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Knowledge, attitude, and practice of forensic practitioners during COVID-19 pandemic in Arab countries

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ARTICLE INFO

Keywords:
Forensic practitioners
Knowledge
Attitude
Arab countries
COVID-19 pandemic

ABSTRACT

COVID-19 pandemic burdens forensic practice worldwide. The experience of crisis management is a lesson learned that guides future preparedness for similar casualties. Thus, the present study takes an in-depth look at the knowledge, attitude, and practice of forensic practitioners during the COVID-19 pandemic in the Arab world. A comprehensive questionnaire was adopted in compliance with optimum international standards for the management of deaths during the pandemic. The survey was electronically distributed in 13 Arab countries. The responses were received from 29 forensic practitioners from 11 countries. Total median knowledge, attitude, and practice scores of respondents constituted 37.9%, 74%, and 36.8% of optimum scores respectively. Regarding knowledge, better scores are related to risk assessment and routes of exposure to Coronavirus, whereas, least scores were related to ventilation and negative pressure system. Most of the participants had a positive attitude, 85.2% were concerned about proper management of COVID-19 deaths, and 77.8% trusted the decisions of their teams. Considering practice, better scores are related to forensic staff competence, whereas, least scores were related to ventilation and negative pressure system. Most of the participants had a positive attitude, 85.2% were concerned about proper management of COVID-19 deaths, and 77.8% trusted the decisions of their teams. Considering practice, better scores are related to forensic staff competence, whereas, least scores were related to the implementation of ideal safety measures. Participants described the management process as useful (52%), reliable (35%), high quality (21%), and cost-effective (17%), however, they expressed challenges as staff infection, limited resources, and infrastructure issues. This survey guides readjusting of procedures and future preparedness for similar disasters in the Arab world. This research adopted a questionnaire that could be used in initial and periodic assessments in any medicolegal institute worldwide. Also, it could support infrastructure projects and disaster management plans.

1. Introduction

During the Coronavirus disease (COVID-19) pandemic, frontline healthcare providers worldwide are fighting to save patients’ lives, whereas, forensic practitioners are struggling to maintain a good forensic practice. The highly infectious diseases often result in large numbers of deaths that overwhelm the capacities of medicolegal systems. An appropriate post-mortem examination, storage, transfer, and dignified disposal of the bodies should be accomplished urgently and safely. Ineffective management of deaths during the pandemic could result in serious medical and legal consequences [1].

Coronavirus is a newly emerged pathogen and its mysteries are gradually resolved. Thus, many peoples, even within the medical field, assume that the management of potentially infected corpses does not require the same precautions as dealing with living patients [2].

Coronavirus is classified as Hazard Group-3 (HG3) pathogens that could survive in the infected bodies even after death. Besides, cryopreservation enhances the survivability of the virus and prolongs its persistence in the corpses. Medicolegal autopsy necessitates the performance of aerosols-generating procedures that liberate the virus from infected bodies. Thus, Forensic staff members are at great risk to catch the infection due to their proximity to the corpses [3].

The challenge facing medicolegal systems during the COVID-19 pandemic is to find a balance between medico-legal requirements and the safety of the personnel involved in the handling of potentially infected corpses. The International organizations issued guidelines concerning the management of deaths during the current crisis [3–7]. However, the handling of deaths is governed by social traditions and religious beliefs of victims in different societies. Therefore, the standards and jurisdiction are often amended to comply with local community values [5].
The Arab states consist of 22 Arab countries located in Western Asia and North Africa. For decades, forensic practitioners serving justice in the management of civil and criminal cases. Clinical forensic medicine in Arab countries deal with living persons and comprises; physical and sexual assault examination; age estimation for medicolegal purpose; determination of the degree of infirmity; and participation in the resolution of medical malpractice claims [8,9]. Post mortem examination is an essential duty of forensic practitioners in Arab nations. Generally, autopsy practice is unfavorable among the public because of delayed funeral and misconception of dead body disfigurement. The constraints toward autopsy in the Arab world are cultural rather than religious. The contemporary Islamic scholars permit autopsy for serving justice in suspicious deaths. Thus, an autopsy is practiced in Arab countries only upon request of the medicolegal system [10,11].

