DOI: https://doi.org/10.24191/ijsms.v6i1.12875

Nurses' Knowledge and Practice Towards Prevention of Surgical Site Infection

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Received: 8 August 2020
Accepted: 28 February 2021
Published: 31 March 2021

ABSTRACT

Surgical Site Infection (SIS) is a common healthcare-associated infection that significantly impacts patient safety and financial losses for health systems. Enhancing nurses' knowledge and practice is an essential component in the prevention of the spread of infection. The study aims to assess the knowledge and practice of preventing surgical site infection among nurses. A cross-sectional study was conducted among 306 nurses in two public hospitals in Malaysia. Data were obtained from self-administered questionnaires and analyzed using the IBM Statistical Packages for Social Science (SPSS) Window Version 23. This study revealed that 85.3 % of nurses had good knowledge, and 97.7 % had good practice regarding SSI prevention. However, there was no significant difference between the nurses' knowledge and practice towards Prevention SSI (x^2: 1.10; p-value: 0.28). There was a statistically significant association between working unit/ward and the total knowledge score (x2:

24.51; p-value: 0.01). Nurses who worked in the Operation Theatre were found to have higher percentage of good knowledge (n: 108; 35.3%). It can be concluded that the nurses had good knowledge and practice regarding surgical site infection. Successful strategies of infection control measures were the well-structured guidelines, continuing education programs, adequate supervision, good support, and regular basis of the necessary consumables and supplies.

Keywords: *Knowledge; practice; nurses; prevention; surgical site infection*

INTRODUCTION

Healthcare-associated infection (HAIs) / "nosocomial" / "hospital" infection is an infection occurring in a patient during the process of care (hospital or other health care facility) which was not present or incubating at the time of admission and can also appear after discharge. It represents the most frequent adverse event during care and a primary global safety concern for both patients and healthcare professionals. (WHO, 2017). Surgical site infection (SSI) is one of the most common healthcare-associated infections (HAIs) worldwide and a major challenging problem clinically (Diaz & Newman, 2015).

SSI is an infection that happens within 30 days after the operation if no implant is left in place or within one year of operation if an implant is left in place. The infection appears to be related to general surgery operations (Smith & Dahlen, 2013). Most SSIs are avoidable (Mellin-Olsen, McDougall, & Cheng, 2017). Strict compliance with hygienic practices and proper cleaning can reduce bacterial load which will inevitably reduce SSIs (Liu et al., 2018).

Since nurses deal with and respond more often to surgical patients on their hospitalization journey, it is essential for them and other specialists in the team to provide adequate care and ensure the prevention of SSIs (Nordström et al., 2019). Hence, this study aimed to assess knowledge, practice, and related factors associated with the prevention of Surgical Site Infection among nurses in the public hospital.

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LITERATURE REVIEW

According to the Center for Disease (CDC), 500,000 SSIs occur annually, contributing to surgical mortality, prolonged hospital stay, and redoubled medical prices. It places a significant economic burden on the attention system (McGraw et al., 2012; Diaz & Newman, 2015). Although SSI incidence is lower in high-income countries, it remains the second most frequent HAI type in Europe and the United States of America (WHO, 2017). WHO had set out 29 recommendations for preventing SSIs to ensure high-quality care for every patient, irrespective of the available resources (Allegranzi et al., 2016).

Despite the widespread availability of evidence-based guidelines, SSI rates have not measurably fallen. This is probably due to inadequate knowledge of and/or non-compliance with correct practices (Leaper et al., 2015), especially among the nurses that can play a leading role in initiatives that aim to minimize the risk of SSIs (Labeau et al., 2010). Several studies were found that the SSI Prevention knowledge among nurses was low and reduced, respectively (Sadia et al., 2017; Qasem & Hweidi, 2017; Novelia, Sia, & Songwathana, 2015; and Famakinwa et al. , 2014. However, Oluwakemi et al., (2017), revealed that the nurses had sufficient knowledge, with 92.4% of respondents having good hand hygiene before surgery and dressing patient wounds and 86.1% of surgical ward nurses always wash their hands before starting work. Although most of the studies reported that nurses had poor knowledge, they had excellent surgical site infection prevention practices (Teshager et al., 2015; Sickder, 2010). Research in Greece showed a high level of knowledge for SSI prevention and a low level of knowledge for the full meaning of SSI time incidence (Balodimou et al., 2018).

