Am J Transl Res 2022;14(2):1339-1346
www.ajtr.org /ISSN:1943-8141/AJTR0138871

Original Article

Comparison of the disinfection effect of iodophor at two different temperatures on the skin of surgical field and its influence on blood pressure and heart rate of patients

Shuangshuang Hu[1*], Weihua Lu[1*], Yinglian Di[2], Fan Geng[1], Wenling Cheng[1], Yongmei Jin[2]

Departments of [1]Operating Room, [2]Nursing, Seventh People's Hospital of Shanghai University of Traditional Chinese Medicine, Shanghai 200137, China. [*]Equal contributors and co-first authors.

Received September 4, 2021; Accepted January 4, 2022; Epub February 15, 2022; Published February 28, 2022

Abstract: Objective: To compare the disinfection effect of iodophor at two different temperatures on the skin of surgical field and its influence on blood pressure and heart rate of patients. Methods: The clinical data of 150 patients who underwent surgery in the Seventh People's Hospital of Shanghai University of TCM were collected and divided into two groups based on different disinfection temperatures; the observation group (constant 36°C) and the control group ((24±2)°C), with 75 patients in each. The postoperative disinfection effects of the two groups were evaluated including the disinfection effect, blood pressure, heart rate, body temperature, cold sensation, gastrointestinal reactions, stress response, incidence of complications in the perioperative period, incision healing and satisfaction rate. Results: The disinfection efficacy of the observation group was 96.00%, which was higher than that of the control group (81.33%, P<0.01); the blood pressure and heart rate of patients in the observation group after disinfection were lower than those in the control group (P<0.001); the body temperature was higher than that of the control group (P<0.001); the cold sensation was weaker and gastrointestinal adverse reactions were less than those of the control group (P<0.05); the MDA, GSH-PX and SOD levels after disinfection in the observation group were lower than those of the control group (P<0.001); the incidence rate of complications in the observation group was lower than that of the control group (P<0.05) and the incision healing rate was higher than that of the control group (P<0.05). Patients in observation group were more satisfied with disinfection method, disinfection effect, prevention of complications, postoperative recovery and disinfection times than patients in the control group (P<0.01). Conclusion: Iodophor at constant temperature is more effective in skin disinfection of the surgical field, with little influence on blood pressure, heart rate and body temperature. This helps to reduce the cold sensation of skin, the incidence rate of gastrointestinal adverse reactions and complications, promote incision healing and improve the satisfaction rate of the surgery. It is worthy of wide application and promotion.

Keywords: Iodophor at constant temperature, surgical field, skin disinfection, blood pressure, heart rate, incision healing, cold sensation, gastrointestinal reactions

Introduction

Surgery, a widely-used invasive treatment in clinical practice, refers to the medical practice where doctors excise and suture the lesion tissue of patients locally in the human body using medical devices, mostly scalpels, surgical scissors, needles and other devices to cure diseases and keep patients healthy [1]. It has high requirements for disinfection of the patients' skin in the area of the surgical field, and inappropriate disinfection will increase the risk of surgery as well as the nosocomial infection rate [2, 3]. Iodophor is an amorphous conjugate of elemental iodine and polyvinylpyrrolidone, which is purple-black. It is a widely-used bactericidal disinfectant in medical treatment and can kill bacteria in vegetative form, fungi and some viruses [4, 5]. At the same time, iodophor can also be used for the skin disinfection before surgery, disinfection of injection site, disinfection of the vagina or other situations [6, 7]. However, there is a lack of uniform consensus on the temperature of iodophor in clinical prac-

tice [8, 9]. Previous studies have shown that although iodophor disinfection at room temperature has a good disinfection effect for skin of the surgical field, it holds a greater impact on the patients' stress response, resulting in significant fluctuations in the patients' blood pressure and heart rate [10]. Domestic scholars have stated that iodophor disinfection at room temperature causes greater stress response of patients [11]. While during the surgery, iodophor is heated to make it closer to the human body temperature, so as to achieve a good disinfection effect and provide an ideal surgical field which helps patients successfully go through the surgery. However, this has not been verified. Therefore, in this study, we focused on the disinfection effect of iodophor at two temperatures on the skin of the surgical field and the influence on patients' blood pressure and heart rate.