Further limitations on the conduction of autopsies in the Arab world emerged with the commencement of COVID-19 pandemic. The Islamic medical jurisprudence is greatly concerned to protect body handlers and community members from being infected. Besides, the dignity of COVID-19 deaths and the emotions of their loved ones are to be respected [12,13]. International organizations issued policy procedures, guides, and protocols that address the appropriate management of deaths during the COVID-19 pandemic [3–7]. However, the compliance of forensic practitioners with the standards during the current disaster is not assessed in the Arab nations. A transparent honest evaluation of forensic practice is necessary for readjusting the procedures and rectify the pitfalls. Besides, The experience of crisis management is a lesson learned that guides future preparedness for similar casualties. Thus, this study takes an in-depth look at the knowledge, attitude, and practice of forensic practitioners regarding the management of post mortem cases during the COVID-19 pandemic in the Arab world.

2. Subjects and methods

2.1. Study design

The current research is a pilot cross-sectional study.

2.2. Study population

The 35 forensic practitioners from 13 Arab countries were contacted and the purpose of the study was elucidated. They were encouraged to participate in the study and to distribute web-based questionnaires to their colleagues in their countries as much as possible. The invited forensic practitioners were practicing forensic in the following Arab countries; Algeria, Libya, Egypt, Sudan, Iraq, Syria, Palestine, Jordan, Lebanon, Kingdom of Saudi Arabia (KSA), Kuwait, Bahrain, and United Arab Emirates (UAE). No forensic staff members could be contacted from 9 countries, these countries were; Comoros, Djibouti, Mauritania, Morocco, Oman, Qatar, Somalia, Tunisia, and Yemen.

2.3. Survey instrument

The questionnaire was constructed after a thorough review of guidelines issued by international organizations in the management of deaths during the COVID-19 pandemic [3–7]. The questionnaire was comprehensively formulated to meet the optimum international standards. Approval was obtained from the Research Ethics Committee of Faculty of Medicine, Alexandria University (IRB Number: 00012098, FWA Number: 0018699, Approval serial number: 0304677). SurveyMonkey platform was used in the formulation of the survey that was electronically distributed to the participants. It was mentioned that the completion of the questionnaire needs an average of 15 min. Submission of a self-administered questionnaire was considered as implied consent for participation in the study.

A structured questionnaire was used to cover the following domains:

1- Demographic Characteristics:
- Personal data: gender, age, specialty, level of education, nationality.
- Occupational data: duration of experience, job level, a country in which he/she works.

2- Knowledge, Attitude, and Practice of Forensic Practitioners During Pandemic:

Knowledge (K), attitude (A), and practice (P) of forensic practitioners regarding the management of post mortem cases during COVID-19 pandemic were assessed. The questions were formulated in three types:
- Single correct answer questions.
- Multiple correct answers questions.
- 5 Point Likert Scale questions (1: Strongly disagree, 2: disagree, 3: neutral, 4: agree, 5: Strongly agree).

Knowledge domain was assessed using multiple correct answers questions from K1 to K7 and single correct answer questions in K8 and K9. All attitude questions were 5 Point Likert Scale questions. Regarding practice questions, they were multiple correct answers questions from P1 to P7 and 5 Point Likert Scale questions from P8 to P13. The headings of KAP questions are illustrated in Fig. 1.

3- Challenges and Perspectives:
- Frequency of forensic autopsies of suspected/confirmed cases infected with Coronavirus.
- Refusal of conduction of high-risk autopsies.
- Experienced challenges in the workplace during the pandemic.
- Description of the management process in the workplace during the pandemic.

2.4. Statistical methods

Face validity was applied as an assessment of different questions by two experts in the field to judge whether questions measure what they are supposed to measure. The reliability of questions was assessed using split-half reliability by calculating the Spearman-Brown coefficient, as well as, the Guttman Split-half coefficient [14]. They revealed a moderate correlation of questions with a coefficient of 0.541 and 0.534 respectively. All statistical tests were two-sided, judged at 0.05 significance level, and were performed using the IBM SPSS statistics program (version 21).

