Hand washing practice among health care workers in Ethiopia: systemic review and meta-analysis, 2020

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ABSTRACT
Objective: Hand washing with soap and water is the single most weapon against infectious agents. Proper hand washing is not only reduces nosocomial infection, but also prevents the spread of current global concern Novel Corona viruses (COVID-19) and other viral illnesses like cold and flu. Therefore, the aim of this study is to assess hand washing practice among health care workers in Ethiopia.

Methods: In the current meta-analysis, the target variables search from different databases, like Google Scholar, African Journals OnLine, PubMed, and Scopus. All necessary data extracted by using a standardized data extraction format. Heterogeneity across the studies was evaluated using the I² index and Cochran's Q test. A random effect model computes to estimate the pooled proportion of hand washing practice among health care workers.

Results: In this meta-analysis, we included fifteen observational studies summarize the proportional of hand washing practice among health care workers. In the current study, the pooled hand washing practices among Ethiopian was 57.87% (95% CI: 44.14–71.61). Subgroup analysis conduct to identifying the sources of heterogeneity.

Conclusion: The overall pooled proportion of hand washing practice among health care workers was low. Hand washing with water and soap is recommended at least for 20 s to prevent contagious disease like Corona viruses.

1. Introduction

Hand washing is the process of mechanically removing soil and debris from the hands using plain water and soap [1, 2]. According to world health organization guidelines hand washing remains the most effective measure to prevent the mode of transmission of micro-organisms [3]. In the previous researcher reported that there are insufficient hand washing practices due to lack of appropriate equipment, inadequate knowledge and unfavorable attitudes among health care workers [4, 5, 6]. A study of medical students about hand washing practice showed that only 44.12% of the participants always washed their hands with soap and water [7]. Continuous health education improves hand washing practice among health care providers 69.9% [8].

According to Ethiopian national guidelines Hand hygiene is a general term referring to any action of cleansing hands [9]. Hand washing is effective measure in preventing infection transmission. Proportion of hand hygiene practice in different studies was 16.5%, 41% and 62.1% [10, 11, 12]. Only 87.5% health care providers used the hand hygiene products [13]. Lack of running water and soap in the wards is one of the major contributory that inhibited appropriate hand washing practice in health institution [14]. More than 70% of U.S. and 66% of Canadian adults would avoid a health care facility or office if they found their restroom to be unclean [15]. Evidences showed that the proportion of hand wash before and after every patient contact was lowered 12.3% [16].

A study conducted in Australia among medical staff showed that about 67% of participants wash their hands before making hand contact with a patient [17]. In a study conducted in Nigeria the rate of hand washing before and after simple procedures were 13.6 and 59.7% respectively [18]. Nursing students had good hand washing practices (62.1%) as compared to medical students (19.6%) [19]. And also 70% of medical students used soap and water whereas only 6.36% used alcohol

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based agents for hand washing practice [20]. Scientific evidence showed that the average hand washing practice of midwives and nurses was 44.8% [21]. In Pakistan (96.10%) of participants had good hand washing practice [22]. Nurses had better (66%) hand wash practice than other professionals (63.8%) [23].

Many efforts were made to determine the level of hand washing practice among health care workers to prevent infectious diseases like the Novel corona virus. However, the proportion of hand washing practice among different study findings in Ethiopia was found to be inconsistent with discrepancy. Therefore, to address this gap, this systematic review and meta-analysis was conducted with the aim of evaluating the overall pooled proportion of the hand washing practice among health care workers.

2. Methods

2.1. Search strategy

This systemic review with meta-analysis conduct from the primary observational studies. The observational studies evaluate based on hand washing practice assessment materials (questionnaire). In terms of language, the articles published in English only were included in the analysis. The search was conducted in electronic databases, such as Google Scholar, African Journals OnLine, PubMed, and Scopus is using the following MeSH and free-text terms: hand washing practice”, “hand hygiene practice”, “health care workers”, health care “professional” and “Ethiopia” (appendix 1). This searched was carried out from June 21 to July 27, 2020.

2.2. Inclusion and exclusion criteria

All original research articles were conducted only in Ethiopian settings that fulfill the following inclusion criteria included in this meta-analysis. Those articles which were published in English, conducted with cross-sectional study and having a quantitative research design. Those articles which didn’t fully access at the time of our search process were excluded.

