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Further observations on hydrogen peroxide antiseptics and COVID-19 cases among healthcare workers and inpatients

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SUMMARY

Background: The use of prophylactic antiseptics to protect against coronavirus disease 2019 (COVID-19) has been suggested. This study investigated hydrogen peroxide antiseptics (HPA) at two hospitals in Ghana.

Methods: Cases of COVID-19 among healthcare workers (HCWs) using hydrogen peroxide (HP-HCWs) or not using hydrogen peroxide (NHP-HCWs), vaccinated or unvaccinated, were recorded at Shai-Osudoku Hospital (SODH), Dodowa, and Mount Olives Hospital (MOH), Techiman, between May 2020 and December 2021. The effect of HPA in all inpatients at MOH was also observed. Permutation tests were used to determine *P* values.

Findings: At SODH, there were 62 (13.5%) cases of COVID-19 among 458 NHP-HCWs but no cases among eight HP-HCWs ($P=0.622$) from May to December 2020. Between January and

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Mouthwash
Nasal rinse
COVID-19
Healthcare workers



March 2021, 10 (2.7%) of 372 NHP-HCWs had COVID-19, but there were no cases among 94 HP-HCWs ($P=0.206$). At MOH, prior to HPA, 17 (20.2%) of 84 HCWs and five (1.4%) of 370 inpatients had COVID-19 in July 2020. From August 2020 to March 2021, two of 54 (3.7%) HCWs who stopped HPA had COVID-19; none of 32 NHP-HCWs contracted COVID-19. At SODH, none of 23 unvaccinated HP-HCWs and 35 (64%) of 55 unvaccinated NHP-HCWs had COVID-19 from April to December 2021 ($P<0.0001$). None of 34 vaccinated HP-HCWs and 53 (13.6%) of 390 vaccinated NHP-HCWs had COVID-19 ($P=0.015$). No inpatients on prophylactic HPA (total 7736) contracted COVID-19.

Conclusion: Regular, daily HPA protects HCWs from COVID-19, and curtails nosocomial spread of SARS-CoV-2.

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Introduction

Two years after the first reported cases of severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) infection in Wuhan, China, the coronavirus disease 2019 (COVID-19) pandemic has affected over 400 million people with approximately 5.9 million deaths to date [1]. Within this relatively short period, several variants of the parent SARS-CoV-2 have emerged, four of which have been identified by the World Health Organization (WHO) as variants of concern (VOCs), including the most recent Omicron variant [2,3]. All these VOCs have been associated with marked increases in infection rates [2]. For that reason, many countries worldwide have experienced a fourth wave of COVID-19. Ghana recently confirmed the presence of the Omicron variant, which led to the fourth wave of the pandemic in Ghana in December 2021 [4].

In the global effort to limit the spread of SARS-CoV-2, focus has been on protecting healthcare workers (HCWs) who receive and manage infected individuals, including the critically ill. Although these HCWs could contract COVID-19 in the community, they are more likely to do so from exposure to diagnosed, suspected and unsuspected cases of COVID-19 in hospitals and during contact tracing [5–9]. The health of HCWs is therefore extremely important, especially as there is an estimated shortage of 17.4 million HCWs globally, with the greatest challenges being in Africa and South-East Asia [8].

Furthermore, although HCWs represent less than 2–3% of the population in the majority of countries, 14–35% of HCWs have contracted COVID-19 to date, with some fatalities, on account of their increased risk [10]. Moreover, nearly one-quarter of HCWs have experienced stress-induced depression, anxiety and burnout [10]. Even more disturbing is a report of resurgence of infection in a highly vaccinated health system workforce [11].

Over the past 12 months, several SARS-CoV-2 vaccines have been developed and deployed on a massive scale globally under emergency use certificates to prevent SARS-CoV-2 infection. It has turned out, however, that a fully vaccinated individual would now need one or two more booster doses to remain protected from severe forms of COVID-19. It is unlikely, therefore, that the global herd immunity projected if 70–85% of the population were fully vaccinated can be achieved, as more and more booster doses will be needed.

