

Les mesures de prévention et de contrôle des infections pendant la pandémie de COVID-19: impact sur la prévalence des infections nosocomiales à l'Hôpital universitaire de Sahloul, Sousse, Tunisie

The Infection Prevention and Control measures during the COVID-19 pandemic: Impact on the Prevalence of Hospital-Acquired Infections at Sahloul University Hospital, Sousse, Tunisia

Salma Balhi^{1,2}, Bouthaina Hamza¹, Marwa jardak^{3,4}, Nihel Haddad^{1,2}, Hela Ghali^{1,2}, Sana Bhiri^{1,2}, Houyem Said Laatiri^{1,2}, Asma Ben Cheikh^{1,2}

1. University of Sousse, Faculty of Medicine of Sousse
2. Preventive and community medicine department, Sahloul University Hospital of Sousse.
3. University of Monastir, Faculty of pharmacy of Monastir, drug development laboratory LR12ES09
4. Pharmacy department, sahloul hospital of sousse

ABSTRACT

Introduction: Hospital-acquired infections (HAI) represent a growing public health concern and are the most common adverse events in healthcare delivery. Improvements in infection prevention and control (IPC) practices at both national and facility levels are decisive for successfully preventing HAIs. The relevance of IPC in preventing the spread of disease was underscored during the COVID-19 pandemic. However, the impact of COVID-19 preventive measures on HAIs remains debated.

Aim: This study aims to investigate the impact of the IPC program implemented during the COVID-19 pandemic at Sahloul University Hospital in Tunisia on the prevalence of HAIs. Additionally, the study will assess compliance with IPC measures during the same period.

Methods: A pre-interventional study design will be conducted at Sahloul University Hospital in Sousse, Tunisia. The study will compare HAI prevalence over three periods: pre-pandemic (2019), during the pandemic (2020) and post-pandemic (2022). For the Point prevalence survey, all hospital wards (units or departments) will be included in the survey, except the emergency department, hemodialysis unit and endoscopy units. Four key IPC program criteria will be analyzed: hand hygiene compliance, environmental cleaning, sanitary waste management, and the consumption of personal protective resources, including alcohol-based hand sanitizer, surgical masks and disposable gloves.

Expected results: This study specifically explores the effects of IPC measures implemented during the COVID-19 pandemic on HAIs prevalence. Its findings are expected to contribute valuable insights into sustainable strategies for maintaining high compliance rates and reducing HAI prevalence beyond crisis periods.

Keys words: Hospital acquired infection, prevalence, COVID-19, infection prevention and control

RÉSUMÉ

Introduction: Les infections nosocomiales (IN) représentent un problème majeur de santé publique et figurent parmi les événements indésirables les plus fréquents lors de la prestation de soins. L'amélioration des pratiques de lutte et de prévention des infections au niveau des établissements est déterminante pour prévenir efficacement les IN. L'importance des pratiques de prévention et de contrôle des infections a été soulignée pendant la pandémie de COVID-19. Cependant, l'impact de ces mesures préventives liées au COVID-19 sur les IN demeure un sujet de débat.

Objectifs: Analyser l'impact du programme de prévention et de contrôle des infections mis en œuvre pendant la pandémie de COVID-19 à l'hôpital universitaire Sahloul, Sousse sur la prévalence des IN ; et évaluer le degré de conformité de ces mesures préventives pendant la même période.

Méthodes: Une étude pré-interventionnelle sera menée à l'hôpital universitaire Sahloul de Sousse, en Tunisie. L'étude comparera la prévalence des IN sur trois périodes : avant la pandémie (2019), pendant la pandémie (2020) et après la pandémie (2022). Pour l'enquête de prévalence, toutes les unités de l'hôpital (services ou départements) seront incluses dans l'enquête, à l'exception du service des urgences, de l'unité de dialyse et des unités d'endoscopie. Quatre critères du programme de prévention et de contrôle des infections seront analysés : la conformité à l'hygiène des mains, le bio-nettoyage de l'environnement, la gestion des déchets d'activités sanitaires et la consommation de ressources, y compris le gel hydroalcoolique, les masques chirurgicaux et les gants jetables.

Résultats attendus: Cette étude explore spécifiquement les effets des mesures de prévention instaurées pendant la pandémie de COVID-19 sur la prévalence des IN. Les résultats attendus devraient fournir des informations précieuses pour des stratégies durables visant à réduire la prévalence des IN au-delà des périodes de crise et maintenir des taux de conformité élevés.