Studies reported that respondents' characteristics associated with knowledge and practice in the prevention of the SSI, such as age, total years of work experience in nursing or in the surgical unit, hours that been spend in surgical training courses, and monthly income (Qasem & Hweidi, 2017); nurses working experience (Alghabeesh et al., 2014); gender and their level of education (Teshager et al., 2015).

METHODOLOGY

A cross-sectional study was conducted among 306 nurses working in four targeted units/wards in two public hospitals in Malaysia between January to June 2020.

All nurses directly involved in the patient care at Orthopaedic, Surgical, Operation Theatre (OT) and Obstetrics, and Gynaecology wards/units who had consented to participate were included in the study. Data was collected using a self-administered questionnaire adapted from Sickder et al. (2017). The respondents' characteristics regarding their age, gender, ethnicity, marital status, religion, educational level, ward or unit, and working experience in the ward or unit). 25 multiple choice questions were used to assess the nurses' knowledge. Each of the correct response was scored as one and incorrect as 0. The score of more than 14 questions was answered correctly and was categorized as adequate knowledge, and those who scored less were classified as poor knowledge. Meanwhile, the nurses' practice was assessed by 25 questions using a 4-point Likert scale ranging from never practice=1, seldom practice=2, sometimes practice=3, always practice=4). The total scores ranged from 0 to 75, and the score was transformed into a percentage. The higher scores indicated a higher level of practice. The original questionnaire had been translated into the Malay language by the backward and forward translation process. The content and the commencing date by three experts; Infection Control Doctor, a Trained Infection Control Nurse, and a Nursing Lecturer. A pilot study conducted, and Cronbach's Alpha's result was 0.85, which indicates the questionnaire has acceptable and good internal consistency to apply in the present study. The Ethical Approval was gained from the institutional ethics committee, Medical Research and Ethics Committee (MREC) – KKM/NIHSEC/P19-2799(6), both the Hospital Directors' and the respondents' consent. All data were collected and analyzed using SPSS (Statistical Package for Social Science) Version 23.0. Descriptive statistics was used to analyze demographic data, knowledge, and practice towards preventing SSI, while Pearson Chi-square was used to determine the association between the respondents' characteristics, knowledge, and practice.

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RESULTS

Demographic Characteristics of the Respondents

Table 1 demonstrates the characteristics of the respondents. Almost half of the respondents were at the age of 26 to 30 years old. Most of them were female (84%), Malay (90.2%), married (83.7%), and had diploma in nursing (93.1%). The majority of the nurses who participated in this study were from the Operation Theatre Unit (35.5%), followed by the surgical ward nurses (26.5%). More than half of them (68.3%) had working experiences of below ten years in the respective wards/unit, and 35.9% had experience of less than five years.

Table1: Demographics Characteristics of the Respondents

Variables	Frequency (*n*)	Percentage (%)
Age		
20-25 years old	15	4.9
26-30 years old	143	46.7
31-35 years old	66	21.6
36-40 years old	44	14.4
40-45 years old	23	7.5
More than 46 years old	15	4.9
Gender		
Male	49	16.0
Female	257	84.0
Ethnic		
Malay	276	90.2
Chinese	3	1.0
Indian	18	5.9
Others	9	2.9
Marital Status		
Married	256	83.7
Single	46	15.0
Divorced/ Widowed	4	1.3
Educational Level		
Diploma	285	93.1
Degree	19	6.2
Master	2	0.7

Table 1 (continued).

Variables	Frequency (*n*)	Percentage (%)
Working Area		
Surgical Ward	81	26.5
Obstetrics & Gynaecology Ward	44	14.4
Orthopaedic Ward	73	23.9
Operation Theatre	108	35.3
Working Tenure		
Less Than 5 Years	110	35.9
6-10 years	99	32.4
11-15 years	46	15.0
16- 20 years	27	8.8
Above Than 20 years	24	7.8

Nurses' Knowledge of SSI Prevention

The study reported that the nurses had good knowledge of SSI prevention (n: 261; 85.3%) (Table 2). There is no significant difference in terms of knowledge towards the prevention of SSI between nurses at these two hospitals (t: 0.12; p-value: 0.91), thus strongly supports the fact that the hospital nurses in Malaysia possessed good knowledge of SSI prevention.

