



## Suitability of the NNIS index for estimating Orthopaedics surgical-site infection risk at a university hospital in INDIA

Amit Kumar

Senior Resident, Department of Orthopaedics, Institute of Medical Sciences, Banaras Hindu University, Varanasi

Ghanshyam Narayan Khare

Professor, Department of Orthopaedics, Institute of Medical Sciences, Banaras Hindu University, Varanasi

### ABSTRACT

*Surveillance for surgical-site infection is a standard procedure to control surgical infections and establish prevention measures. Methods: A total of 745 elective orthopaedic surgical procedures performed over 12 months were followed prospectively for 12 months after surgery. Each patient was classified according to American Society of Anaesthesiologists(ASA) score and National Nosocomial infections surveillance(NNIS) risk index was calculated for each patient. Result: Study found a strong relationship between NNIS Index and surgical site infection development. Nearly eleven fold higher incidence rate in wound class iii/iv(22.22%) compare to wound class i/ii(2.02%), three fold higher in ASA $\geq$ 2(6.5%) to ASA<2(2.38%), eleven fold higher in duration of surgery >2hours(8.46%) to duration of surgery <2hours(0.79%). Poor wound condition class iii/iv(RR=11,95%CI=1.67-3.11) and prolong duration of surgery >2hours(RR=10.71,95%CI=1.32-3.42) were significantly responsible for infection. The study could not find statistically significant association between ASA score and SSIs. Conclusion: The NNIS index system is suitable for prediction of SSIs for this population.*

**KEYWORDS :: NNIS, Surgical site infection ,ASA,wound class, Duration of surgery,CDC**

### Introduction

Surgical site infections (SSIs) are not uncommon in developing countries. Health care associated infections (HAIs) with a reported incidence range from 1-2% in developed countries, to 15-25% in countries with limited resources [1]. It is important to recognize that SSIs can range from a relatively trivial wound discharge with no other complications to a life-threatening condition.

To control surgical infections and establish prevention measures, infection risk factors need to be identified, which are normally related with the host, microorganism, environment and type of implanted material. Knowing these factors is important for action planning and practice.

Surveillance for SSI is a standard procedure in many hospitals in western countries. Centre for Disease control and Prevention (CDC, 1996) has stated that United States has a countrywide surveillance system[2]. Surgical site infection rates are an established measure of quality of clinical care and reliable surveillance data are the foundation of effective infection control programs. Unfortunately, Surveillance of SSIs is a persistent problem in orthopaedic surgery in india.

### Methods

This prospective study was conducted at the department of orthopedic surgery in collaboration with department of Microbiology, university hospital Banaras Hindu University, Varanasi, India over 12-months period from March 2012 to February 2013. Operating room in the hospital is built in new modern way maintained at positive pressure with respect to corridors and adjacent areas. Surgical instruments are sterilized by autoclaving (monitoring of steam autoclave performance is satisfactory). Surgical attire and drapes as per standard protocol were used. Adherence to the principles of asepsis by all scrubbed personnel, excellent surgical technique, post-operative wound care, and discharge planning with optimum protocols for home wound care have been perfectly implemented.

### Subjects:

A total of 745 elective orthopaedic surgical procedures were performed. Those patients were followed prospectively for 12 months after surgery. Wounds were inspected for signs of infection at the 2<sup>nd</sup> day, 5<sup>th</sup> day, discharge time and subsequent follow up and when there was clinical suspicion of wound infection. Patients were taught to return to the hospital for re-examination whenever any signs or symptoms of Wound infections (pain, tenderness, localized swelling, or fever) developed after discharging from the hospital. On clinical suspicion of infection sample for culture sensitivity and blood sample for complete blood count and CRP determination were collect-

ed[16,31,32,33].

Each patient was classified according to American Society of Anaesthesiologists(ASA) score and National Nosocomial infections surveillance(NNIS) risk index was calculated for each patient[3,4].

### Statistical analysis:

Results were expressed in percentage. Relative risk and 95% confidence interval for incidence rate of surgical site infection was computed. Univariate analysis of the categorical outcome (development of surgical site infection) and each individual associated factor were conducted. The level of statistical significance was at 0.05

### Observations

Surgical site infection was found in 26(3.49%) patients. As most of the patients were operated for lower limb surgery(334). Majority of infection belonged to this group(13)followed by spine surgery(5). Miscellaneous included repair of congenital deformity, excision of tumour, grafting, external fixator, tendon or nerve surgery, removal of implant, biopsy and debridement. Incidence rate was highest in spine surgery (6.41%)> total knee replacement(4.55%)> upper limb surgery(3.95%)>lower limb surgery(3.89%)> miscellaneous(1.99%)>- total hip replacement=shoulder arthroplasty.

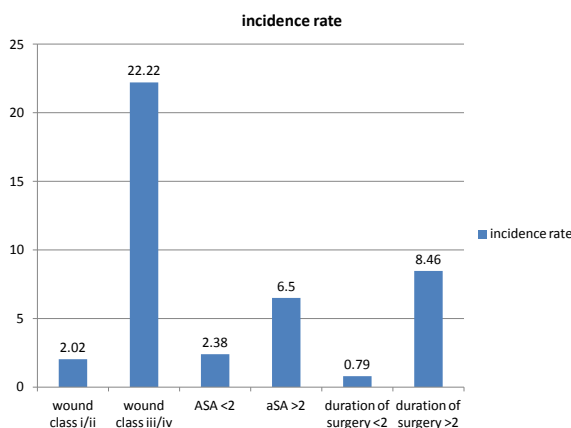
Type of intervention	Total number of patients	Number of SSI patients	Incidence rate (%)	Incidence rate in developed country%
Arthroplasty				
THR	28	0	0	1.26
TKR	22	1	4.545	4.4
HIP	53	1	1.887	4.06
hemireplacement				
Shoulder arthroplasty	3	0	0	0.7
Spine surgery	78	5	6.410	2.0
Upper limb surgery	76	3	3.947	
Lower limb surgery	334	13	3.892	
Others	151	3	1.987	
<b>Total</b>	<b>745</b>	<b>26</b>	<b>3.49</b>	

Others includes repair of congenital deformities, excision of tumours, grafts, external fixation, operations for tendons, nerves, diseases and removal of implant,biopsy,debridement.