Calculation of KAP questions scores:
- Single correct answer per question was treated as one response.
**K1- Triage for risk assessment before scene examination/autopsy**

1. Travel history
2. Flu-like symptoms before death
3. Contact with COVID-19 patient
4. Contact with people with flu

**K2- Forensic safety measures during pandemic.**

1. Proper infrastructure
2. Assessment of practice & training
3. Proper infection control policies.
4. Disaster management plan.
5. Effective triage policy & procedures
6. Immunization against known hazards
7. Autopsy alternatives.
8. Communication with health officials.
9. Training for safe PM procedures.

**K3- Route of exposure to COVID-19 during management of deaths**

1. Techniques disperse body fluids.
2. Aerosols generate procedures.
3. Use sharp instruments.
4. Handling biological samples.

**K4- Activities that have risk of infection transmission**

1. Complete autopsy
2. DNA sampling
3. External examination
4. Handling at death scene.
5. Dead body washing
6. Embalming
7. Dead body disposal
8. Transportation of deaths
9. X-ray of dead body
10. Dealing with forensic evidence
11. Using oscillating saws
12. Using cameras in working area
13. Cleaning working area
14. Dealing with instruments
15. Handling dirty cleaning utilities

**K5- Categories concerned with biosafety in forensic facilities**

1. Forensic Examiners
2. Junior residents & students
3. Mortuary Technicians
4. Forensic Clinic Staff members
5. Decontamination staff
6. Transportation staff
7. Funeral staff
8. Cleaners
9. Porters

**K6- Aims of infrastructure ventilation & negative pressure system in forensic facilities.**

1. Minimization of offensive odors.
2. Minimization of possibility of infection.
3. Maintain comfortable work environment.
4. Protect public safety.

**K7- Criteria of proper infrastructure ventilation & negative pressure system in forensic facilities**

1. Three isolated zones
2. Extraction systems
3. Down draught Autopsy Table Ventilation.
4. Temperature control.
5. Air distribution system.
6. High air change rates.
7. Separation of working areas
8. Air flow from clean to less clean zone
9. Different pressures in 3 zones
10. Control system (monitor airflow/pressure).
11. Exhaust systems with HEPA filters.

**K8- Effectiveness of standard precautions during autopsy in protection against COVID-19.**

**K9- Minimal required BSL during high-risk autopsies.**

**A1- Concern about management of cases during pandemic***

1. Produced before 11/3/2020
2. Circulated within a month
3. Available to all forensic team.
4. Regularly updated.
5. Available from official sources.
6. Professionally constructed.
7. Compliant with international guidelines.

**A2- Trust in decisions in management during pandemic***

1. Three isolated zones
2. Extraction systems
3. Down draught Autopsy Table Ventilation.
4. Temperature control.
5. Air distribution system.
6. High air change rates.
7. Separation of working areas
8. Air flow from clean to less clean zone
9. Different pressures in 3 zones
10. Control system (monitor airflow/pressure).
11. Exhaust systems with HEPA filters.

**A3- Considering workplace safe during pandemic.***

1. Minimization of offensive odors.
2. Minimization of possibility of infection.
3. Maintain comfortable work environment.
4. Protect public safety.

**A4- Identification of future challenges & opportunities.***

1. Disposable gown
2. Disposable apron
3. Disposable one-piece suit
4. Type IIIR/Surgical masks
5. FFP2 Filtering Respirator
6. FFP3 Filtering Respirator
7. Goggles/face shield
8. Non-Sterile gloves
9. Sterile gloves
10. Heavy-duty gloves
11. Boots/closed shoes
12. Shoe covers
13. Breathing apparatus
14. Dead body bags
15. Considerations PPE shortage

**P1- Local officials’ instructions for management of deaths**

1. Community members.
2. Religious authorities.
3. Healthcare workers
4. Workers of mortuaries
5. Staff of funeral home
6. Burial workers.
7. Embalming staff

**P2- Categories addressed by local officials’ instructions concerning management of deaths.**

1. Community members.
2. Religious authorities.
3. Healthcare workers
4. Workers of mortuaries
5. Staff of funeral home
6. Burial workers.
7. Embalming staff