Mots clés: Infection nosocomiale, prevalence, COVID-19, infection prévention et contrôle

Correspondance

Salma Balhi

Preventive and community medicine department, Sahloul Hospital of Sousse. University of Sousse, Faculty of Medicine of Sousse

Email: salmabalhi@yahoo.fr

INTRODUCTION

Hospital-acquired infection (HAI) are defined as infections acquired by a patient during their process of care (including preventive, diagnostic and treatment services), which were neither present nor incubating at the time of admission [1]. HAIs represent a growing public health concern [1]. They constitute the most common adverse events during healthcare delivery [1]. HAIs lead to an increase in morbidity, mortality, and economic burden [1]. During 2022-2023, a point prevalence survey conducted in EU/EEA acute care hospitals showed that the prevalence of patients with at least one HAI was 7.1% [2]. In Africa, a recent meta-analysis revealed that the pooled point-prevalence of HAIs was more than twice the rate reported in developed countries [3].

According to the World Health Organization (WHO), HAIs are a consequence of poor-quality care, including the lack of an infection prevention and control (IPC) program, lack of hand hygiene (HH) training, and inadequate infrastructures [1]. In fact, up to 50% of HAIs could be prevented by implementing preventive practices [1]. Improvements in IPC at both national and facility levels are decisive for the successful prevention of HAIs, including epidemics of highly transmissible diseases [1-4].

During the COVID-19 pandemic, healthcare system faced many challenges [5-6]. Healthcare settings continued to provide essential care while managing COVID-19 patients [5-6]. Thus, the relevance of IPC in preventing the spread of disease was underscored during this pandemic [7].

However, the impact of COVID-19 preventive measures on HAIs remains a subject of debate [8-9]. Many studies reported that the COVID-19 pandemic influenced the emergence of HAIs, especially in intensive care units, due to the enormous demands on healthcare systems, which reduced the quality of infection control worldwide [10]. Moreover, the irrational use of antibiotics among COVID-19 patients led to the emergence of antimicrobial resistance [10-12]. However, other studies claimed that infection control measures, such as increased use of personnel protective equipment (PPE), and improved hand hygiene, led to a decline in HAI incidence rates [13-15].

In Tunisia, HAIs are also a significant public health issue. According to the Noso-Tun2012 national survey [16], which included 144 public and private establishments, the prevalence of HAIs was 7.2% (affecting 1 in 15 hospitalized patients). Moreover, a cross-sectional study conducted during 2020 at Sahloul University Hospital found that the prevalence of HAIs was estimated at 15.5% [17]. As part of the response to COVID-19, the government implemented early preventive measures, including the use of PPE, patient isolation, and alcohol-based hand rubs [18-19]. A Tunisian study involving 723 frontline healthcare workers found that PPE was even overused during the COVID-19 pandemic [20]. However, the impact of these protective measures taken during the COVID-19 pandemic on HAIs is still unknown in Tunisia.

Therefore, the primary objective of this research protocol will be to investigate the impact of the IPC program implemented during the COVID-19 pandemic at Sahloul University Hospital in Tunisia on the prevalence of HAIs.

Additionally, the study will aim to assess compliance with IPC measures over the same period.

Research Questions

- What was the impact of the IPC measures implemented at Sahloul University Hospital in Sousse, Tunisia, during the COVID-19 pandemic on the prevalence of HAIs?
- How did compliance with IPC practices evolve during the same period?

METHODS

Study design and institutional setting

A pre-interventional study design will be conducted at Sahloul University Hospital in Sousse, Tunisia. The study will compare HAI prevalence over three periods time (Fig 1).

• **Before the COVID-19 pandemic (2019):** baseline for HAI prevalence prior to the implementation of IPC reinforcement programs.

• **During the COVID-19 pandemic (2020):** implementation of enhanced IPC programs in response to the COVID-19 pandemic.

• **Post-COVID-19 pandemic (2022):** evaluation of the sustainability and long-term effectiveness of the IPC measures after the acute phase of the pandemic

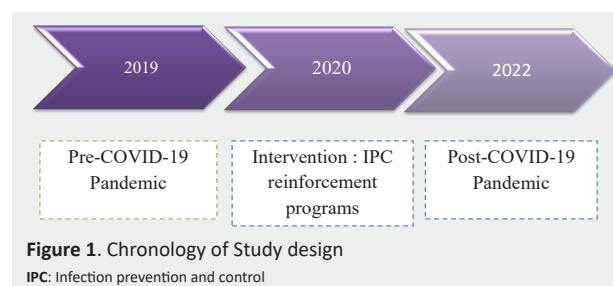


Figure 1. Chronology of Study design
IPC: Infection prevention and control

Sahloul University Hospital is a teaching and referral hospital with a surgical focus, located in central Tunisia. The hospital operates 654 active beds and recorded 25,969 inpatient admissions in 2024. Since 1991, an annual point-prevalence survey (PPS) has been conducted under the supervision of the Prevention and Care Safety Department, with data collected through a single-pass survey of each hospital service. These PPS data will be used to assess HAI prevalence during the study periods.