2.3. Data extraction

Data were extracted by three authors using a pre-piloted and standardized data extraction format prepared in a Microsoft excel. The data extraction sheet was piloted on five randomly selected papers and modified accordingly. This form includes the study characteristics, like author/s name, year of publication, study area, study design, sample size, practice, and the quality score of each study extracted from each included article by five independent authors. Any disagreements at the time of data abstraction were agreed upon by discussion and consensus.

2.4. Statistical analysis

The data extraction format includes primary author, publication year, region, study design, study hospitals, sample size, and proportion. After extraction, the data analyzed using STATA version 11 statistical software [24]. The pooled proportion of this meta-analysis reported as the pooled practice of health care workers about hand washing with 95% confidence intervals (CIs), p-values < 0.05 were considered statistically significant. Heterogeneity across the studies evaluated using the I^2 index and Cochran’s Q test (I^2 statistics below 25% indicated low heterogeneity, between 25% and 50% moderate heterogeneity, and over 75% high heterogeneity) [25]. Because the test statistic indicated significant heterogeneity among studies (I^2 >75%, p < 0.05), a random effects model was used to evaluate practice of health care workers about hand washing practice with 95% confidence interval (CI).

To identify heterogeneity in the included studies, sub-group analysis by data collection techniques and study areas (both hospitals and health centers and hospitals only) intended to conduct hand washing practice among health care workers across the different regions in the country.
Funnel plot asymmetry, Egger’s and Begg-Mazumdar Rank correlation tests were used to check for publication bias. Two researchers independently carried out the statistical analysis and results from crosscheck for consistency.

3. Result

3.1. Study selection process

The database search yields 539 articles retrieved from PubMed, Scopus, Google Scholar, and African Journals Online. Accordingly, 512 duplicate articles were removed. From the remaining 27 articles, 12 articles excluded because of their titles and abstracts were not in line with our inclusion criteria (full article not found, different population, different setting and different outcome). Finally, 15 articles include for this systemic review and meta-analysis (Figure 1).

3.2. Characteristics of included studies

Fifteen studies with a total of 3198 health care workers include in our study. All included studies applied a cross sectional study design to evaluate hand washing practices of health care workers. The eligible

| S. no | First Author | Publication Year | Region | Health Facility Name | Type of guideline | Sample Size | Level of hand washing practice % (95% CI) |
|-------|--------------|------------------|--------|----------------------|------------------|-------------|------------------------------------------|
| 1     | Geberemariyam et al [26] | 2018 | Oromia | Arsi Hosp and HC | Local | 648 | 69.40 (65.85, 72.95) |
| 2     | Kebebe et al [27] | 2015 | Oromia | Jimma Hosp | WHO | 17 | 75.00 (54.42, 95.58) |
| 3     | Legese et al [28] | 2016 | Oromia | Agaro Hosp and HC | Local | 73 | 98.60 (95.90, 101.30) |
| 4     | Alemu et al [29] | 2015 | Oromia | Shenen Gibe Hosp | Local | 47 | 68.08 (54.75, 81.41) |
| 5     | Desta et al [30] | 2018 | Amhara | Debre Markose Hosp | CDC | 150 | 44.00 (36.06, 51.94) |
| 6     | Alemayehu et al [31] | 2016 | Amhara | Dessie Hosp | Local | 208 | 87.50 (83.01, 91.99) |
| 7     | Gulilat et al [32] | 2014 | Amhara | Bahir Dar Hosp & HC | Local | 354 | 81.90 (77.89, 85.91) |
| 8     | Gezie et al [33] | 2019 | Amhara | Dessie Hosp | National | 191 | 29.30 (22.85, 35.75) |
| 9     | Awoke et al [34] | 2018 | Harar | Harar Hosp | NM | 110 | 29.50 (20.98, 38.02) |
| 10    | Jamie et al [35] | 2020 | Harar | Harar Hosp | NM | 166 | 16.27 (10.66, 21.88) |
| 11    | Teklehaymanot et al [36] | 2019 | Harar | Harar Hosp | Local | 125 | 74.60 (66.97, 82.23) |
| 12    | Jemal et al [37] | 2018 | Afar | Dubti Hosp | NM | 91 | 44.00 (33.80, 54.20) |
| 13    | Gebresilassie et al [38] | 2014 | Tigray | Mekelle Hosp & HC | Local | 483 | 61.50 (57.16, 65.84) |
| 14    | Tenna et al [39] | 2013 | Addis Ababa | Addis Ababa Hosp | National | 261 | 54.50 (48.46, 60.54) |
| 15    | Yohannes et al [40] | 2019 | SNNPR | Hadya Hosp | National | 274 | 35.00 (29.35, 40.65) |