**P3- Risk assessment for suspected/confirmed cases before autopsy.**

1. AM radiological studies
2. AM lab studies (PCR)
3. PM X-Ray examination
4. PM CT examination
5. PM Swab (PCR for COVID-19)
6. PM swab (other pathogens).
7. Notifications of suspicions

**P4- Safety measures in forensic facilities during pandemic.**

1. Assessment of available resources.
2. PPE rationalization plan.
3. Policy for testing/sampling.
4. Separate access for staff & visitors.
5. Screening of employees & visitors.
6. Isolation for examiners contacted with cases
7. Application of safety precautions
8. Decrease staff during autopsy
9. Excluding high-risk groups
10. Annual immunizations of staff
11. Posters for infection control
12. Signs for social spacing.

**P5- Morgues preparedness & resources during pandemic.**

1. PPE for COVID-19 cases
2. BSL-3 for autopsy, embalming rooms.
3. Staff changing room
4. Down draught Autopsy Table Ventilation.
5. Doors are automatically closing
6. Separate air supply for working areas
7. Negative pressures different in 3 zones.
8. Central monitoring system
9. HEPA filters & exhaust air systems
10. Secured storage room
11. Specimen storage area
12. Cleaning station room.

**P6- Available PPE for forensic teams during pandemic.**

1. Disposable gown
2. Disposable apron
3. Disposable one-piece suit
4. Type IIIR/Surgical masks
5. FFP2 Filtering Respirator
6. FFP3 Filtering Respirator
7. Goggles/face shield
8. Non-Sterile gloves
9. Sterile gloves
10. Heavy-duty gloves
11. Boots/closed shoes
12. Shoe covers
13. Breathing apparatus
14. Dead body bags
15. Considerations PPE shortage

**P7- Autopsy alternatives in suspected/confirmed cases.**

1. External Examination
2. Minimally invasive procedures
3. Virtual Autopsy

**P8- Competence of forensic team in routine work before pandemic.**

**P9- Clarity of workplace goals & plans during pandemic.**

**P10- Performance of team after supervisors feedback.**

**P11- Adherence to safety precautions during pandemic.**

**P12- Accessibility of forensic staff to PPE.**

**P13- Training of forensic staff for infection control measures.**

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* Multiple correct answers in questions (Multiple responses)
** Single correct answer in questions
*** 5 Point Likert Scale (1: strongly disagree, 2: disagree, 3: neutral, 4: agree, 5: strongly agree)

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**Fig. 1.** Questions assessing knowledge, attitude, and practice of the participating forensic practitioners.
• Multiple correct answers per question were treated as multiple responses.
• Point Likert Scale questions were coded as strongly disagree = 1 to strongly agree = 5.

The total knowledge, attitude, and practice scores were calculated. The calculated scores were converted into percentages by the following equation: Percentage = (Score / Maximum possible score)*100 [15].

For data analysis, the choice of the test was based on variables’ distribution by the Kolmogorov-Smirnov test as well as the sample size. Mann-Whitney, as well as Kruskal-Wallis tests, were performed to compare median knowledge, attitude, and practice scores between different categorical variables [14].

3. Results

The current study included the responses of 29 forensic practitioners from 11 Arab countries. Half of the participants had a doctorate in forensic medicine and more than half (58.4%) of them are practicing forensically for more than 10 years. Forensic medicine examiners constituted 76.8% of the participants, whereas the rest were specialized in forensic pathology and other forensic sciences. Regarding job level, intermediate middle, and senior managers constituted 40.9% 27.3%, and 31.8% respectively (Table 1).

Regarding the countries where the respondents work; 40% of the participants were working in Eastern Mediterranean countries (Iraq, Syrian, Palestine, Jordan, Lebanon), 32% were practicing forensic medicine in North African countries (Algeria, Egypt, Sudan), and 28% were practicing forensic in Gulf Arabian countries (KSA, Kuwait, UAE). Considering nationality, North African and Eastern Mediterranean countries were the motherlands of 52% and 44% of the participants respectively. Only one participant had Gulf Arabian nationality.

