Original Article

RFP Indian Journal of Hospital Infection
Volume 2 Number 2, July - December 2025

Incidence and Grading of Surgical Site Infections Using the Southampton System in a Tertiary Care Hospital in South-western India

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Abstract

Background: Surgical site infections (SSIs) represent a significant global public health challenge, contributing substantially to morbidity, mortality and increased healthcare costs. Effective classification and grading systems are crucial for surveillance, risk stratification and guiding clinical management. The Southampton Wound Grading System offers a standardized approach to categorize postoperative wound complications.

Methods: This prospective, observational, analytical study was conducted at a tertiary care teaching hospital in south-western India, involving 1000 consecutive patients undergoing elective surgery at the General surgery unit. Post-operative wound infections were identified and graded according to the Southampton Grading System. Data on SSI incidence and grade distribution were collected.

Results: The overall incidence of post-operative wound infections was 12.5% (n=125). A majority of infections were detected on Post-operative Day 7 (52%, n=65), followed by Post-operative Day 3 (27.2%, n=34). According to the Southampton Grading System, Grade I infections were the most prevalent (36%, n=45), followed by Grade II (28%, n=35), Grade III (24%, n=30), Grade IV (9.6%, n=12), and Grade V (2.4%, n=3).

Conclusions: The distribution across Southampton grades indicates a predominance of milder infections, yet a notable proportion of severe cases. The Southampton Grading System proved to be a practical and effective tool for categorizing and assessing the severity of SSIs, supporting its utility for clinical surveillance and quality improvement initiatives.

KEYWORDS

• Surgical site infection • Wound grading • Southampton system • Incidence
• Tertiary care • India

Introduction

Surgical site infections (SSIs) are among the most common healthcare-associated infections, posing a substantial burden on healthcare systems worldwide. Defined as infections occurring at the incision site within 30 days of surgery, or up to one year if an implant is involved, SSIs arise when bacteria infiltrate through surgical incisions, originating from the patient's own skin, surgical instruments or the operating environment.[1] These infections are a major cause of complications

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Received on: 20.07.2025 **Accepted on:** 13.10.2025

following surgical procedures, contributing significantly to both perioperative morbidity and mortality.[2] Globally, SSIs are responsible for a large number of healthcare-associated infections, with estimates exceeding 2 million cases annually in the United States alone.[3]

The profound impact of SSIs extends beyond immediate clinical complications. Patients who develop SSIs typically experience prolonged hospital stays, with an average increase of 8.2 to 11 days in hospitalization duration.4,5 This extended stay not only increases functional disability and emotional stress for the patient but also escalates the economic burden on hospitals due to increased drug usage, the need for isolation and additional diagnostic studies.4 Furthermore, SSIs are a leading cause of unplanned hospital readmissions after surgery, elevating the risk of readmission by fivefold and contributing to higher intensive care unit admissions and increased mortality rates, ranging from two to eleven times greater than in uninfected patients.5 The persistent challenge of SSIs, despite continuous advancements in infection control practices, underscores the critical need for effective preventive measures and robust surveillance systems.6

Given the significant clinical and economic consequences of SSIs, the implementation of standardized classification and grading systems is paramount. Such systems are essential for accurate surveillance, effective risk stratification and guiding appropriate clinical management strategies.7 While the Centers for Disease Control and Prevention (CDC) provides a widely recognized classification system that categorizes SSIs into superficial incisional, deep incisional and organ/space infections, other systems, such as the ASEPSIS score and the Southampton Wound Grading System, offer more detailed and graded assessments of wound complications.8,9 The distinction between these systems is important: CDC criteria primarily classify infections based on anatomical depth whereas graded systems like Southampton focus on the clinical appearance and progression of the wound itself. This difference in focus allows for a more granular understanding of the wound's status, which can be particularly valuable for day-to-day clinical management and auditing of surgical outcomes.

The Southampton Wound Grading System is recognized for its simplicity, reproducibility and ease of understanding in clinical practice.10,11,13 It categorizes wound complications on a scale from Grade 0 (normal healing) to Grade V (deep or severe wound infection with tissue breakdown).12,13 This standardized measurement tool facilitates the detection and quantification of surgical site infections, thereby supporting efforts to improve surgical performance and sterilization protocols.[11] Its applicability in classifying surgical site infections is considered straightforward and effective.[11]

Despite the global recognition of SSIs as a major public health concern, detailed regional data on their incidence and severity, particularly in specific healthcare settings, remain crucial for targeted interventions. In countries like India, where healthcare infrastructure and patient populations can vary significantly, understanding local epidemiological patterns and the practical applicability of international grading systems in tertiary care hospitals is vital.14 This study addresses a gap in the existing literature by providing detailed incidence data on various grades of SSIs and evaluating the practical utility and validity of the Southampton Grading System.