Materials and methods

General information

The clinical data of 150 patients who underwent surgery in the Seventh People's Hospital of Shanghai University of TCM from January 2020 to October 2020 were retrospectively selected. In the control group, patients' skin in the area of the surgical field was disinfected with iodophor at room temperature ((24±2)°C), while in the observation group, the skin around the surgical field was disinfected with iodophor at constant temperature (36°C). This study was approved by the hospital Ethics Committee (No. 2021-IRBQYYS-027), and the patients or their family members signed informed consent forms.

Inclusion and exclusion criteria

Inclusion criteria: (1) Patients who met the surgical treatment indications, and those who could survive the surgery [12]; (2) Patients who received iodophor disinfection to disinfect the skin of the surgical field who were without history of drug allergy; (3) Patients who provided complete baseline data and follow-up data. Exclusion criteria: (1) Patients with mental disorders, blood system diseases or other diseases; (2) Patients with cognitive dysfunction, severe liver or kidney dysfunction; (3) Patients with systemic infectious diseases or sepsis.

Methods

The preparation of the operating room including disinfection was done before surgery. The operating room temperature (24±2°C) and its internal content (≤200 cfu) were controlled within the normal range. The 0.5% iodophor (Changshu Xinghai Pharmaceutical Co., Ltd., China) and electrothermal constant temperature water bath cauldron (HNS11-9, Shanghai Fifth Factory of Medical Devices) were prepared before surgery [13, 14].

In the control group, the skin of surgical field of patients was disinfected with iodophor at room temperature. One day before surgery, iodophor was put in an unopened plastic bottle placed in the operating room at room temperature of 25°C. After the required temperature of iodophor was confirmed before surgery, gauze dipped in iodophor was used for disinfection, and the disinfection area was gradually enlarged from the center of the skin of surgical field to the area about 15 cm around the surgical incision.

In the observation group, the skin of surgical field of patients was disinfected with warmed iodophor. One day before surgery, iodophor was put in an unopened plastic bottle placed in the operating room. The bottle was then shaken and warmed in the electric thermostatic water bath cauldron for 0.5 h until the temperature of iodophor inside reached 36°C. The skin of surgical field was disinfected the same as the control group, during which a piece of gauze was only applied once [15]. The disinfection effect of the patients was evaluated after surgery in both groups.

Outcome measures

(1) Disinfection effect was evaluated, and it was divided into significantly effective, effective and ineffective. Significantly effective: the disinfection effect was good, and the patient was not infected; effective: the disinfection basically met the needs of the surgery and the stress response of the patient was mild; ineffective: the disinfection effect was bad, and it affected the surgery negatively. Disinfection efficacy = (significantly effective cases + effective cases)/total cases *100%. (2) Blood pressure (including diastolic blood pressure and systolic blood pressure), heart rate and body

Table 1. Comparison of general information between both groups (n, $\bar{x}$±sd)

Index	Observation group (n=75)	Control group (n=75)	χ^2/t	P
Gender (n)			0.108	0.742
Male	43	41		
Female	32	34		
Age (Y)	53.4±4.4	53.3±4.3	0.139	0.890
BMI (kg/m^2)	23.6±3.3	22.6±3.2	1.884	0.062
Operation types (n)			0.287	0.963
Cesarean section	21	24		
Appendectomy	18	17		
Hernia repair	16	15		
Mastectomy	10	8		
Surgical treatment of chest wall tumor	10	11		

Note: BMI: body mass index. χ^2: statistical value of chi-square test; t: statistical value of t-test.

temperature were recorded before and after disinfection in both groups [16]. (3) Incidences of cold sensation of skin and the gastrointestinal reactions (including nausea and vomiting, abdominal discomfort, defecation sensation, diarrhea and abdominal pain) were recorded in both groups [17]. (4) Stress responses of patients were recorded in both groups. The levels of malondialdehyde (MDA), glutathione peroxidase (GSH-PX) and superoxide dismutase (SOD) were measured by enzyme-linked immunosorbent assay before and after disinfection in both groups [18]. (5) The incidence of complications and incision healing rate were recorded in both groups. Arrhythmia, incision infection, pulmonary infection, urinary tract infection and incision healing rate were also recorded. Incidence of complications = the sum of cases of each complication/total cases *100%. Incision healing rate = the number of cases of incision healing/total cases *100%. (6) Satisfaction rate was evaluated in both groups. After disinfection, satisfaction rate was evaluated using general a satisfaction questionnaire including the satisfaction with the disinfection method, disinfection effect, prevention of complications, postoperative recovery and disinfection times. The total score of each item was 100 points. Scores ≥90 points were satisfied; 60-89 points were fairly satisfied and scores <60 points were unsatisfied. Satisfaction rate = (satisfied cases + fairly satisfied cases)/total cases *100% [19, 20].

