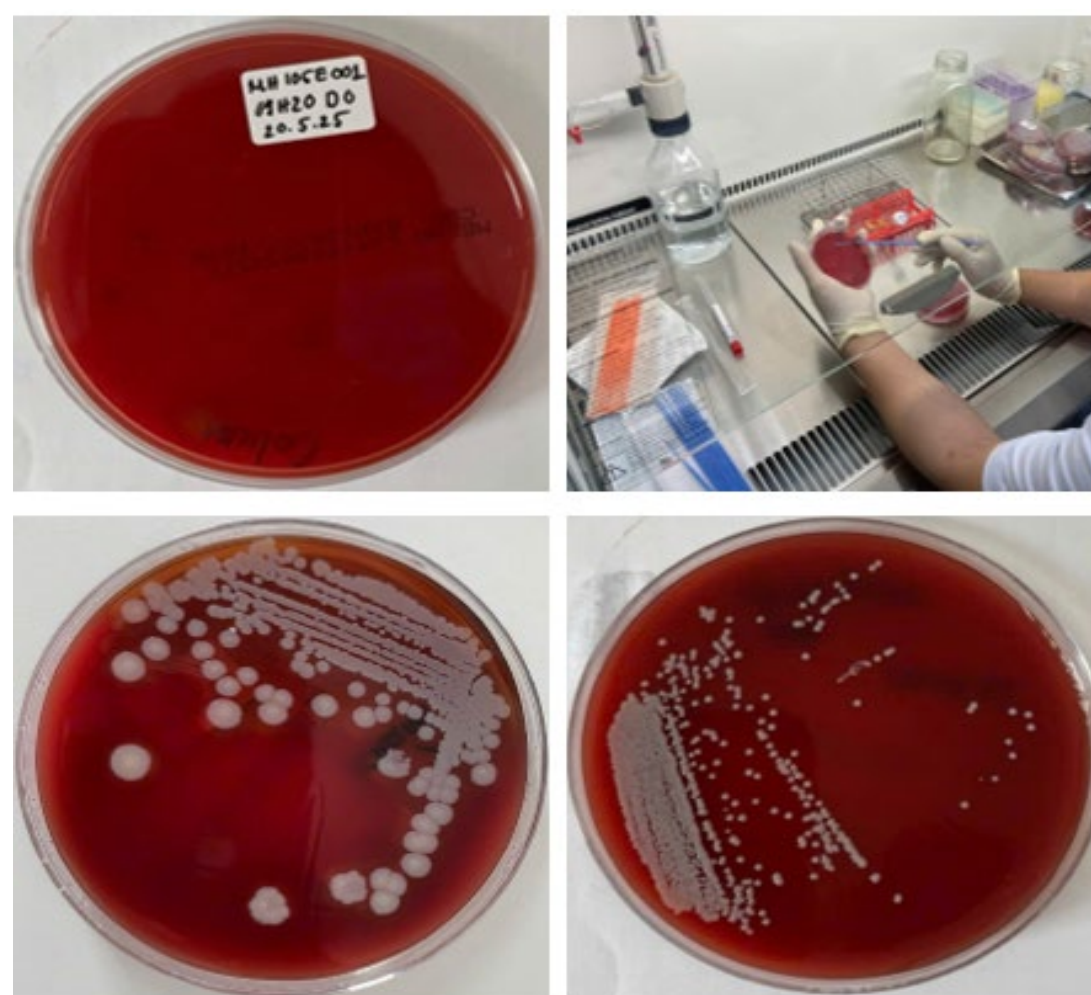
Automated Antimicrobial Susceptibility Testing by VITEK® 2 COMPACT (VITEK® 2 AST-GP Gram Positive Antibigram Card; AST-N Gram-Negative Susceptibility Card)