Hosp = Hospital, HC = Health Center, NM = Not Mentioned, WHO = World Health Organization, CDC = Communicable Disease Control.

Figure 2. Meta-analysis (forest plot) of the prevalence on hand washing practice among health care workers in Ethiopia, 2020.
fifteen studies were published from 2013 to 2020. The overall distribution of studies based on region included in this review were four from the Oromia region [26, 27, 28, 29], four from the Amhara region [30, 31, 32, 33], three from the Harar region [34, 35, 36] one from Afar [37] one from the Tigray [38] one from the Addis Ababa [39] and one from the Southern Nations Nationalities and People’s Region (SNNPR) [40]. The highest level of hand washing practice was in the Oromia [28] and the lowest hand washing practice in the Harar region among health care workers [35]. Moreover, eleven studies conducted only in the hospitals and four studies in the hospitals and health centers (Table 1). In the case of data collection technique: nine studies used a self-administer questionnaire [26, 27, 28, 29, 30, 31, 33, 36, 39], two studies used both self-administer questionnaire and direct observation [34, 40] one structured interview and observational study [32] one only observational study [35] and one face to face interview, observation and focus group discussion [38] used for data collection technique. An individual who got training has good hand washing practice than an individual who didn’t get [26, 30]. The low performance of hand washing was related to inadequate hand washing supply in the health facility [28, 35]. All of the studies reported high response rates (>90%). The overall percentage of hand washing practice among health care workers was 57.81% (95% CI: 45.11, 70.51) (Figure 2).

3.3. Pooled proportion of hand washing practice among health care workers in Ethiopia

In this study, the Pooled proportion of hand washing practice among health care workers in Ethiopia was 57.81% (95% CI: 45.11–70.51) (Figure 2). Using the random effects model statistically significant level of heterogeneity was observed in the included primary studies (I-squared = 97.6%; p < 0.001). Since there is heterogeneity in the included studies, we performed subgroup analysis. In order to identifying the sources of heterogeneity, we had conducted sub group analysis by using data collection technique (self-administer questionnaire only and mixed types) and study areas (both hospitals and health centers and hospitals only) to determine the pooled proportion of hand washing practice among health care workers (Figures 3 and 4). The result of subgroup analysis, revealed that, the low level of hand washing practice was observed among study groups used mixed (observational study and interview, self-administered) types of data collection technique of hand washing practices and health care workers who are working in hospitals only, which showed that 44.68% (95% CI: 22.62, 66.75) and 50.56% (95% CI: 37.00, 64.11) respectively.

3.4. Publication bias

Both funnel plots of precision asymmetry and the Egger’s test of the intercept were explore to identify the existence of publication bias in the included studies. Visual examination of the funnel plot showed symmetric distribution of studies implies no publication bias (Figure 5). We also conduct Egger’s test of the intercept was -0.22 (95% CI: -0.44, 0.01), p > 0.05, this implies that there is no publication bias. Additionally we conducted sensitivity analysis, for the purpose of further investigating the potential source of heterogeneity observed in the hand washing practice among health care workers in Ethiopia. The result of sensitivity analyses using random effects model showed that there was no single study affected the overall hand washing practice of health care workers.

4. Discussion

In this study, systemic review and Meta-analysis was conducted to estimate the pooled proportion of the hand washing practice among
health care workers in Ethiopia. The overall pooled proportion of the hand washing practice among health care workers was 57.81% (95% CI: 45.11–70.51). This finding is in line with those of studies conducted in Nigeria (55.2% and 59.7%) [18, 48], in India (62.1) [19] and in Rome (62.1) [12].