Study population

All hospital wards (units or departments) will be included in the survey, except the emergency department, hemodialysis and endoscopy units, due to their short length of stay. Departments included in our analysis will be categorised as :

- **Intensive care units:** surgical resuscitation, post-operative general surgery, post-operative cardiovascular and thoracic surgery, post-operative cardiovascular pediatric surgery, cardiology intensive care unit, medical resuscitation, pediatric resuscitation, and transplant unit.
- **Surgical department:** surgery, orthopedics, pre-cardiovascular and thoracic surgery, neurosurgery,

maxillofacial surgery, urology, and burns service.

• **Medical department:** internal medicine, gastroenterology, cardiology, pediatrics, nephrology, neurology, and rehabilitation.

All patients present at Sahloul University Hospital during 48 hours or greater prior to the survey will be considered. The study will exclude SARS-CoV-2 suspected or confirmed positive cases, which will be isolated and admitted to wards or specialized critical care units.

Infection-prevention practices prior to COVID-19 pandemic

The hospital has a prevention and care safety department established in 1992, and a Hygiene and Nosocomial Infection Control Committee (CLIN), set up in 2010. The Prevention and Care Safety Department manages various activities related to hospital hygiene and quality of care, including active surveillance of HAIs and other adverse events, environmental decontamination, central sterilization of reusable medico-surgical devices, healthcare waste management, implementation of contact precautions for infected and colonized patients, and the promotion of hygiene through supervision, assistance, and training.

Infection prevention and control strategy implemented during COVID-19 pandemic in Sahloul hospital

From the declaration of the first case of SARS-CoV2 infection in Tunisia, on March 4, 2020, a COVID-19 committee was established at Sahloul University Hospital. The IPC program aimed to minimize the risk of contamination within the hospital. This strategy was based on :

Epidemiological surveillance: Continuous monitoring to detect and respond to cases promptly.

Training at-risk workers: The Prevention and Security of Care Department conducted both theoretical and practical training sessions for healthcare workers. The aim of these sessions was to ensure mastery and compliance with hospital hygiene rules and protective measures against the risk of SARS-CoV-2 contamination. These sessions focused on good hand hygiene practices, standard precautions, prevention of COVID-19 transmission, proper donning and doffing of PPE, and biocleaning of isolation units for COVID-19 patients.

Drafting guides, procedures and protocols: Comprehensive documents were developed to standardize and guide infection control practices. For example: the development of the guide "Hygiene Recommendations for COVID-19 Units and Hospitalization Services, the procedure: "Pathway for a COVID-19 Patient Undergoing an Interventional Radiology Procedure" and the preparation of posters and videos on wearing surgical and FFP2 masks, as well as the organization of septic isolation.

Assessment of professional practices: regular audits were conducted including hand hygiene audit of healthcare professionals, audit of biocleaning practices, audit of infectious healthcare waste management practices.

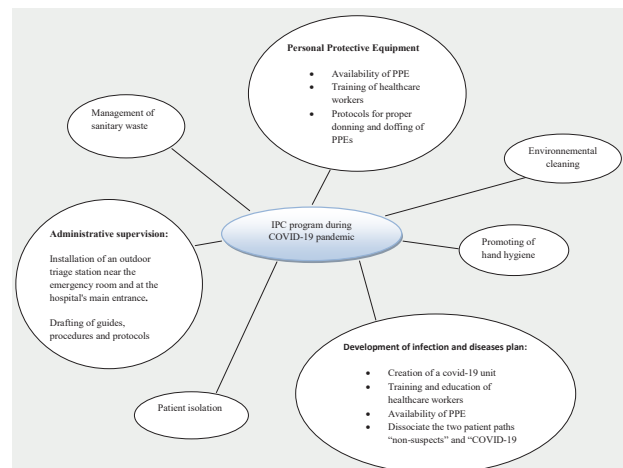


Figure 2. Infection and prevention control program implemented at Sahloul university hospital during the COVID-19 pandemic

Data collection procedure

Primary outcome: The point prevalence survey

Data collection will be carried out by the Prevention and Care Safety Department investigator team, including doctors, senior hygiene technicians, and nurses. All participants will undergo a half-day training course prior to the survey and will be supervised by two principal investigators. Data will be collected from medical records, laboratory reports, temperature charts, radiographs, and consultation with the referring health professionals. In some cases, additional follow-up will be necessary to obtain the results of complementary examinations during the survey in order to confirm (or disprove) the HAI. Each ward will be surveyed only once on a single day. The total duration of each prevalence survey will be two weeks. Data will be collected retrospectively using a standardized form inspired by the "NosoTun 2012" national nosocomial infection survey form [25]. This form will be structured into four main sections :

i) **Demographic data and hospitalization information,** gender, date of hospitalization, ward type, diagnosis, date of discharge.