The search for new strategies to contain the pandemic must, therefore, continue, and include focusing on measures to prevent contracting and spreading SARS-CoV-2. The growing

interest in the use of oro- and nasopharyngeal antiseptics to inactivate SARS-CoV-2 to control the pandemic is, therefore, not surprising [12–15].

In a recent preliminary communication [16], the authors drew attention to clinical information on hydrogen peroxide antiseptics (HPA) against SARS-CoV-2 in HCWs in two hospitals, plus inpatients in one of these hospitals. As a follow-up, this article reports observations on the use of HPA among HCWs at Shai-Osudoku District Hospital, (SODH), Dodowa from May 2020 to December 2021, and among HCWs and inpatients at Mount Olives Hospital (MOH), Techiman from August 2020 to December 2021.

Methods

Study sites

SODH is a 135-bed government hospital providing secondary level health care. It is located in Dodowa, 34 km east of Accra, the capital city of Ghana. Currently, there are 502 permanent staff. SODH is a WHO sentinel site for respiratory diseases, malaria and tuberculosis, working in collaboration with Noguchi Memorial Institute for Medical Research of the College of Health Sciences, University of Ghana. SODH initially performed real-time polymerase chain reaction (RT-PCR) assays at Noguchi Memorial Institute for Medical Research, Accra, Ghana, but now has an RT-PCR testing facility onsite. Apart from HCWs at the on-site COVID-19 treatment centre who wear full-suit protective clothing, all other HCWs, including those in the Emergency Department, wear pre-pandemic hospital clothing, gloves and footwear. Emergency care staff occasionally use N95 masks; otherwise, all HCWs use various types of masks, including cloth masks sewn at the facility, and ordinary masks sold to the public on the open market. In accordance with national policy, all HCWs at government health facilities wear masks.

MOH is a 73-bed registered private hospital, located in Techiman, the administrative capital of the Bono East Region of Ghana. It has 89 staff. Samples of nasal and throat swabs are sent to Holy Family Hospital, Techiman, and Kintampo Government Hospital, Kintampo, both in the Bono East Region, for confirmation of COVID-19. HCWs and inpatients wear pre-pandemic facility-issued clothing. For the first 3 months (July–September 2020), N95 masks were used at MOH. Subsequently, masks sold on the open market were used. Mask wearing is mandatory at the facility.

Study design, participants and interventions

As noted in the authors' preliminary report [16], this observational study began fortuitously in April 2020. The authors had learnt that eight nurses in the Emergency Department of SODH were, of their own volition, using HPA daily. The authors' team had proposed the use of HPA for prevention of COVID-19 in the community. With permission from SODH management, the authors monitored cases of COVID-19 among HCWs using HPA (HP-HCWs) and HCWs not using HPA (NHP-HCWs) at SODH from May 2020 to December 2021. Over time, more HCWs at SODH started using HPA.

Similarly, upon permission from the Chief Executive Officer of MOH, the authors noted the occurrence of COVID-19 among HCWs at the facility from July 2020 prior to the introduction of HPA. Following voluntary introduction of HPA use through advocacy by management based on the authors' publication [17], cases of COVID-19 among HP-HCWs and NHP-HCWs at MOH from August 2020 to December 2021 were noted. For all inpatients at MOH, the hospital management adopted and modified the recommendation of major dental associations, such as the American Dental Association, for pre-dental-treatment oral rinsing with hydrogen peroxide and other oral hygiene solutions from August 2020 [18].