On the other hand, our finding suggested that the proportion of the hand washing practice was higher than studies conducted in Sudan (18.15) [49], in Japan (33.6%) [50], in Turkey (37%) [51], in Germany (41%) [11], in Syria (45.7%) [52], in Nepal (49.6%) [41] and Turkey (50%) [42]. The possible reason might be due to the study participants and methods of data collection. In the current review, the study participants were graduated health care workers, whereas, in some study area [41] both health care workers and students were incorporated. Also the methods of data collection in the current review were both self-administered questionnaire and interview, whereas in other study area [42] was only observational. However, this Meta-analysis was lower than studies conducted in several findings, 64.2% [45], 67% [17], 70% [20], 71% [53], 72.8% [46], 75% [43], 75.9% [54], 76% [44], 76.1% [55], 96.1% [22]. The possible explanation might be, the current review of hand washing practice among health care workers was pooled proportion results of fifteen studies, whereas, the others studies were conducted in a single area.

In the current study, sub-group analysis was done based on the study area and data collection technique used for conducted study. The result of the subgroup analysis showed that variability was observed in overall pooled hand washing practice among health care workers. Health care workers who are working in both hospitals and health centers had relatively highest pooled proportion of the hand washing practice than health care workers who are working in hospitals only with the results of 77.77% and 50.56% respectively. Due to the fact that, patient flow and work load is high in hospitals and they perceived that hand washing takes time as a result hand washing practice is low among health care workers who are working in hospitals [32, 47]. And also in Ethiopia context, physicians working in hospitals rather than in health centers and physicians have low hand washing practice when we compare from other health professionals particularly nurses [39, 41, 46].

Figure 4. Forest plot of subgroup analysis by study area on hand washing practices among health care workers in Ethiopia.

Figure 5. Meta funnels presentations of the proportion of hand washing practice among health care workers in Ethiopia, 2020, whereby SE PIV (standard error of proportion) plotted on the Y-axis and log PIV (logarithm of proportion) on the X-axis.
In other words, studies conducted with self-administration questionnaires only of data collection technique showed that slight increment of hand washing practice (64.38%) as compared to studies conducted by mixed type of data collection techniques (44.68%). The possible reason might have, observational data collection technique reflects the hidden and actual activities of human beings, however, in self-administered questionnaire mostly reflects their knowledge, principles and obligation rather than their actual practice which is liable for social desire bias. Although, there were some limitations, our study provided important information about the hand washing practice among health care workers in national level. Therefore, researchers and policy makers can easily compare on principle and the actual practice of hand washing practice among health care workers to prevent some nosocomial infection in the health facilities. However, the limitations are; first the present study was included only English articles were considered to provide this nationally based review. Second, the review didn’t show the possible reason for the low hand washing practice among health care workers because of majority studies incorporated in this review were descriptive studies.

Declarations

Author contribution statement

Haileyesus Gedamu: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Wrote the paper. Teshager W/giorgis: Performed the experiments; Wrote the paper. Getasew Tesfa: Analyzed and interpreted the data. Yilkal Tafera: Contributed reagents, materials, analysis tools or data; Wrote the paper. Minichil Genet: Contributed reagents, materials, analysis tools or data.

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Data availability statement

Data included in article suplementary material/referenced in article.

Declaration of interests statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