The primary objectives of this study were twofold: first, to determine the incidence of various grades of post-operative wound infections utilizing the Southampton Grading System and second, to assess the utility and validity of the Southampton Grading System for the classification and management of surgical site infections in this specific clinical setting.

Methods

Study Design and Setting

This study was conducted as a hospital-based prospective observational analytical study carried out within the general surgery unit of a tertiary care teaching hospital located in south-western India.

Participants

A total of 1000 consecutive patients undergoing various elective surgical procedures were included in the study cohort. The demographic characteristics of this overall study population, from which the surgical site infection data were derived, are important for understanding the context of the findings. The mean age of the patients was 43.34 ± 18.28 years. The cohort exhibited a male predominance, with 63.5% of patients being male and 36.5% female. The mean BMI of the patients was 23.82 ± 4.53 kg/m², with 48.2% of the patients having a normal BMI. A notable proportion of patients presented with various comorbidities, including obesity (10.6%), diabetes mellitus (8%) and hypertension (3.1%).[1] Other less common comorbidities included ischemic heart disease

(1.8%) and chronic kidney disease

(1.5%).[1] These baseline characteristics provide a comprehensive overview of the patient population served by the tertiary care center during the study period.

Data Collection

Post-operative wound infections were actively monitored and identified through daily clinical assessment of surgical sites. Once an infection was suspected or confirmed, the specific post-operative day on which the infection was detected was recorded. All identified wound infections were graded using the standardized criteria of the Southampton Grading System.

Definitions

Surgical Site Infection (SSI): An SSI was defined as an infection occurring at the surgical incision site within 30 days following the operative procedure. For procedures involving an implant, this timeframe extended to one year.9 Clinical manifestations indicative of an SSI included, but were not limited to, purulent drainage from the surgical site, localized pain or tenderness, swelling, erythema (redness), increased warmth around the wound, fever or delayed wound healing.9,15 The diagnosis was made clinically by the attending surgeon or physician and in some cases, supported by microbiological isolation of an organism from an aseptically obtained wound specimen.9,15

Southampton Grading System Criteria: The Southampton Wound Grading System classifies postoperative wound complications into six distinct grades (0 to V), reflecting increasing severity.12,13 The specific criteria for each grade are as follows:

- **Grade 0:** Denotes normal healing, with no signs of complications.
- **Grade I:** Characterized by normal healing but with the presence of mild bruising or erythema. This grade is further subdivided:
  - **Ia:** Some bruising
  - **Ib:** Considerable bruising
  - **Ic:** Mild erythema

Grade II: Indicates erythema accompanied by other signs of inflammation. This grade also has subdivisions based on the location of inflammation:

  - IIa: Erythema and inflammation at a single point
  - IIb: Erythema and inflammation around sutures
  - IIc: Erythema and inflammation along the wound line
  - IId: Erythema and inflammation around the wound area

- **Grade III:** Defined by the presence of clear or haemoserous discharge. Subtypes specify the volume and duration of discharge:
  - **IIIa:** Clear or haemoserous discharge at one point only, typically less than
  - 2 cm in extent.
  - **IIIb:** Clear or haemoserous discharge along the wound, exceeding 2 cm in extent.
  - IIIc: Large volume of clear or haemoserous discharge.
  - IIId: Prolonged clear or haemoserous discharge, lasting for more than 3 days.
- **Grade IV:** Characterized by the presence of pus. This grade is subdivided by the extent of purulence:
  - **IVa:** Pus at one point only, typically less than 2 cm in extent.
  - **IVb:** Pus along the wound, exceeding 2 cm in extent.
- **Grade V:** Represents a deep or severe wound infection, potentially accompanied by tissue breakdown, or a hematoma requiring aspiration. This grade signifies the most severe form of wound complication.

Results

A total of 1000 consecutive patients undergoing elective surgery in the General surgery unit were included in this prospective study. The results presented herein focus exclusively on the incidence and grading of post-operative wound infections.

Overall Incidence of Post-operative Wound Infections

Of the 1000 patients evaluated, 125 developed post-operative wound infections, yielding an overall incidence rate of 12.5%. The distribution of patients with and without post-operative wound infections is detailed in Table 1.