Statistical analysis

SPSS 18.0 software was used for data processing. χ^2 test was performed for the comparison of enumeration data, which was expressed as n (%). All measurement data conformed to a normal distribution and were expressed as mean ± standard deviation ($\bar{x}$±sd). Independent sample t-test was used for comparison between groups, and paired t-test was performed for the comparison within group. P<0.05 indicated statistically significant difference.

Results

Comparison of general information between both groups

There was no statistical significance in the general data between the two groups; thus, they were comparable (all P>0.05). See **Table 1**.

Comparison of disinfection effect between both groups

The disinfection efficacy of the observation group was 96.00%, which was higher than that of the control group (81.33%, P<0.01, **Table 2**).

Comparison of blood pressure, heart rate and body temperature between two groups before and after disinfection

Before disinfection, there was no statistical significance between two groups (P>0.05). The blood pressure and heart rate after disinfection in both groups were higher than those before disinfection (P<0.001); body temperature after disinfection was lower than that before disinfection (P<0.001). After disinfection, the blood pressure and heart rate of patients in the observation group were lower than those in the

Table 2. Comparison of disinfection effect between both groups (n, %)

Groups	Significantly effective	Effective	Ineffective	Disinfection efficacy
Observation group (n=75)	54 (72.00)	18 (24.00)	3 (4.00)	72 (96.00)
Control group (n=75)	47 (62.67)	14 (18.67)	14 (18.67)	61 (81.33)
χ^2				8.027
P				0.005

Note: χ^2: statistical value of chi-square test.

Table 3. Comparison of blood pressure, heart rate and body temperature between both groups before and after disinfection ($\bar{x}\pm sd$)

Groups	Diastolic blood pressure (mmHg)	Systolic blood pressure (mmHg)	Heart rate (times/min)	Body temperature (°C)
Observation group (n=75)				
Before disinfection	75.88±5.45	124.69±16.32	73.23±7.39	36.67±0.41
After disinfection	82.31±6.89***,###	132.31±6.89***,###	81.16±9.48***,###	36.24±0.40***,###
Control group (n=75)				
Before disinfection	75.89±5.46	124.70±16.34	73.25±7.42	36.68±0.43
After disinfection	88.42±7.02***	140.29±20.49***	90.48±12.16***	35.68±0.35***

Note: Compared with that before disinfection, ***P<0.001; compared with control group, ###P<0.001.