3.1. Knowledge, attitude, and practice scores of forensic practitioners

Table 2 demonstrates nine questions assessing knowledge (K) of forensic practitioners regarding the management of deaths during the pandemic. The optimum knowledge score is 58 and the participants’ scores ranging from 0 to 55. The median knowledge score is 22 that constitutes 37.9% of the optimum score. The better mean score percentages are related to triage for risk assessment and routes of exposure to Coronavirus during the management of infected deaths where mean score percentages are 66.25% and 56% respectively. The least score percentages were related to the criteria and aim of infrastructure ventilation and negative pressure system in forensic facilities where the mean score percentages are 23.5% and 34.25% respectively.

Table 3 elucidates five questions assessing the attitude (A) of forensic practitioners regarding the management of deaths during the pandemic. All questions are the 5-Point Likert Scale. Thus, the optimum attitude score of the survey is 25, and the participants’ scores ranging from 13 to 23. The total median attitude score is 18.5 that constitutes 74% of the optimum score. Most of the participants were concerned about the proper management of COVID-19 deaths (85.2% positive attitude) and more than three-quarters trusted the decisions of their team during the pandemic (77.8% positive attitude). Besides, two-thirds (66.7%) of the respondents were willing to be engaged in an improvement plan for future infectious hazards. Nevertheless, only 40% consider their workplaces as a safe environment, and 25.9% identified future challenges and opportunities.

Table 4 reveals 13 questions assessing the practice (P) of forensic practitioners regarding the management of post mortem cases during the pandemic. The optimum practice score is 68, and the participants’ scores ranging from 4 to 56. The total practice median score is 25 that constitutes 36.8% of the optimum score. The better mean score percentages are related to the competence of forensic practitioners in routine work (82%). The least scores were related to the implementation of ideal safety measures, morgue preparedness, autopsy alternatives, and availability of appropriate personal protective equipment (PPE) during the pandemic where mean score percentages are 25.5%, 29.5%, 35.3%, and 41.1% respectively.

The responses of the participants to questions addressing safety were less than the ideal international standards. Regarding the knowledge domain, 13.8% of participants correctly answered all items of appropriate forensic safety measures (K2). Also, 55.2% identified that the standard precautions during the autopsy are somewhat effective in protection against COVID-19 (K8), and 41.4% could identify Biosafety level-3 (BSL-3) as the minimal required BSL during high-risk autopsies (K9) (Table 1). Considering the attitude domain, 40% of participants agreed and strongly agreed that their workplaces are safe during pandemic (A3) (Table 3). As regards the practice domain, the mean score percentage of a question assessing the application of safety measures during pandemic (P 4) is 25.5% of the optimum score. Besides, only 14 out of 29 participants (48% response rate) provide answers to a question that asks about the adherence of forensic practitioners to the safety precautions during a pandemic (P11).

3.2. Forensic practitioners scores and their demographic characteristics

Table 1

Demographic characteristics of the participating forensic practitioners (n = 29).

| Demographic Characteristics | Number | percentage |
|----------------------------|--------|------------|
| Gender                     |        |            |
| Female                     | 25     | 82.8%      |
| Male                       | 7      | 23.5%      |
| Age (year)                 |        |            |
| 20-29                      | 24     | 75.9%      |
| 30-39                      | 8      | 27.6%      |
| 40-49                      | 8      | 27.6%      |
| 50-59                      | 6      | 20.7%      |
| 60-69                      | 1      | 3.4%       |
| Forensic Specialty         |        |            |
| Forensic Medicine          | 17     | 70.8%      |
| Forensic Pathology & Forensic Sciences | 7 | 23.1% |
| Level of Education         |        |            |
| Bachelor                   | 3      | 10.3%      |
| Master of Forensic Medicine| 8      | 27.6%      |
| Doctorate of Forensic Medicine | 11 | 37.9% |
| Experience Duration (year) |        |            |
| Less than 10               | 10     | 34.5%      |
| 10 - less than 20          | 7      | 23.4%      |
| More than 20               | 7      | 23.4%      |
| Job Level Description      |        |            |
| Intermediate Management (Clinical duties) | 9 | 30.9% |
| Middle Management (Administrative & clinical duties) | 6 | 20.7% |
| Senior Management (Administrative duties) | 7 | 23.4% |

Table 1

Total knowledge (K), attitude (A), and practice (P) scores of forensic practitioners were compared according to their specialties, levels of education, duration of experience, job levels, and the region where they work. Fig. 2 elucidates that forensic medicine examiners had higher scores (K 27, A 18, P 28) in comparison to other specialties (K 19, A 17, P 22). The statistical significance was detected in knowledge and attitude domains (Kp = 0.009, Ap = 0.001).