Table 1: Incidence of Post-operative Wound Infections (N=1000)

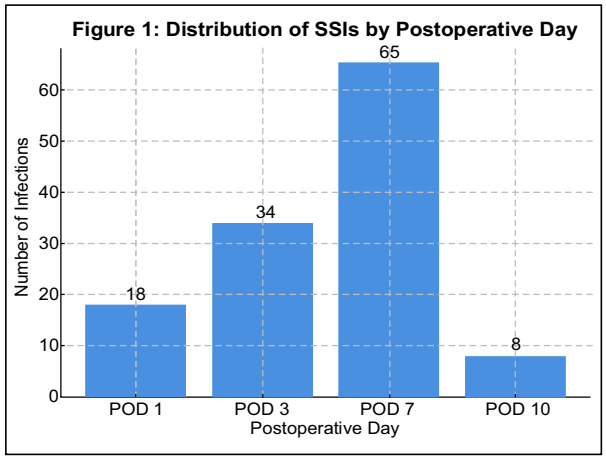
Post-operative wound infections	N	%
Yes	125	12.5
No	875	87.5
Total	**1000**	**100**

Distribution of Post-operative Wound Infections by Day of Detection

Among the 125 patients who developed post-operative wound infections, the timing of detection varied. The majority of these infections were identified on Post-operative Day 7 (n=65, 52%), followed by detections on Post-operative Day 3 (n=34, 27.2%), Post-operative Day 1 (n=18, 14.4%), and Post-operative Day 10 (n=8, 6.4%). The temporal distribution of wound infection detection is summarized in Table 2 and visually represented in Figure 1.

Table 2: Distribution of Post-operative Wound Infections by Day of Detection (n=125)

Post-Operative Day	N	%
POD 1	18	14.4
POD 3	34	27.2
POD 7	65	52.0
POD 10	8	6.4
Total	**125**	**100**

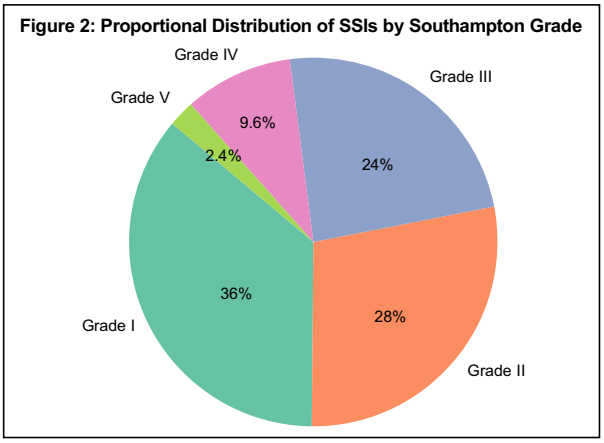


Distribution of Surgical Site Infections According to Southampton Grading System

The severity of the 125 post-operative wound infections was classified using the Southampton Grading System. The distribution across the various grades indicated a predominance of milder infections. Grade I accounted for the largest proportion of infections (n=45, 36%), followed by Grade II (n=35, 28%). Grade III infections constituted 24% (n=30) of the total, while Grade IV and Grade V infections, representing more severe complications, were observed in 9.6% (n=12) and 2.4% (n=3) of cases, respectively. The detailed distribution of SSIs by Southampton grade is presented in Table 3 and visually depicted in Figure 2.

Table 3: Distribution of Surgical Site Infections According to Southampton Grading System (n=125)

Southampton Grading System	N	%
Grade I	45	36.0
Grade II	35	28.0
Grade III	30	24.0
Grade IV	12	9.6
Grade V	3	2.4
Total	**125**	**100**



Discussion

The findings of this prospective observational study provide valuable insights into the incidence and grading of surgical site infections in a tertiary care hospital in south-western India. The overall SSI incidence of 12.5% observed in this cohort of 1000 general surgery patients falls within the global range reported by the World Health Organization, which varies from 0.5% to 15% depending on the type of operation and patient status.[4] However, when viewed in the context of specific regional data, such as a reported wound infection rate of 25.8% in an orthopedic hospital in Cairo, Egypt, our incidence rate appears to be at the lower end of the spectrum for developing countries.[4] Despite this, a 12.5% SSI rate represents a significant burden for a single tertiary care institution. Surgical site infections are a leading cause of unplanned hospital readmissions and are known to increase hospital stays by an average of 10 to 11 days, contributing substantially to healthcare costs and patient morbidity.[5] This observed incidence underscores the persistent need for continuous vigilance and targeted infection control interventions within this specific healthcare setting to mitigate the adverse outcomes associated with SSIs.

The temporal analysis of infection detection revealed that the majority of SSIs (52%) were identified on Post-operative Day 7, followed by Post-operative Day 3 (27.2%). This pattern aligns with the typical clinical presentation of many SSIs, which often manifest several days after surgery. The peak detection at Post-operative Day 7 has important implications for post-discharge surveillance protocols and patient education, emphasizing the need for continued monitoring beyond the immediate post-operative period. Early detections on Post-operative Day 1 or 3, though less frequent (14.4% and 27.2% respectively), may suggest more aggressive infections or those directly related to intraoperative contamination, warranting prompt clinical attention.