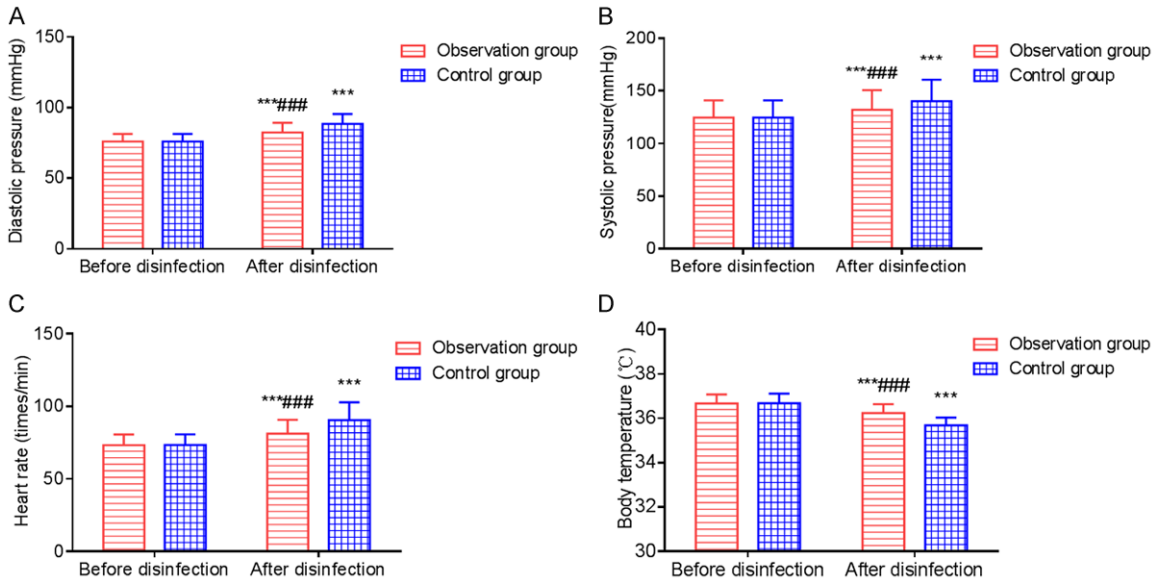

Figure 1. Comparison of blood pressure, heart rate and body temperature between both groups before and after disinfection. A: Diastolic blood pressure (mmHg); B: Systolic blood pressure (mmHg); C: Heart rate (times/min); D: Body temperature (°C). Compared with that before disinfection, ***P<0.001; compared with control group, ###P<0.001.

control group (P<0.001); body temperature of patients in the observation group was higher than that in the control group (P<0.001). See **Table 3** and **Figure 1**.

Comparison of cold sensation of skin and gastrointestinal reactions between both groups

The cold sensation of the skin and the incidence of nausea and vomiting, abdominal discomfort, defecation sensation, diarrhea and abdominal pain in the observation group were lower than that in the control group (P<0.05, **Table 4**).

Comparison of stress response between both groups

There was no significant difference in stress response before disinfection between two

Table 4. Comparison of cold sensation of skin and gastrointestinal reactions between both groups (n, %)

Groups	Cold sensation of skin	Gastrointestinal reactions			
		Nausea and vomiting	Abdominal discomfort	Defecation sensation	Diarrhea and abdominal pain
Observation group (n=75)	2 (2.67)	1 (1.33)	0 (0.00)	1 (1.33)	0 (0.00)
Control group (n=75)	9 (12.00)	2 (2.67)	1 (1.33)	2 (2.67)	3 (4.00)
χ^2	4.807			3.856	
P	0.028			0.049	

Note: χ^2: statistical value of chi-square test.

Table 5. Comparison of stress response between both groups ($\bar{x}\pm sd$)

Group	MDA (mmol/mL)	GSH-PX (μg)	SOD (U/mL)
Observation group (n=75)			
Before disinfection	5.39±0.43	62.32±3.69	85.35±7.83
After disinfection	2.25±0.31***,###	36.39±3.21***,###	62.12±5.36***,###
Control group (n=75)			
Before disinfection	5.40±0.45	62.34±3.71	85.34±8.82
After disinfection	3.79±0.41***	49.87±4.23***	78.57±7.72***

Note: MDA: malondialdehyde; GSH-PX: glutathione peroxidase; SOD: superoxide dismutase. Compared with that before disinfection, ***P<0.001; compared with control group, ###P<0.001.

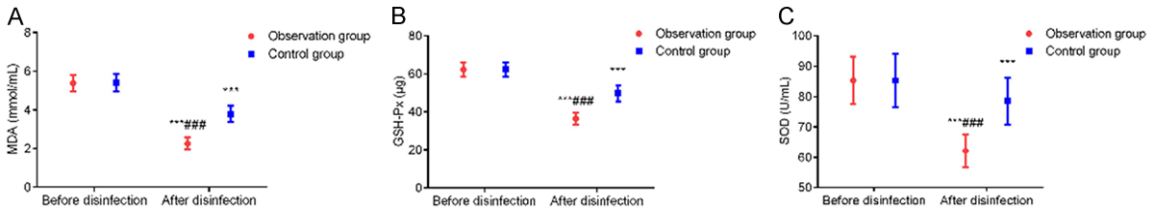

Figure 2. Comparison of stress response between both groups. A: MDA (mmol/mL); B: GSH-PX (μg); C: SOD (U/mL). MDA: malondialdehyde; GSH-PX: glutathione peroxidase; SOD: superoxide dismutase. Compared with that before disinfection, ***P<0.001; compared with control group, ###P<0.001.

groups (P>0.05). After disinfection, MDA, GSH-PX and SOD levels in both groups were lower than those before disinfection (P<0.001); MDA, GSH-PX and SOD levels after disinfection in the observation group were lower than those in the control group (P<0.001). See **Table 5** and **Figure 2**.