References

[1] Suzan C. Smelzer, Brenda G. Bare, Janice L. Hinkle, Kerry H. Cheever. Brunner and Suddarth’s Text Book of Medical-Surgical Nursing. fourteenth ed., London
[2] T.W. Wong, W. Wai-San Tam, Handwashing practice and the use of personal protective equipment among medical students after the SARS epidemic in Hong Kong, Am. J. Infect. Contr. 33 (10) (2005 Dec 1) 580–586.
[3] World Health Organization, WHO Guidelines on Hand hygiene in Health Care: First Global Patient Safety challenge Clean Care Is Safer Care, World Health Organization, 2009.
[4] N.L. Hughes, Hand washing: going back to basics in infection control, AJN Am. J. Nurs. 106 (7) (2006 Jul 1) 96.
[5] B. Allegrante, D. Pittet, Role of hand hygiene in healthcare-associated infection prevention, J. Hosp. Infect. 73 (4) (2009 Dec 1) 305–315.
[6] J. Ahmed, F. Malik, Z.A. Memon, T.B. Arif, A. Ali, S. Nasim, J. Ahmad, M.A. Khan, Compliance and knowledge of healthcare workers regarding hand hygiene and use of disinfectants: a study based in Karachi, Cureus 12 (2) (2020 Feb).
[7] O.O. Afolabi, E.O. Adebunmi, S. Medaravaru, A.O. Igte10, O.E. Dada, A study to ascertain the practice of hand hygiene among medical students in common wealth of Dominica, Arch. Med. 8 (2016) 5.
[8] E. Okafor, T.A. Ekwere, I.P. Okafor, Hand hygiene knowledge and practices among healthcare providers in a tertiary hospital, south west, Nigeria, Int. J. Infect. Control 9 (2013).
[9] Federal Ministry of Health (FMoH) of Ethiopian, Infection Prevention and Patient Safety, FMoH, Addis Ababa, 2010.
[10] N.M. Abdelia, M.A. Tefera, A.E. Eredie, et al., Hand hygiene compliance and associated factors among health care providers in Gondar University Hospital, Gondar, North West Ethiopia, BMC Publ. Health 14 (1) (2014 Dec 1) 96.
[11] J. Hammerschmidt, T. Manser, Nurses’ knowledge, behaviour and compliance concerning hand hygiene in nursing homes: a cross-sectional mixed-methods study, BMC Health Serv. Res. 19 (1) (2019 Dec 1) 547.
[12] V. Bacciolli, V. D’Egidio, F. De Soccio, G. Migliara, A. Massimi, F. Alessandri, G. Tellan, C. Maruzzu, C. De Vito, M.V. Ranieri, P. Villari, Effectiveness over time of a multimodal intervention to improve compliance with standard hygiene precautions in an intensive care unit of a large teaching hospital, Antimicrob. Resist. Infect. Contr. 8 (1) (2019 Dec 1) 92.
[13] S.K. Joshi, A. Joshi, B.J. Park, U.R. Aryal, Hand washing practice among health care workers in a teaching hospital, J. Nepal Health Res. Council (2013 May 9).
[14] H.W. Murni, Knowledge, attitude and barriers to hand hygiene practice: a study of Kampala International University undergraduate medical students, Int. J. Community Med. Public Health 5 (9) (2018 Sep) 3782–3787.
[15] C. Fuller, J. Savage, S. Besser, A. Hayward, B. Cookson, B. Cooper, S. Stone, ‘The dirty hand in the latex glove’: a study of hand hygiene compliance when gloves are worn, Infect. Contr. Hosp. Epidemiol. 32 (12) (2011 Dec) 1194–1199.
[16] J. Ahmed, F. Malik, Z.A. Memon, T.B. Arif, A. Ali, S. Nasim, J. Ahmad, M.A. Khan, Compliance and knowledge of healthcare workers regarding hand hygiene and use of disinfectants: a study based in Karachi, Cureus 3 (1) (2020 Feb).
[17] H. Glayas, Understanding non-compliance with hand hygiene practices, Nurs. Stand. (2014→) 29 (35) (2015 Apr 29) 40.
[18] B.A. Alex-Hart, P.I. Opara, Hand washing practices amongst health workers in a teaching hospital, Am. J. Infect. Dis. 7 (1) (2011 Jan 1) 8–15.