Results

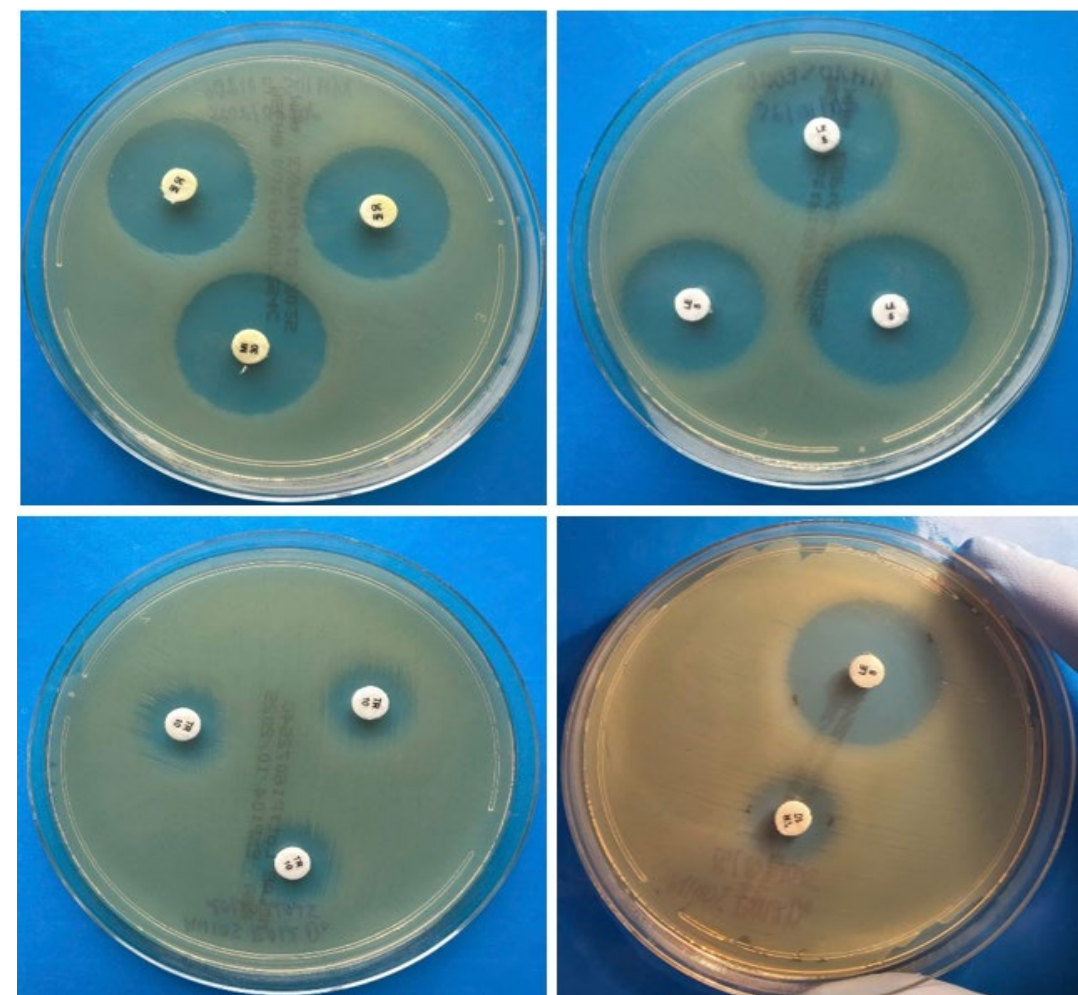
A total of 407 patients were enrolled, with injuries primarily resulting from traffic (35%) and domestic accidents (30%). Wound infection rates at admission were 12.5% at MH105 and 16% at MH354. Among 55 bacterial isolates identified from admission wound cultures, 44% were multidrug-resistant organisms (MDROs), most commonly methicillin-resistant *Staphylococcus aureus* (MRSA). After 30 days of follow-up, 401 patients were included in the final analysis (five lost to follow-up and one withdrawn). Sixteen patients developed SSI, yielding an overall incidence of 4.0%. *Staphylococcus* species were the predominant pathogen (44%), followed by *Enterobacter cloacae* complex. MDROs accounted for 44% of SSI pathogens.



Sample collection at the hospital



Isolation of bacteria at the MIPM laboratory



Kirby-Bauer disk diffusion antimicrobial susceptibility test for *Stenotrophomonas maltophilia* MH105 E012 D3
TR - Trimethoprim; MI - Minocycline;
LE - Levofloxacin.

Discussion

Total of 16 bacterial isolates were recovered from surgical site infections, of which all three *Staphylococcus aureus* isolates were identified as MRSA (3/3 = 100%). Although the number of isolates in our study was limited, this finding highlights the significant burden of antimicrobial-resistant Gram-positive pathogens in surgical site infections. The observed MRSA proportion was higher than that reported at Military Hospital 103, where MRSA accounted for 73.0% of *S. aureus* isolates between 2014 and 2021, indicating a persistently high prevalence of methicillin resistance in military healthcare settings [1]. *Enterobacter cloacae* isolates showed a resistant phenotype characterized by consistent resistance to amoxicillin/clavulanate and cefazolin, with some strains also exhibiting resistance to gentamicin. However, these isolates remained susceptible to third- and fourth-generation cephalosporins, carbapenems, amikacin, and ciprofloxacin. No ESBL-producing or carbapenem-resistant phenotypes were detected among the *Enterobacter cloacae* isolates in this study.

The susceptibility profile of the *Enterobacter cloacae* isolates recovered in this study appeared more favorable than that reported in previous Vietnamese hospital-based studies, where resistance to third-generation cephalosporins and ESBL production among *Enterobacteriales* were common, and carbapenem-resistant *Enterobacter* spp. have increasingly been documented in tertiary-care settings. Nevertheless, the limited number of isolates in the present study precludes definitive conclusions regarding local resistance trends [2].

We did not observe any significant differences between SSI rates with ASA score, wound classification, and surgical time.

Conclusions

Although the observed SSI rate was modest (4.0%), a substantial proportion of preoperative wound infections and SSIs were caused by MDRO pathogens. These findings highlight the need for improved provider awareness and clinical guidance to support effective empiric antibiotic therapy for traumatic wounds. Strengthening antimicrobial stewardship and infection management practices may help optimize treatment outcomes and support rapid return to duty for civilian and military patients.

References

- Hai LHL, An NV. Antibiotic resistance situation of *Staphylococcus aureus* strains causing wound infections at Military Hospital 103 in 2022. VMJ. 2024;54(2). doi:10.51298/vmj.v54i32.1139712135.. doi:1007/s11356-021-16601-8.
- Miyoshi-Akiyama T, et al. Epidemiology of *Enterobacter cloacae* strains producing a carbapenemase or metallo-beta-lactamase in Vietnamese clinical settings in 2014–2017. J Med Microbiol. 2020;69:842–850

Partners/Collaborators

- Naval Medical Research Unit INDO PACIFIC (NAMRU-IP)
- Vietnam Military Institute of Preventive Medicine (MIPM)
- Vietnam Military Hospital 105 (MH105)
- Vietnam Military Hospital 354 (MH354)