Fig. 3 reveals that forensic practitioners with a doctorate in forensic had higher scores (K 27, A 19, P 31) in comparison with less scientific degrees (K 22, A 17, P 25). The statistical significance was detected in the practice domain (Pp = 0.002).

Regarding the duration of experience, those with experience of more than 10 years and less than 20 years had the highest scores (K 41.5, A 19, P 43), followed by those with experience of more than 20 years (K 25, A 18.5, P 27), and lastly, those with experience less than 10 years (K 21, A 16, P 24), as shown in Fig. 4.

Considering the job level, the highest median knowledge score was in middle managers (K 34) followed by senior managers (K 23) and
In the present study, 82% of respondents stated that medicolegal autopsies to suspected/confirmed COVID-19 infected cases were performed in their workplaces. The rate of high-risk autopsies is daily at 18%, weekly at 32%, monthly at 27%, and less than once a month at 23%. More than half (52%) of the participants declare the previous refusal of conduction of high-risk autopsies. The infection of forensic staff, limited resources, and infrastructure issues were mentioned by 71%, 48%, and 28% of participants respectively. There was no evidence that infection of forensic practitioners with Coronavirus was related to the handling of infective cadavers. Also, unclear regulations, decreased productivity and employee morale issues were mentioned by 28%, 24%, and 21% of participants respectively.

Despite challenges, most of the participating forensic practitioners had positive perspectives. They described the management process in their forensic facilities as useful (52%), reliable (35%), high quality (23%). Whereas, the highest median practice score was in senior managers (P 40) followed by middle managers (P 29) and intermediate managers (K 22). The median attitude scores were nearly similar in the three groups, as demonstrated in Fig. 5.

Table 2
Descriptive Analysis for Questions Assessing Knowledge (K) the Participating Forensic Practitioners (n = 29).

| Knowledge Questions | Min-MaxIQR | Medianscore | Median score %* | Mean score (SD) | Mean score %** | Participants with correct answers*** n % |
|---------------------|------------|-------------|-----------------|----------------|--------------|-------------------------------------|
| K1- Triage for risk assessment before scene examination /autopsy during pandemic (n = 29)(/4) | 0-41-4 | 3 | 75% | 2.65(1.54) | 66.25% | 12 41.4% |
| K2- Appropriate forensic medicine safety measures during pandemic. (n = 29) (/9) | 0-91-7 | 4 | 44.4% | 4.27(3.09) | 47.4% | 4 13.8% |
| K3- Route of exposure to COVID-19 during management of infected bodies. (n = 29) (/4) | 0-41-3 | 2 | 50% | 2.24(1.27) | 56% | 6 20.7% |
| K4- Activities that may have a risk of transmission of COVID-19 infection. (n = 29) (/15) | 0-152-8.5 | 5 | 33.3% | 5.41(4.33) | 36.1% | 1 3.4% |
| K5- Categories that concerned with biosafety in forensic facilities. (n = 29) (/4) | 0-91-9 | 5 | 55.6% | 4.62(3.61) | 51.3% | 8 27.6% |
| K6- Aims of infrastructure ventilation & negative pressure system in forensic facilities (n = 26) (/4) | 0-40-2.5 | 1 | 25% | 1.37(1.34) | 34.25% | 2 6.9% |
| K7- Criteria of proper infrastructure ventilation & negative pressure system in forensic facilities (n = 26) (/11) | 0-110-4 | 1 | 9% | 2.58(3.28) | 23.5% | 1 3.4% |
| K8- Effectiveness of standard precautions during autopsy in protection against COVID-19.(n = 26) (/5) | 0-10-1 | 1 | NA | NA | NA | 16 55.2% |
| K9- Minimal required biosafety level at working areas during high-risk autopsies.(n = 26) (/5) | 0-10-1 | 0 | NA | NA | NA | 12 41.4% |
| Total optimum Knowledge score (/58) | 0-5513.5-34 | 22 | 37.9% | 24.13(15.32) | 41.6% | |