[19] S.S. Nair, R. Hanuman tappa, S.G. Hiremath, M.A. Siraj, P. Raghunath, Knowledge, attitude, and practice of hand hygiene among medical and nursing students at a tertiary health care centre in Raipur, India, SRM Prev. Med. 2014 (2014 Feb 6).
[20] G. Mohamed, A. Dardapati, Knowledge, attitude and practice of hand hygiene among medical students—a questionnaire based survey, Unique J. Med. Dental Sci. 2 (3) (2014 Sep) 127–131.
[21] Philmone U. Handwashing Compliance Among Nurses and Midwives Caring for Newborn Babies in Rwanda: A cross-sectional study, Arch. Publ. Health 76 (1) (2018 Dec 1) 69.
[22] M. Saqlain, M.M. Muni, S. ur Rehman, et al., Knowledge, attitude, practice and perceived barriers among healthcare professionals regarding COVID-19: a Cross-sectional survey from Pakistan, J. Hosp. Infect. (2020 May 11).
[23] M. Al-Hussami, M. Darawad, Almhairat II, Predictors of compliance handwashing practice among healthcare professionals, Healthc. Infect. 16 (2) (2011 Jul 13) 79–84.
[24] J. Haimmueller, Xu Y. Ebalance, A Stateta package for entropy balancing, J. Stat. Software 54 (7) (2013).
[25] T.B. Huerdo-Medina, J. Sánchez-Meca, F. Marín-Martínez, J. Botella, Assessing heterogeneity in meta-analysis: Q statistic or I2 index? Psychol. Methods 11 (2) (2006) 193.
[26] B.S. Geberemariyam, G.M. Donka, W. Wordofa, Assessment of knowledge and practices of healthcare workers towards infection prevention and associated factors in healthcare facilities of West Arsi District, Southeast Ethiopia: a facility-based cross-sectional study, Arch. Publ. Health 76 (1) (2018 Dec 1) 69.
[27] B. Kebebe, T. Tefera, H. Hisha, Knowledge, attitude and practices of infection prevention among anesthesia professionals at Jim ma University teaching hospital; Oromia region, south west Ethiopia, May 2015, Int. J. Anesthesiol. Res. 3 (11) (2015 Dec 16) 176–180.
[28] T. Legene, B.F. Hurissa, Assessment of the knowledge and practices of health care providers on hand-washing and glove utilization at Agaro Health Center and Hospital, South West Ethiopia, J. Prev. Infect. Contr. 1 (2) (2016) 2.
[29] B.S. Alemu, A.D. Bezune, J. Joseph, A.A. Gehru, Y.Y. Ayene, B.A. Tamene, Knowledge and practices of hand washing and glove utilization among the health care providers of shenen gibe hospital, South West Ethiopia, Science 3 (3) (2015 May 9) 391–397.
[30] M. Desta, T. Ayenew, N. Sitotaw, et al., Knowledge, practice and associated factors of infection prevention among healthcare workers in Debre Markos referral hospital, Northwest Ethiopia, BMC Health Serv. Res. (2018).
[31] R. Alemayehu, K. Ahmed, O. Sada, Assessment of knowledge and practice on infection prevention among health care workers at Dessie referral hospital, Amhara region, south Wollo zone, North East Ethiopia, J. Community Med. Health Educ. 6 (2016) 2163–71.
[32] K. Gullat, G. Tiruneh, Assessment of knowledge, attitude and practice of health care workers on infection prevention in health institution Bahir Dar city administration, Sci. J. Publ. Health 2 (5) (2014 Aug 7) 384–393.
[33] H. Grube, E. Lota, F. Admasu, S. Gedamu, A. Dires, B. Goshiye, Health Care Workers Knowledge, Attitude and Practice towards Hospital Acquired Infection Prevention at Dessie Referral Hospital, Northeast Ethiopia, 2019.
[34] N. Awoke, B. Ged, A. Aroa, T. Tekalign, K. Paulos, Nurses practice of hand hygiene in HIVost Fana specialized University hospital, Harari regional state, Eastern Ethiopia: observational study, Nurs. Res. Pract. 2018 (2018 Apr 16).
[35] A.H. Jamie, Hand washing practices among health care workers in Jugal hospital, Harar, Ethiopia, J. Antivir. Antiretrovir. (2020).