Table 2: Nurses' Knowledge and Practice towards Prevention of SSI

Prevention of SSI	Poor		Good	
	Frequency	Percentage	Frequency	Percentage
Knowledge	45	14.7	261	85.3
Practice	7	2.3	299	97.7

The nurses scored the highest marks for the question on the purpose of pre-operative skin preparation (95.1%), the purpose of surgical handwashing (94.8%), and the prophylaxis antibiotics to prevent SSI (93.5%). But they had the lowest score for the questions on laboratories in assessing patient's nutritional status; in which only 18.3% answered correctly, followed by the best method for pre-operative shaving (19.6%) and the best agent for pre-operative skin preparation (20.9%) (Table 3).

Table 3: Frequency Distribution of Nurses' Knowledge towards Prevention of Surgical Site Infection

No.	Multiple choice Questions	Frequency (Percentages)	
		Correct	**Incorrect**
1	Which one is the best method for pre-operative shaving	60 (19.6)	**246 (80.4)**
2	When is the best time for pre-operative hair removal	82 (26.8)	224 (73.2)
3	Which one is the best agent for pre-operative skin preparation?	64 (20.9)	**242 (79.1)**
4	What is the purpose for pre-operative skin preparation?	**291 (95.1)**	15 (4.9)
5	How would you disinfect surgical site infection?	256 (83.7)	50 (16.3)
6	Which one is true answer for prophylaxis antibiotics?	**286 (93.5)**	20 (6.5)
7	When should you administer prophylaxis to surgical patient?	202 (66.0)	104 (34.0)
8	What is the purpose of pre-operative showering?	236 (77.1)	70 (22.9)
9	What is the best skin agent for pre-operative showering to prevent surgical site infection?	273 (89.2)	33 (10.8)
10	Which one is correct for the malnourished surgical patient?	223 (72.9)	83 (27.1)
11	What are laboratories in assessing patient's nutritional status?	56 (18.3)	**250 (81.7)**
12	What is the correct level of blood sugar which enhances function of white blood cell adequate to prevent SSI?	190 (62.1)	116 (37.9)
13	What is the best antiseptic solution to disinfect the surface of dressing trolley?	173 (56.5)	133 (43.5)
14	Which is the correct purpose for surgical hand washing?	**290 (94.8)**	16 (5.2)
15	Which are the correct steps of hand washing?	253 (82.7)	53 (17.3)
16	Which one is the correct answer for the benefit of wound dressing?	276 (90.2)	30 (9.8)
17	When do you change the surgical wound dressing?	171 (55.9)	135 (44.1)
18	How do you select dressing solution?	273 (89.2)	33 (10.8)
19	What is the purpose of maintenance of normal nutritional status for surgical patients?	270 (88.2)	36 (11.8)

Table 3 (continued).

No.	Multiple choice Questions	Frequency (Percentages)	
		Correct	Incorrect
20	What kind of diet should be provided for the post-operative patients?	280 (91.5)	26 (8.5)
21	Which one is the correct answer for surgical patients with compromised immune system?	224 (73.2)	82 (26.8)
22	How do you prevent infection of patients with immunodeficiency disorder?	98 (32.0)	208 (68.0)
23	Which statement is correct for diagnosis of surgical site infection?	109 (35.6)	197 (64.4)
24	Which answer is a good sign of no surgical site infection?	259 (84.6)	47 (15.4)
25	Which laboratory is used to ensure SSI?	282 (92.2)	24 (7.8)

Nurses' Practices towards Prevention of SSI

It was found that 97.7% of the nurses who participated in this study had good practice in preventing SSI (Table 2). There is no significant difference in terms of the nurses' practices towards preventing SSI in both hospitals (t: 0.12; p-value: 0.91). This indicates that the hospital nurses in Malaysia exercise good practice towards the prevention of SSI.