The distribution of SSIs according to the Southampton Grading System provided a nuanced understanding of infection severity. The study found a clear predominance of milder infections, with Grade I (normal healing with mild bruising or erythema) accounting for 36% and Grade II (erythema plus other signs of inflammation) for 28% of all SSIs. This suggests that a substantial proportion of infections encountered in this cohort were superficial and less severe, potentially allowing for earlier detection before significant progression. However, the presence of Grade III (clear or haemoserous discharge), Grade IV (pus) and Grade V (deep or severe wound infection with or without tissue breakdown) cases, though less frequent (24%, 9.6%, and 2.4% respectively), highlights that more severe infections still occur and contribute significantly to patient morbidity. Infections classified as Grade IV and V are considered major complications, often requiring more intensive management, including debridement or reoperation.8,13 This dual finding a majority of milder infections alongside a notable presence of severe cases underscores the importance of a comprehensive grading system like Southampton that can capture the full spectrum of wound complication severity, from subtle signs to profound tissue involvement. Such a system is invaluable for informing clinical decision-making, resource allocation and patient counselling.

The utility of the Southampton Grading System in clinical practice is strongly supported by these findings. Its inherent simplicity and reproducibility make it an easily understandable and applicable tool for routine clinical surveillance.10,11,13 This ease of implementation is particularly beneficial in various healthcare settings, including those with resource constraints, as it facilitates consistent data collection without requiring complex diagnostic tools. The system provides a standardized method for classifying wound complications, which is critical for internal auditing of surgical performance and evaluating the effectiveness of infection control protocols.[11] By consistently applying this system, healthcare providers can identify trends in SSI occurrence and severity, allowing for targeted interventions and continuous quality improvement initiatives. Furthermore, the Southampton system aids in risk stratification, enabling clinicians to tailor preventive measures and follow-up plans, given that higher-grade wounds are demonstrably associated with increased risk of complications.14

Regarding its validity and applicability, the Southampton system's graded approach, ranging from Grade 0 to V, effectively reflects the increasing severity of wound complications, from mild bruising to deep infection with tissue breakdown.12,13 This hierarchical structure provides a clear clinical continuum for assessing wound healing. Previous research has also indicated a significant association between the nature of surgery and the grade of the surgical wound as classified by the Southampton system.[11] While the system's utility in classification and risk stratification for general surgical site infections is widely supported, it is important to acknowledge that some studies have suggested its predictive value for specific outcomes, such as breast reconstruction SSIs, may be limited compared to other systems like ASEPSIS.8,9 This suggests that while the Southampton system is robust for descriptive classification and general clinical surveillance, its predictive power might be context-dependent, varying across different surgical specialties or specific outcome measures. Nevertheless, for the broader context of general surgical site infections, its descriptive and classification utility remains a valuable asset for clinical practice and research.

Limitations of the Study

This study was conducted at a single tertiary care hospital in south-western India, which inherently limits the generalizability of the findings to other institutions or diverse geographical regions. The incidence and distribution of SSI grades can vary significantly based on patient population characteristics, surgical practices and local epidemiological factors.

Implications for Clinical Practice

The findings from this study strongly advocate for the routine integration of the Southampton Grading System into clinical practice for SSI surveillance and quality improvement in general surgery. Its straightforward application can facilitate the identification of emerging trends in

infection rates and severity, enable the evaluation of the efficacy of existing infection control bundles and guide the development of targeted interventions for specific grades of infection. Furthermore, the observed timing of infection detection emphasizes the importance of consistent post-operative follow-up, especially for patients who are discharged early to ensure timely identification and management of SSIs.

Conclusions

This study demonstrates an overall surgical site infection incidence of 12.5% in a tertiary care hospital in south-western India, with a predominant detection on Post-operative Day 7. The application of the Southampton Grading System revealed that while milder infections (Grade I and II) were most prevalent, a notable proportion of severe cases (Grade IV and V) were also observed. The Southampton Grading System proved to be a simple, reproducible and valuable tool for the comprehensive classification and assessment of surgical site infections in this tertiary care setting. Its utility lies in enhancing SSI surveillance, facilitating effective risk stratification and contributing to improved patient outcomes through targeted interventions and continuous quality assurance initiatives. The findings underscore the importance of standardized wound grading in clinical practice and highlight avenues for future research to further refine SSI prevention and management strategies.

Note: The authors declare that there is no funding received for this study and there is no conflict of interest.

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