As noted above, the daily use of HPA among HCWs was entirely voluntary at both institutions [16]. The concentration of hydrogen peroxide used for mouthwashing/gargling was 1%, and the concentration used for nasal rinsing (two drops per each nostril) was 0.5%. The duration of mouthwashing and gargling, and nasal rinsing was 1 min. At SODH, HPA was practised daily, except during peak periods of SARS-CoV-2 transmission when some HCWs resorted to twice-daily application. At MOH, HPA was applied twice daily. SARS-CoV-2 vaccination of HCWs began in March 2021 at both SODH and MOH. By November 2021, all HCWs at MOH were fully vaccinated. All HCWs at both facilities received the Oxford Astra Zeneca vaccine, apart from one HCW at MOH who received the Johnson and Johnson vaccine. The Omicron VOC emerged in November 2021 and led to the fourth wave of the pandemic in Ghana in December 2021. The authors' observations at both facilities (SODH and MOH) ended on 31st December 2021.

Outcomes

Cases of COVID-19 [*N* (%)] among HP-HCWs and NHP-HCWs were recorded, and the effect of vaccination on cases of COVID-19 in relation to HPA was noted in HCWs at SODH. At MOH, cases of COVID-19 prior to prophylactic HPA were recorded, and the effects of HPA and vaccination on cases of COVID-19 in HCWs and inpatients were noted.

Data collection and analysis

At both SODH and MOH, data were collected by staff designated by management, and were reviewed by the heads of the two institutions and representatives of the authors' team. The significance of the influence of HPA on cases of COVID-19 during the pre-vaccine and the vaccine periods at SODH was determined with permutation testing (using the Infer package in R; there were 10,000 permutations producing the null distribution in each test). $P < 0.05$ was considered to indicate significance.

Quality assurance

Data on cases of COVID-19 among HCWs (SODH, MOH) and inpatients (MOH), HPA and vaccination status were checked and rechecked to ensure the correctness of information obtained from the facilities. Moreover, the facilities had the opportunity to confirm their respective data.

Ethical considerations

This study followed ethical principles, with prior permission from the management of SODH and MOH for collection of data on HPA prophylaxis, COVID-19 occurrence and RT-PCR testing. Hospital management at both facilities was assured that the information provided would be kept strictly confidential, and that published reports would be devoid of personal identifiers of HCWs and patients. The aggregated data reported are, therefore, devoid of any personal details. Before submission for publication, hospital management at both facilities was shown a copy of this manuscript for their approval, and to ensure that HCW and patient identity had been protected.

Results

The use of HPA was beneficial to both vaccinated and unvaccinated HCWs, and offered significant protection for both groups at SODH. HPA also curtailed nosocomial spread of COVID-19 at MOH. No COVID-19 deaths occurred among HCWs during the period of observation. No adverse events of the use of HPA were reported.

Pre-vaccine period at SODH

Table 1 shows the COVID-19 status of HP-HCWs and NHP-HCWs at SODH prior to the introduction of vaccines in Ghana. Between May and December 2020, no cases of COVID-19 were recorded among eight HP-HCWs. In contrast, a number of cases occurred in NHP-HCWs ($P = 0.622$). From January 2021 to March 2021, the number of HP-HCWs at SODH increased markedly from eight to 96, and none of these staff contracted COVID-19,

Table 1

Coronavirus disease 2019 status and use of hydrogen peroxide at Shai-Osudoku District Hospital before introduction of vaccines

| Period | Hydrogen peroxide users | | | Non-hydrogen peroxide users | | | P-value |
|--------------|-------------------------|----------------|-------|-----------------------------|----------------|-------|---------|
| | N (%) | | | N (%) | | | |
| | Negative cases | Positive cases | Total | Negative cases | Positive cases | Total | |
| May–Dec 2020 | 8 (100%) | 0 | 8 | 396 (86.5%) | 62 (13.5%) | 458 | 0.622 |
| Jan–Mar 2021 | 94 (100%) | 0 | 94 | 362 (97.3%) | 10 (2.7%) | 372 | 0.206 |

whereas some of the NHP-HCWs did contract COVID-19 ($P=0.206$). Incidentally, two of the 62 NHP-HCWs who had COVID-19 in 2020 were re-infected in January 2021 after a full recovery.