Most of them claimed that they always practised washing hands before and after changing wound dressing and touching the surgical site (94.1%); using face mask during cleansing surgical wound dressing (92.5%); cleaning and disinfecting the surface of the dressing trolley with the antiseptic solution' (89.9%) and discarding the soiled material in the proper place after performing wound dressing (89.9%). But there were about 16.3% of the nurses who claimed that they never practiced performing pre-operative shaving right before surgery; assessing patient's body mass index (BMI) before and after surgery (12.1%) and learning shaving method from others, and applying it to pre-operative patients (8.8%) (Table 4).

Table 4: The Distribution of Practices towards Prevention of Surgical Site Infection among Nurses in Public Hospitals

No	Items	Frequency (Percentages)			
		Never Practice	Seldom Practice	Sometimes Practice	Always Practice
1	Alcohol and Chlorohexidine Gluconate (CHG) are the antimicrobials most used for the patient's skin preparation in my ward	3 (1.0)	13 (4.2)	78 (25.5)	212 (69.3)
2	I wash my hands before and after changing wound dressing and touching the surgical site	0 (0.0)	4 (1.3)	14 (4.6)	**288 (94.1)**
3	I wash my hand before wearing sterile gloves	3 (1.0)	6 (2.0)	25 (8.2)	272 (88.9)
4	I perform pre-operative shaving right before surgery	**50 (16.3)**	22 (7.2)	131 (42.8)	103 (33.7)
5	I administer pre-operative prophylactic antibiotic within one hour before surgery	23 (7.5)	16 (5.2)	94 (30.7)	173 (56.5)
6	I advise my patient to take pre-operative showering 6 to 12 hours before surgery	13 (4.2)	20 (6.5)	97 (31.7)	176 (57.5)
7	I advise my patient to take pre-operative showering or bathing with antimicrobial agents	23 (7.5)	14 (4.6)	107 (35.0)	162 (52.9)
8	I perform prescribed glucose test before and after surgery in a diabetic patient	9 (2.9)	17 (5.6)	78 (25.5)	202 (66.0)
9	I administer injection insulin or give oral medication as ordered in a diabetic patient	22 (7.2)	18 (5.9)	66 (21.6)	200 (65.4)
10	I assess my patient's body mass index (BMI) before and after surgery	**37 (12.1)**	56 (18.3)	92 (30.1)	121 (39.5)
11	I advise a malnourished patient to has healthy nutritious food intakes (especially protein diet)	5 (1.6)	13 (4.2)	81 (26.5)	207 (67.6)
12	I advise my patient to take vegetables and fruits before and after surgery	11 (3.6)	25 (8.2)	106 (34.6)	164 (53.6)

Table 4 (continued).

No.	Items	Frequency (Percentages)			
		Never Practice	**Seldom Practice**	**Sometimes Practice**	**Always Practice**
13	I advise my patient with compromised immune system to avoid contact with people with infection	11 (3.6)	13 (4.2)	84 (27.5)	198 (64.7)
14	I advise obese patients to practice less intake of carbohydrate	12 (3.9)	28 (9.2)	105 (34.3)	161 (52.6)
15	I use sterilized dressing materials for cleansing surgical wound dressing	2 (0.7)	10 (3.3)	31 (10.1)	263 (85.9)
16	I use povidone-iodine and normal saline for cleansing surgical wound dressing	11 (3.6)	16 (5.2)	58 (19.0)	221 (72.2)
17	I use an aseptic technique during surgical wound dressing	2 (0.7)	7 (2.3)	25 (8.2)	272 (88.9)
18	I learn the shaving method from others and apply it to pre-operative patients	**27 (8.8)**	45 (14.7)	102 (33.3)	132 (43.1)
19	I used aseptic technique when obtaining swab culture	1 (0.3)	10 (3.3)	39 (12.7)	256 (83.7)
20	I advise an immunodeficiency disorder patient to maintain personal hygiene	6 (2.0)	16 (5.2)	54 (17.6)	230 (75.2)
21	I assess and monitor surgical site condition	4 (1.3)	10 (3.3)	46 (15.0)	246 (80.4)
22	I separate infected from non-infected cases during dressing	8 (2.6)	14 (4.6)	61 (19.9)	223 (72.9)
23	I use face mask during cleansing surgical wound dressing	0 (0.0)	5 (1.6)	18 (5.9)	283 (92.5)
24	I clean and disinfect the surface of the dressing trolley with antiseptic solution	1 (0.3)	7 (2.3)	23 (7.5)	275 (89.9)
25	I discard the soiled material in the proper place after performing wound dressing	4 (1.3)	6 (2.0)	21 (6.9)	275 (89.9)

Association between Demographic Characteristics of the Respondents, Knowledge and Practice towards Prevention of SSI

Table 5 shows the association between nurse's knowledge and practice in the prevention of SSI. This study showed no association between the nurse's knowledge in preventing SSI with their practice (x^2: 1.10; p-value: 0.28).