ii) **Exposure to risk factors**

• **Intrinsic factors:** conditions such as diabetes, obesity, malnutrition, and immunodeficiency

• **Extrinsic factors :** external risks including antibiotic use in the previous six months, surgery within the past 30 days, the use of invasive medical devices such as urinary catheters, vascular catheters (central/peripheral), and mechanical ventilation.

iii) **Data on diagnosed HAIs and microbiological cultures:** information collected will include presence of HAI during hospital admission, site and number of HAI per patient, microbiological cultures performed, and the micro-organisms identified.

iv) **Antibiotic therapy:** details of antimicrobial treatments will be recorded, including the type of antimicrobial(s) used, indication for treatment, duration of therapy.

Monitoring of compliance with IPC measures

For this study, four criteria from the IPC program will

be analyzed: HH compliance, environmental cleaning, sanitary waste management, as well as consumption of personal protective resources, including alcohol-based hand sanitizer and other PPE (surgical masks and disposable gloves).

The evaluation of HH compliance, environmental cleaning and sanitary waste management will be based on professional practice assessment audits, following the latest scientific recommendations. These audits are part of the routine activities of the Prevention and Care Safety Department and are conducted annually.

Hand Hygiene Audit

The primary outcome will be the HH compliance rate. WHO guidelines will be used to define HH opportunities [26]. HH compliance will be defined as the sum of observed HH practices (handwashing and alcohol-based hand rub) divided by the total number of opportunities.

Biocleaning Audit

For this audit, we will follow the general rules of biocleaning, which include 12 criteria. An overall compliance rate will be calculated.

Healthcare Waste Management Audit

The audit form will be based on the guide to good practice in the management of healthcare waste (DAS). This involves two types of waste: sharp and cutting objects, and soft and solid waste. The primary outcome will focus on the sorting and packaging steps of waste. The audit will comprise 20 criteria. A global compliance score will be calculated for this dimension.

Resource consumption

For the consumption of alcohol-based hand sanitizer and PPE, including gloves and surgical masks, data will be provided by the hospital's Pharmacy Department. The results of these four criteria will be compared over the study period.

STATISTICAL ANALYSIS

Statistical analysis will be performed by IBM SPSS Statistics 25.0 software (SPSS; Chicago, IL, USA). Categorical variables will be expressed in frequencies and percentages, while continuous variables will be expressed in means (standard deviations) or medians (interquartile range). HAI prevalence will be determined as the percentage of patients with at least one infection out of the total number of patients observed during each survey. To analyze the variations in HAI rates before and after the COVID-19 pandemic, we will use the following formula for Percentage change: $(\text{new value} - \text{old value}) / \text{old value} \times 100$ [27].

Pearson Chi square test will be used to determine the difference in the rate and types of HAIs between different periods. To compare continuous variables across different

periods, an ANOVA test will be used. Confidence interval (CI) of 95% and a p value of 0.05 or less will be considered statistically significant for all analyses.

STRENGTHS AND LIMITATION OF THE RESULTS

This study highlights key strengths that should be mentioned. Firstly, to our knowledge, this is the first tunisian study which will focus on the impact of the IPC program during the COVID-19 pandemic on the prevalence of HAIs in the short term (2020) and medium term (2022). Secondly, the HAI survey will be exhaustive and not limited to a single department or unit. However, this study has limitations, mainly due to the retrospective nature of data collection.

EXPECTED RESULTS

At the local level (Sahloul hospital), these results will serve as reference for continuous quality improvement initiatives. HAIs are an indicator of care quality, and understanding their trends provides a basis for targeted interventions. Secondly, the results of this study are expected to have broad applicability across various hospital settings. The IPC program evaluated during this study can serve as a reference model for other hospitals aiming to combat HAIs effectively. The lessons learned will guide policy development, training programs, and resource allocation to foster sustainable improvements in infection prevention.

Ethical considerations

Confidentiality and anonymity of the data will be ensured throughout the study. Only anonymous and summarized data will be shared as part of this analysis. The research ethics boards of the hospital approved these surveys.

CONCLUSIONS

HAI remains a significant healthcare problem, significantly impacting patient outcomes, healthcare costs, and public health systems. Evaluating the effectiveness of prevention measures is crucial to understanding and mitigating these risks. This study specifically explores the effects of IPC measures implemented during the COVID-19 pandemic. Its findings are expected to contribute valuable insights into sustainable strategies for maintaining high compliance rates and reducing HAI prevalence beyond crisis periods.

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