Comparison of complications and incision healing between two groups

The incidence of arrhythmia, incision infection, pulmonary infection and urinary tract infection in the observation group was lower than that in control group (P<0.05); the incision healing rate in the observation group was higher than that in control group (P<0.05, **Table 6**).

Comparison of overall satisfaction between both groups

The satisfaction rate in the observation group with disinfection methods, disinfection effect, prevention of complications, postoperative recovery and disinfection times was higher than that in the control group (P<0.01). See **Table 7**.

Discussion

Iodophor is the most commonly used skin disinfectant in the operating room. Since a large area of the skin of the surgical field needs to be exposed and disinfected during the operation, it is likely to cause massive heat loss of the

Table 6. Comparison of complications and incision healing between both groups (n, %)

Groups	Incision healing	Perioperative complications			
		Arrhythmia	Incision infection	Pulmonary infection	Urinary infection
Observation group (n=75)	73 (97.33)	0 (0.00)	0 (0.00)	1 (1.33)	1 (1.33)
Control group (n=75)	65 (86.67)	2 (2.67)	2 (2.67)	3 (4.00)	2 (2.67)
χ^2	5.797			4.807	
P	0.016			0.028	

Note: χ^2: statistical value of chi-square test.

Table 7. Comparison of overall satisfaction between both groups (n, %)

Groups	Satisfied	Fairly satisfied	Dissatisfied	Overall satisfaction
Observation group (n=75)	61 (81.33)	12 (16.00)	3 (4.00)	73 (97.33)
Control group (n=75)	56 (74.67)	8 (10.67)	13 (17.33)	62 (85.33)
χ^2				8.963
P				0.003

Note: χ^2: statistical value of chi-square test.

patient's skin. In addition, the operation is risky and invasive, during which the patients' body temperature drops. On this occasion, iodophor disinfection may produce a strong sense of cold stimulation, resulting in patient discomfort and affecting the surgery negatively [21].

Previous studies have shown that the cold stimulation generated by local disinfection of the skin of surgical field with iodophor can affect abdominal and visceral sensory thresholds [22]. In this study, the application effect of iodophor at two temperatures on skin disinfection of the surgical field was compared. The results showed that the disinfection efficacy in the observation group (96.00%) was higher than that in the control group (81.33%); the blood pressure and heart rate after disinfection in the observation group were lower than those in the control group; the body temperature was higher than that in the control group; the cold sensation of skin was weaker and gastrointestinal adverse reactions after disinfection were less than those in the control group, suggesting that the constant temperature iodophor is effective in the skin disinfection of surgical field, which has little negative effect on the vital signs of patients, and helps to reduce cold sensation of skin and gastrointestinal reactions [23]. The main reason may be due to the fact that at room temperature (24°C) iodophor removes a large amount of heat from the patients' body surface and increases the sensitivity of the skin and viscera. Cold stimulation from iodophor increases the sensitivity of peripheral temperature receptors and central cold-sensitive neurons in the body while decreases the excitability of the thermogenic central nervous system [24]. This affects patients' normal vital signs. However, iodophor at body temperature has fewer negative effects on the vital signs of patients, which is more suitable for the skin. It can reduce patients' stress response, promote incision healing, thus obtaining higher disinfection satisfaction from patients [25]. In this study, the levels of MDA, GSH-PX and SOD after disinfection in the observation group were lower than those in the control group; the incidence rate of complications in the observation group was lower than that in the control group; the incision healing rate was higher than that in the control group; the satisfaction with the disinfection method, disinfection effect, prevention of complications, postoperative recovery and disinfection times in the observation group was higher than that in the control group. This demonstrates that iodophor at body temperature used for skin disinfection of the surgical field can reduce the stress response, improve the disinfection satisfaction and promote the incision healing. Chen Jing et al. reported that the iodophor solution close to human body temperature could significantly reduce the physiological stimulation to the patients during the disinfection compared with the iodophor solution at the operating room temperature, which is consistent with the results of this study [26]. Where

the patient's body is less prone to stress response, which is conducive to the recovery after surgery.