Table 5: The association between Knowledge with Practice towards Prevention of SSI

Knowledge	Practice (Frequency / Percentage)		Statistical Test (*p*-value)
	Inadequate	Adequate	
Poor Knowledge	2 (28.6)	43 (14.4)	1.10 (0.28)
Good Knowledge	5 (71.4)	256 (85.6)	

This study reported that the nurses' knowledge and practice towards preventing SSI were not significantly associated with their demographic nature except that the nurses' knowledge with the ward they were working at (x^2: 24.51; p-value: 0.01). Nurses who worked in the OT were found to have a higher percentage of good knowledge towards the prevention of SSI (n: 99; 37.9%) as compared to the nurses from other wards, followed by the nurses who worked in the Surgical Ward (n: 71; 27.2%) and Orthopaedic Ward (n: 66; 25.3%) while 42.2% (n: 19) nurses who worked in Obstetrics and Gynaecology Ward reported having a higher percentage of poor knowledge towards preventing SSI (Table 6).

Table 6: The Association between Knowledge towards Prevention of SSI with Demographic Characteristic of the Respondents

Variables	Frequency (*n*) / Percentage (%)		Statistical Test (*p*-value)
	Inadequate	Adequate	
Ward			24.51 (0.01)*
Surgical Ward	10 (22.2)	71 (27.2)	
O & G Ward	19 (42.2)	25 (9.6)	
Orthopaedics Ward	7 (15.6)	66 (25.3)	
Operation Theatre	9 (20.0)	**99 (37.9)**	

DISCUSSION

This current study reported that the 306 nurses working in the Orthopaedic, Surgical, Operation Theatre and Obstetrics, and Gynaecology wards/unit had good knowledge and practices in preventing SSI and their knowledge and practices had no significant difference between the two hospitals, which high suggests that nurses in Malaysia possess adequate knowledge and practices in preventing SSI. Their knowledge related to preoperative skin preparation, the correct purpose for surgical handwashing, and the importance of prophylaxis antibiotics to prevent SSI was highly commendable. This is due to the availability of guidelines on policies and procedures on infection prevention and control practices, which is a priority in every healthcare institution to maintain a safe environment. It is supported with good governance that consists of multi-tier committees that oversee and coordinate at different levels. The excellent support and motivation from nurses and the hospital administration, especially in providing well-structured continuous education, also plays an essential role in preventing SSI in Malaysia (Ministry of Health, 2019).

This study is in line with previous studies, which concurred that continuous educational programs and professional training related to surgical infections would expose their nurses to a body of knowledge on SSI Prevention (Oluwakemi et al., 2017; Balodimou et al., 2018). However, the knowledge in preventing SSI in this current study contradicts with the study by Novelia et al. (2017) in Indonesia as their nurses had poor knowledge of SSI Prevention since their three-year certified diploma in midwifery curriculum in Indonesia does not explicitly focus on evidence-based practices regarding the prevention of SSI. Qasem and Hweidi (2017) and Sadaf, Inayat, Afzal and Hussain (2018) agreed that the lack of special courses regarding evidence-based guidelines for preventing SSIs and misconceptions stemming from the improper assessment of nurses' educational and learning needs are factors which predisposed the nurses to have insufficient knowledge in prevention of SSI. Another factor reported by Qasem and Hweidi (2017) and Sadaf et. al. (2018) was the lack of motivation from both the nurses themselves and the hospital administration and the lack of available research sources for the nurses to update and implement evidence-based practices. Thus, contributing to the contradiction of their study with this current study.