As regard to risk factor in study patients, most of them belong to wound class i/ii, ASA score <2 and duration of surgery <2 hours. Univariate analysis showed that wound class iii/iv and duration of surgery was statistically significant at the 0.05 significance level as their 95% confidence interval for relative risk do not contain 1.

Risk factor	Number of patients Without SSI (No.719 ) (96.51%)	Number of patients With SSI (No.26) (3.49%)	% of infection	Relative risk RR	95%CI	
Wound class iii/iv	42	12	(22.22)	11	1.67-3.11	significant
Wound class i/ii	677	14	(2.02)			
ASA score <2	532	13	(2.38)	2.731	0.25-1.75	
ASA score ≥ 2	187	13	(6.5)			
Duration of Surgery >2hr	248	22	(8.46)	10.708	1.32-3.42	significant
Duration of surgery <2hr	497	4	(0.79)			

Among NNIS Risk Index incidence rate was high in wound class iii/iv (22.22%) ASA>2(6.5%) and duration of surgery>2hours (8.46%).



In NNIS Risk scoring, incidence rate was 0% among patients with risk score 0(wound class i/ii, ASA <2 and Duration of surgery <2hours).Patients having score 1(either of wound class iii/iv or ASA>2 or duration of surgery>2 hours),incidence rate was 9.25%.Those with score 2(having any of the two index)the rate was 18.75%. While incidence rate highest (21.05%) in patients with score 3(having all three index).

NNIS risk score	Without SSI	With SSI	%
0	580	0	0
1	98	10	9.25
2	52	12	18.75
3	15	4	21.05

**Discussion**

Infections in orthopaedic patients are an unresolved problem. Infections occur even though surgeons take meticulous aseptic precautions during surgery and patients are strictly managed before and after surgery[5,8,11,13,14,15,17,20].

The incidence rate of surgical site infection in this study was 3.49% which is though high against international standard (<1-2%)[6].

**Evolution of the National Nosocomial infection surveillance (NNIS) System and Development of the NNIS Index [9]**

The NNIS system was developed in the early 1970s when hospitals in the USA were selected to report their epidemiological surveillance data for inclusion in a national data bank. Data were collected using

standard protocols and the clinical criteria and definitions used were those adopted by CDC[7]. The methodology proposed by NNIS was used in five hospitals in Brazil in 1991 and the method was soon accepted as being adequate for Brazilian hospitals. Later, the NNIS method was extended to more than 70 hospitals in Brazil, Argentina and Uruguay for the purpose of a prospective multi-centred study.

Risk factor	Score ascribed	
	0	1
Physical condition of patient according to the ASA classification	<3	=3
Class of contamination of surgical wound according to the NRC classification	Clean or potentially contaminated	Contaminated or infected
Length of surgery (in terms of the 75 percentile for the procedure)	≤75	>75

Source: Adapted from Starling et al. [22].

**Risk factors and SSIs**

Though there are several risk factors for infection[5,8]. Some are modifiable others non modifiable, host specific and procedure specific. So we confined ourselves to NNIS risk factors i.e. wound class, ASA score and duration of surgery[12]. Surgical site infection rate is much higher for class iii/iv or dirty wounds(22.22%) as compared to other classes(2.02%). The underlying reason may be presence of devitalized tissue and pre-existing clinical infection which are generally encountered in class IV wounds. These findings are in agreement with other authors. In our study poor wound condition i.e. class iii/iv(RR=11,95%CI=1.67-3.11) and prolong duration of surgery >2hours(RR=10.71,95%CI=1.32-3.42) were significantly responsible for infection as reported in other studies. Unlike previous study, the study could not find statistically significant association between ASA score and SSIs[11,13,14,15,17,20, 22,23,24,25,26]. Higher incidence rate in ASA score≥2(6.5%) confirms a direct relation between clinical severity and infection. It is known that weakening chronic conditions can represent risk factors for surgical wound infections, due to the host's low resistance level.

**NNIS and SSIs**

Our study found a strong relationship between NNIS Index and surgical site infection development. Nearly eleven fold higher incidence rate in wound class iii/iv(22.22%)compare to wound class i/ii(2.02%), three fold higher in ASA ≥2(6.5%) to ASA<2(2.38%), eleven fold higher in duration of surgery >2hours (8.46%) to duration of surgery <2 hours (0.79%). Our study also confirmed that development of surgical site infection is directly related to NNIS score and validates NNIS system for epidemiological study of SSIs in orthopaedics.

**Summary**

This study is considered one of the few studies that survey SSIs in orthopedic department in India. We concluded that incidence of SSIs in Orthopaedic patients in India is higher than that reported in developed countries. The rate of surgical incidence site infection in this study was 3.49% which is though high against international standard (<1-2%).The possible major risk factors that can be labelled from this study are duration of surgery and wound class. The NNIS index system was shown to be a very good predictor for this population. In the era of restricted hospital budgets and increased bacterial resistance, long-term surveillance of SSIs rates and follow-up of compliance may provide a way to improve performance at low costs[21]. Surveillance system for SSI should be developed for university hospitals to monitor incidence of SSI, evaluate local practice and improve quality of health care.

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