Pre-vaccination period at MOH

At the end of July 2020, HPA was not in use among staff or inpatients at MOH. In that month alone, one fifth ($N=17$, 20%) of HCWs ($N=84$) at MOH developed COVID-19. Also, five (1.4%) of 370 patients admitted in July 2020 contracted the disease. Following the introduction of HPA among the HCWs, the majority ($N=52$, 62%) elected to use it from August 2020 onwards; the remaining 32 (38%) HCWs chose not to use HPA. Between August 2020 and March 2021, two of the HP-HCWs had COVID-19. They had travelled to another part of the country for a period of 1 week in which they did not use HPA, and contracted COVID-19 soon after. None of the 32 NHP-HCWs had COVID-19, and none of the 3387 inpatients using HPA from August 2020 to March 2021 had COVID-19.

Vaccination period at SODH

Table II shows the occurrence of COVID-19 in relation to vaccine status and HPA. No cases of COVID-19 were recorded in HP-HCWs, irrespective of their vaccine status. However, substantial numbers of unvaccinated and fully vaccinated NHP-HCWs contracted COVID-19. Of the 53 vaccinated NHP-HCWs who had COVID-19, the majority ($N=47$) had the disease in December 2021.

Vaccination period at MOH

Between April 2021 and December 2021, MOH administered HPA to a total of 4726 inpatients. From August 2020 to December 2021, MOH admitted a total of 7736 patients, none of whom contracted COVID-19. Also, between April and December 2021, only one of the 89 HCWs at MOH, all fully vaccinated and using HPA, had COVID-19. That individual stopped using HPA in December 2021.

Discussion

The results of this real-world observational study provide clinical evidence that prophylactic HPA protects HCWs and inpatients from COVID-19. Over a period of 19 months, no HCWs, vaccinated or unvaccinated, using 1% hydrogen peroxide for mouthwash and throat gargle, and 0.5% hydrogen peroxide for nasal rinse at least once daily developed COVID-19 at SODH. Among these were the eight frontline emergency care nurses who had used HPA daily from May 2020. On the other hand, by

November 2021, a significant number of both vaccinated and unvaccinated NHP-HCWs had contracted COVID-19. Surprisingly, in December 2021 alone, when the Omicron variant was dominant in Ghana [4], as many as 47 new cases of COVID-19 were recorded among the HCWs, all of whom were fully vaccinated and not using HPA. These observations, therefore, confirm the authors' previous suggestion that HPA protects HCWs from COVID-19 [16].

At MOH, the observations were also indicative of the efficacy of HPA against SARS-CoV-2 infection. One month prior to the introduction of HPA, there had been a rapid spread of COVID-19 at the hospital, affecting 17 staff and five inpatients. A dramatic change in the incidence of COVID-19 occurred following the introduction of HPA in August 2020. With the exception of three HCWs who interrupted the use of HPA for a period (two before vaccines were introduced and one who was fully vaccinated) and contracted COVID-19, no HCWs or inpatients on HPA contracted COVID-19 over the 16-month observation period. The observation of COVID-19 in HCWs who interrupted HPA highlights the importance of maintaining regular, daily use of HPA for protection, noting that inactivation of SARS-CoV-2 by hydrogen peroxide happens within its short incubation period. As the Omicron variant has a much shorter incubation period than other variants [19], this point ought to be stressed in recommending HPA.

It is important to note that 22 cases of COVID-19 were recorded at MOH in July 2020, when the less virulent Wuhan strain was active in Ghana. One would have expected to see more cases from January 2021, when the more virulent Alpha and Beta variants appeared, and even more cases from April 2021 when the Delta variant – which also transmitted more rapidly – arrived in Ghana. Surprisingly, however, within the 16-month study period, no HCWs contracted COVID-19 except for three who interrupted the use of HPA. Also, no cases of COVID-19 occurred among a total of 7736 inpatients, all of whom were on HPA prophylaxis in the period when the more virulent VOCs were spreading. This observation is quite remarkable, and lends support to the assertion that hydrogen peroxide prevents SARS-CoV-2 infection.