In practice, the nurses in the current study were particular on washing their hands before and after changing wound dressing and touching the surgical site, using the face mask during cleansing surgical wound dressing, cleaning and disinfecting the surface of the dressing trolley with the antiseptic solution and discarding the soiled material in the proper place after performing wound dressing in the prevention of SSI. This shows that the strategies implemented by these hospitals, especially by the nursing staff in preventing SSI, were found to be effective. The strategy was the daily supervision and hands-on auditing such as Nursing Audit and National Operating Room Nursing Audit (NORNA). The HAIs and SSI Surveillance which include an effective infection control program: systematic collection, analysis, interpretation, and dissemination of data were found to have contributed to the prevention of SSI in Malaysia. This was supported by a few studies by Jarelnape (2019); Alabdulrazaq, Almutairi, Alhsaon, and Alsaigh (2018); Sadia et al., (2017); Novelia et al., (2017); and Oluwakemi et al., (2017) which found that clinical supervision and monitoring influenced their nurses' practices regarding the prevention of SSI.

Despite the adequate knowledge and practices in the prevention of SSI in these hospitals, the nurses were reported to have limited knowledge on the best methods for pre-operative shaving. However, the clipping shaving method was the best and was stated in the guideline. Confusion arises as most hospitals would use razors for pre-operative shaving due to the limited resources. It is understood that the supply of hospital equipment depends on the hospital authorities and the priority in supplying the necessary consumables. These findings are similar to the studies by Oluwakemi et al., (2017) and Desalew et al., (2019). Their study reported that the shortage of supplies in consumables causes unsatisfactory practices in preventing SSIs.

The nurses in this study were found to lack understanding of the best agents for pre-operative skin preparation. Although studies have shown that Chlorohexidine Gluconate cleansing leads to a lower rate of MRSA colonization in the hospital setting (Metha et al., 2013; Simor et al., 2007), and it was stated in the SSI Prevention Guideline, most of the respondents were unable to answer this question correctly. This is is attributed to the fact that most cleaning procedures in hospitals used Povidone-iodine (PVP-I) which created confusion among the respondents.

This study showed that respondents could not answer a few questions correctly due to a lack of exposure to the guidelines provided. Besides, the questions related to knowledge and practice in SSI prevention such as laboratory question in assessing the patient's nutritional status, the pre-operative shaving right before surgery, and evaluation of patients' body mass index (BMI) before and after surgery are not routinely practised by the nurses. In addition, the nurses' practices in this study were evaluated using a questionnaire. Hence, the results would not reflect the real practice (Sadia et al., 2017). It is recommended to use visibility and infographic education materials to enhance nurses' knowledge and ensure more comfortable assessment.

The current study reported an association between SSI prevention knowledge with the area where the nurses worked. The OT and the surgical nurses were found to have a higher percentage of good knowledge than the nurses in the other wards/units. This is a result of special training and supervision, including specific strategies such as Safe Surgery Saves Life (SSSL) implemented in the OT to prevent SSI. Enhancing the level of knowledge and practices of SSI Prevention among nurses is essential in reducing HAIs, the primary healthcare problem for people worldwide.

CONCLUSION

This study was conducted to assess the knowledge and practices towards preventing surgical site infection among nurses at the Public Hospital. Data were collected using a self-administered questionnaire to 306 nurses in two public hospitals in Malaysia. The results showed that the nurses had an adequate level of knowledge and practices towards preventing surgical site infection. The OT and the surgical nurses were found to have a higher percentage of good knowledge than the nurses in other wards/units.

The successful strategies of infection control measures, particularly in reducing the rate of SSI, such as well-structured and continuing education programs, adequate supervision and support as well as regular supply of necessary consumables and supplies were considered essential elements to enhance the nurses' competency regarding the prevention of SSI and eliminate knowledge deficit. In order to improve the quality of care and patient safety from suffering surgical site infection,

continuous in-service educational programs and regular monitoring should be implemented by the hospital organization to update the evidence-based knowledge and practices of nurses. Useful standard guidelines, especially for the nurses in related areas, are essential to enhance the knowledge and SSI prevention practice.

One of the limitations encountered in this study was the lack of local-based research which could serve as a benchmark of reference. The convenient sampling technique used often suffers from biases. Using a questionnaire to assess the practices and attitudes of the nurses in the study may not accurately represent their actual perception on the prevention of SSI.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the Director General of Health Malaysia for his permission to publish this article. We would also like to thank to Universiti Teknologi MARA, all the professionals and health personnel for supporting this study.

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