However, there are also many shortcomings in this study. The sample size in the study is small, which needs to be further verified by studies with larger sample size. Besides, there might be some human errors in data processing, which needs to be further studied and discussed.

In summary, the application of iodophor at body temperature in the disinfection of the skin of surgical field can obtain a good disinfection effect, with fewer effects on the blood pressure, heart rate and body temperature of patients. It helps to reduce the cold skin sensation, the incidence rate of gastrointestinal adverse reactions and complications, promote the incision healing and improve the disinfection satisfaction. Therefore it is worthy of being widely promotion.

Acknowledgements

This work was sponsored by the Shanghai Sailing Program (20YF1437100).

Disclosure of conflict of interest

None.

Address correspondence to: Yongmei Jin, Department of Nursing, Seventh People's Hospital of Shanghai University of Traditional Chinese Medicine, No. 358 Datong Road, Pudong New District, Shanghai 200137, China. Tel: +86-021-58670561-6244; Fax: +86-021-58670561-6244; E-mail: 15201742762@163.com

References

[1] Bell B, O'Donovan J, Wright ST, Gemelli CN, Knight E and Hirani R. Evaluation of a sterile surgical skin marker to indicate the optimal vein for venepuncture in the blood donation setting. Vox Sang 2020; 115: 377-387.

[2] Liang Y, Chen B, Li M, He J, Yin Z and Guo B. Injectable antimicrobial conductive hydrogels for wound disinfection and infectious wound healing. Biomacromolecules 2020; 21: 1841-1852.

[3] Bonifetto R, Zenobio AD, Muzzi L, Turtù S, Zanino R and Zappatore A. Thermal-hydraulic analysis of the DTT toroidal field magnets in DC operation. IEEE Trans Appl Supercond 2020; 30: 1-5.

[4] Seo SG, Joeng J, Kim K, Kim K and Jin SH. Bias stress instability in multilayered MoS2 field-effect transistors under pulse-mode operation. IEEE Trans Electron Devices 2020; 67: 1864-1872.

[5] Zhang Y, Bai Y, Yang H and Zhang B. Low switching frequency model predictive control of three-level inverter-fed IM drives with speed-sensorless and field-weakening operations. IEEE Trans Ind Electron 2019; 66: 4262-4272.

[6] You WX and Su P. Depolarization field in ferroelectric nonvolatile memory considering minor loop operation. IEEE Electron Device Lett 2019; 40: 1415-1418.

[7] Liu C, Chen C, Li X, Hu S, Liu C, Huang K, Dai F, Zhang B, Liu X, Minari T, Noh YY and Chen J. A general approach to probe dynamic operation and carrier mobility in field-effect transistors with nonuniform accumulation. Adv Funct Mater 2019; 29: 1901700.

[8] Fang HK, Chang-Liao KS, Chou KC, Chao TC, Tsai JE, Li YL, Huang WH, Shen CH and Shieh JM. Impacts of electrical field in tunneling layer on operation characteristics of poly-Ge charge-trapping flash memory device. IEEE Electron Device Lett 2020; 41: 1766-1769.

[9] Nakano H, Ito K, Miura A and Majima Y. Solution-processed silicane field-effect transistor: operation due to stacking defects on the channel. Adv Funct Mater 2020; 30: 1908746.

[10] Wu X, Chen C, Teng Y, Wu P, Shi Y, Yang D, Song Z, Wang D and Sun J. A novel high power vacuum diode with a focusing electrode for effective operation in a low guiding magnetic field. Rev Sci Instrum 2020; 91: 014706.

[11] Wang QY. Comparison of two temperatures of iodophor for surgical site disinfection. Chin J Disinfect 2014; 31: 431-432.

[12] Steinkopff A, Jauregui C, Stutzki F, Nold J, Hupel C, Haarlammert N, Bierlich J, Tünnermann A and Limpert J. Transverse single-mode operation in a passive large pitch fiber with more than 200 μm mode-field diameter. Opt Lett 2019; 44: 650-653.