[36] G.Z. Teklehaymanot, Assessment of knowledge, attitude and practice of hand washing among health workers in Jugal hospital Harar, East Ethiopia, Adv. Prev. Med. 2018 (2018 Nov 22).

[37] S. Jemal, Knowledge and practices of hand washing among health professionals in Dubti Referral Hospital, Dubti, Afar, Northeast Ethiopia, Adv. Prev. Med. 2018 (2018 Nov 22).

[38] A. Gebresilassie, A. Kumei, D. Yemane, Standard precautions practice among health care workers in public health facilities of Mekelle special zone, Northern Ethiopia, J. Community Med. Health Educ. 4 (3) (2014) 286.

[39] A. Tenna, E.A. Stenehjem, L. Margoles, E. Kacha, H.M. Blumberg, R.R. Kempker, Infection control knowledge, attitudes, and practices among healthcare workers in Addis Ababa, Ethiopia, Infect. Contr. Hosp. Epidemiol.: Offic. J. Soc. Hosp. Epidemiologists Am. 34 (12) (2013 Dec) 1289.

[40] T. Yohannes, G. Kassa, T. Laelago, E. Guracha, Health-care workers’ compliance with infection prevention guidelines and associated factors in Hadiya zone, Southern Ethiopia, Epidemiol. Int. J. (2019).

[41] S.K. Joshi, A. Joshi, B.J. Park, U.R. Aryal, Hand washing practice among hospital staff: a survey of knowledge, attitude, and practice in A general hospital in Syria, J. Keperawatan Indonesia 21 (3) (2018 Nov 27) 139–149.

[42] A. Garus-Pakowska, W. Sobala, F. Szatko, Observance of hand washing procedures performed by the medical personnel after the patient contact. Part II, Int. J. Occup. Med. Environ. Health 26 (2) (2013 Apr 1) 267–264.

[43] B.R. Panhotra, A.K. Saxena, M. Al-Qarny, A survey of knowledge, attitudes and practices regarding hand hygiene among doctors and nurses in Ribat University Hospital, Int. J. Med. Rev. Case Rep. 4 (2) (2020) 19–27.

[44] B.A. Atienza, J.S. Barrato, G.A. Gabilan, S.M. Gacal, M.M. Marin, A.B. Escabarte, “A minute to clean it”: compliance to hand washing practice among healthcare workers in Iligan city, People: Int. J. Soc. Sci. 3 (2) (2017 Nov 11).

[45] M.B. Garba, L.B. Uche, Knowledge, attitude, and practice of hand washing among healthcare workers in six Intensive Care Units, J. Prev. Med. Hyg. 58 (3) (2017 Sep) E231.

[46] M. Yousif, T. Tancred, M. Abuurad, A survey of knowledge, attitudes and practices regarding hand hygiene among doctors and nurses in Ribat University Hospital, Int. J. Med. Rev. Case Rep. 4 (2) (2020) 19–27.

[47] A. Saitoh, K. Sato, Y. Magara, K. Osaki, K. Narita, K. Shinohi, K.E. Fowler, D. Ratz, S. Saint, Improving hand hygiene adherence in healthcare workers before patient contact: a multimodal intervention in four tertiary care hospitals in Japan, J. Hosp. Med. 15 (5) (2020 May 1) 262–267.

[48] A. Karaali, E. Kepenekli Kadayifci, S. Atci, U. Sili, A. Soyali, G. Colha, Y. Pekru, M. Bakar, Compliance of Healthcare Workers with Hand hygiene Practices in Neonatal and Pediatric Intensive Care Units: Overt Observation, Interdisciplinary Perspectives on Infectious Diseases. Jan, 2014.

[49] C. Jonker, M. Othman, Hand hygiene among hospital staff: a survey of knowledge, attitude, and practice in A general hospital in Syria, J. Keperawatan Indonesia 21 (3) (2018 Nov 27) 139–149.

[50] M. Musu, A. Lai, N.M. Mereu, M. Galletta, M. Campagna, M. Tidore, M.F. Piazza, L. Spada, M.V. Massidda, S. Colombo, P. Mura, Assessing hand hygiene compliance among healthcare workers in six Intensive Care Units, J. Prev. Med. Hyg. 58 (3) (2017 Sep) E231.

[51] K.M. Abd Elaziz, I.M. Bakr, Assessment of knowledge, attitude and practice of hand washing among health care workers in Ain Shams University hospitals in Cairo, J. Prev. Med. Hyg. 50 (1) (2009 Mar 1) 19–25.

[52] A.M. ALSofiani, F. AlOmar, M. ALqaray, Knowledge and practice of hand hygiene among healthcare workers at armed forces Military hospitals, Taif, Saudi Arabia, Int. J. Med. Sci. Publ. Health 5 (6) (2015) 1282–1291.