Unlike at SODH, where there were vaccinated and unvaccinated groups of HCWs using and not using HPA, all HCWs at MOH were fully vaccinated and all were using HPA as of November 2021. It was therefore difficult to ascertain whether the protection of HCWs from COVID-19 was due to the use of HPA or to the vaccine. The fact that SARS-CoV-2 infections almost ceased at MOH within the 16-month study period, with only three HCWs who interrupted the use of HPA contracting COVID-19, indicates an appreciable benefit of the use of HPA. The finding that 53 of the fully vaccinated NHP-HCWs at SODH had COVID-19 strengthens the authors' view that it was HPA rather than the vaccine that protected both vaccinated HCWs from getting COVID-19 at MOH.

Table II

Coronavirus disease 2019 status and use of hydrogen peroxide in unvaccinated and vaccinated healthcare workers at Shai-Osudoku District Hospital from 1st April to 31st December 2021

| Vaccine status | Hydrogen peroxide users | | | Non-hydrogen peroxide users | | | P-value |
|----------------|-------------------------|----------|-------|-----------------------------|------------|-------|---------|
| | N (%) | | | N (%) | | | |
| | Negative | Positive | Total | Negative | Positive | Total | |
| Unvaccinated | 23 (100%) | 0 | 23 | 20 (36%) | 35 (64%) | 55 | <0.0001 |
| Vaccinated | 34 (100%) | 0 | 34 | 337 (86.4%) | 53 (13.6%) | 390 | 0.015 |

During the study period, all VOCs – Alpha, Beta, Delta and Omicron variants – were encountered [4,20], suggesting that HPA inactivated all of these variants. It can be surmised with some degree of confidence, therefore, that hydrogen peroxide remains relevant as an oxidizing agent against the viral envelope and the S protein of all SARS-CoV-2 variants, including the Omicron variant. Attention therefore should be paid to growing evidence that oral and nasal antiseptics, especially hydrogen peroxide, protect against SARS-CoV-2 infection. It is important to note that the use of hydrogen peroxide at a low concentration on a daily basis over several decades has been shown to be safe in dentistry [21]. No adverse events of the use of hydrogen peroxide were reported in this study.

No personal data, such as age, gender and co-morbidities, or clinical information were collected from HP-HCWs, NHP-HCWs or inpatients. The influence of co-variables was not considered in this study. Moreover, the use of HPA was not randomized, as the decision to use HPA was personal at SODH, and was influenced by hospital management rather than the study team at MOH. The study, nevertheless, provides useful information of evidential value to fill a knowledge gap of clinical evidence that HPA protects against SARS-CoV-2 infection [13].

These observations clearly indicate that daily and regular use of 1% hydrogen peroxide as mouthwash and throat gargle for 1 min, and 0.5% hydrogen peroxide for nasal rinse for 1 min provide effective protection against SARS-CoV-2 infection. This mimics its mode of action when used on inanimate surfaces to inactivate coronaviruses [22]. Hydrogen peroxide, therefore, has the potential to mitigate the pandemic, a solution far simpler than had been imagined and which had been proposed earlier [17,23]. Hydrogen peroxide could further mitigate the pandemic when used by both symptomatic and asymptomatic cases of COVID-19 by inactivating the viruses these patients shed [24].

In summary, the significant clinical evidence for the protective effect of hydrogen peroxide against COVID-19, and likewise considering that it is also quite safe, inexpensive and readily available, makes it a valuable prophylaxis to recommend for the protection of HCWs, inpatients and all vulnerable groups against COVID-19. These vulnerable groups may include unvaccinated individuals, the elderly, those in long-term care facilities or homes, sportsmen and sportswomen, teachers, students, front-line security service personnel, airline crew, and pregnant and lactating women.

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Conflict of interest statement

None declared.

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