[13] Program of Randomized Trials to Evaluate Preoperative Antiseptic Skin Solutions in Orthopaedic Trauma (PREP-IT) Investigators, Slobogean GP, Sprague S, Wells J, Bhandari M, Rojas A, Garibaldi A, Wood A, Howe A, Harris AD, Petrisor BA, Mullins DC, Pogorzelski D, Marvel D, Heels-Ansdell D, Mossuto F, Grissom F, Del Fabbro G, Guyatt GH, Della Rocca GJ, Demyanovich HK, Gitajn IL, Palmer J, D'Alleyrand JC, Friedrich J, Rivera J, Hebden J, Rudnicki J, Fowler J, Jeray KJ, Thabane L, Marchand L, O'Hara LM, Joshi MG, Talbot M, Camara M, Szasz OP, O'Hara NN, McKay P, Devereaux PJ, O'Toole RV, Zura R, Morshed S, Dodds S, Li S, Tanner SL, Scott T and Nguyen U. Effectiveness of iodophor vs chlorhexidine solutions for

surgical site infections and unplanned reoperations for patients who underwent fracture repair: the PREP-IT master protocol. JAMA Netw Open 2020; 3: e202215.
[14] Chen YC, Liao CH, Shen WT, Su C, Wu YC, Tsai MH, Hsiao SS, Yu KP and Tseng CH. Effective disinfection of airborne microbial contamination in hospital wards using a zero-valent nanosilver/tio(2)-chitosan composite. Indoor Air 2019; 29: 439-449.
[15] Khalatbari-Soltani S, de Mestral C, Waeber G and Marques-Vidal P. Large regional disparities in prevalence, management and reimbursement of hospital undernutrition. Eur J Clin Nutr 2019; 73: 121-131.
[16] Strowd LC; Society of Dermatology Hospitalists. Inpatient dermatology: a paradigm shift in the management of skin disease in the hospital. Br J Dermatol 2019; 180: 966-967.
[17] Maharana PK, Nawaz S, Singhal D, Jhanji V, Agarwal T, Sharma N and Vajpayee RB. Causes and management outcomes of acquired corneal opacity in a preschool age (0-5 years) group: a hospital-based study. Cornea 2019; 38: 868-872.
[18] Spong AD, Christie LE and Hayes MA. Emergency airway management in the critically ill: a 1 yr review of practice within a london teaching hospital. Br J Anaesth 2018; 121: e11-e12.
[19] Kohoutova M, Horak J, Jarkovska D, Martinkova V, Tegl V, Nalos L, Vistejnova L, Benes J, Sviglerova J, Kuncova J, Matejovic M and Stengl M. Vagus nerve stimulation attenuates multiple organ dysfunction in resuscitated porcine progressive sepsis. Crit Care Med 2019; 47: e461-e469.
[20] Nunayon SS, Zhang H and Lai ACK. Comparison of disinfection performance of UVC-LED and conventional upper-room UVGI systems. Indoor Air 2020; 30: 180-191.
[21] Wang S, Chen J, Wakeling C, Bach S, Orban S and Delaquis P. Disinfection of alfalfa and radish sprouting seed using oxidizing agents and treatments compliant with organic food production principles. J Food Prot 2020; 83: 779-787.
[22] Ries M. Telemedicine application to progressive care units: a new role for telemedicine. Crit Care Med 2018; 46: 816-817.
[23] Zhang SF, Tuo JL, Huang XB, Zhu X, Zhang DM, Zhou K, Yuan L, Luo HJ, Zheng BJ, Yuen KY, Li MF, Cao KY and Xu L. Epidemiology characteristics of human coronaviruses in patients with respiratory infection symptoms and phylogenetic analysis of HCoV-OC43 during 2010-2015 in Guangzhou. PLoS One 2018; 13: e0191789.
[24] Wills SE, Beaufrère HH, Brisson BA, Fraser RS and Smith DA. Pancreatitis and systemic coronavirus infection in a ferret (mustela putorius furo). Comp Med 2018; 68: 208-211.
[25] Bonny TS, Yezli S and Lednicky JA. Isolation and identification of human coronavirus 229E from frequently touched environmental surfaces of a university classroom that is cleaned daily. Am J Infect Control 2018; 46: 105-107.
[26] Jing C, Dan L and Wu RM. Effect of different temperature of iodophor on the physiological function of patients after surgical field disinfection. Super Baby 2017; 6: 29-33.