Multiple correct answers in questions from K1 to K7.
A single correct answer in questions K8 & K9.
NA: Not Applicable SD: Standard deviation.
* Percentage of median value from the maximum (optimum) score of each question.
** Percentage of mean value from the maximum (optimum) score of each question.
*** Participants correctly answered all items of each question.

Table 3
Descriptive analysis for questions assessing attitude (A) of the participating forensic practitioners (n = 29).

| Attitude Questions | Min-MaxIQR | Medianscore | Median score %* | Mean score (SD) | Mean score %** | Positive Attitude*** n % |
|--------------------|------------|-------------|-----------------|----------------|--------------|-------------------------------------|
| A1- Concern about proper management of forensic cases during pandemic (n = 27) (/5) | 2-54-5 | 4 | 80% | 4.30(0.82) | 86% | 23 85.2% |
| A2- Trust in decisions of forensic team in the management during pandemic? (n = 27) (/5) | 2-54-4 | 4 | 80% | 3.96(0.76) | 79% | 21 77.8% |
| A3- Considering workplace as a safe environment, during pandemic. (n = 25) (/5) | 1-42-4 | 4 | 80% | 2.88(1.13) | 58% | 10 40% |
| A4- Identification of future challenges and opportunities. (n = 27) (/5) | 1-43-4 | 3 | 60% | 3.07(0.78) | 60% | 7 25.9% |
| A5- Willingness to be engaged in improvement plan for future infectious hazards (n = 24) (/5) | 2-53-5 | 4 | 80% | 3.92(0.88) | 78% | 16 66.7% |
| Total optimum attitude score (/25) | 13-2316.25-19 | 18.5 | 74% | 18.04(2.66) | 72% | |

All questions are 5 Point Likert Scale: (1: strongly disagree, 2: disagree, 3: neutral, 4: agree, 5: strongly agree).
SD: Standard deviation.
* Percentage of median value from the maximum (optimum) score of each question.
** Percentage of mean value from the maximum (optimum) score of each question.
*** Combined agree and strongly agree.

intermediate managers (K 22). Whereas, the highest median practice score was in senior managers (P 40) followed by middle managers (P 29) and intermediate managers (P 22). The median attitude scores were nearly similar in the three groups, as demonstrated in Fig. 5.

Fig. 6 revealed that forensic practitioners in Gulf Arabian countries had the highest median knowledge and practice scores (K 37, P 42) followed by scores of those working in Eastern Mediterranean countries (K 23.5, P 25) and North African countries (K 18, P 24). The median attitude scores were nearly similar in the three groups.

3.3. Challenges and perspectives

In the present study, 82% of respondents stated that medicolegal autopsies to suspected/confirmed COVID-19 infected cases were performed in their workplaces. The rate of high-risk autopsies is daily at 18%, weekly at 32%, monthly at 27%, and less than once a month at 23%. More than half (52%) of the participants declare the previous refusal of conduction of high-risk autopsies. The infection of forensic staff, limited resources, and infrastructure issues were mentioned by 71%, 48%, and 28% of participants respectively. There was no evidence that infection of forensic practitioners with Coronavirus was related to the handling of infective cadavers. Also, unclear regulations, decrease productivity and employee morale issues were mentioned by 28%, 24%, and 21% of participants respectively.

Despite challenges, most of the participating forensic practitioners had positive perspectives. They described the management process in their forensic facilities as useful (52%), reliable (35%), high quality (21%), and cost-effective (17%). Nevertheless, only 7% and 3% of
The attitude of forensic practitioners in Arab nations is promising. The optimally required knowledge, attitude, and practice of forensic practitioners during the pandemic were formulated in comprehensive questions. Challenges experienced by participants and their perspectives were also considered. The survey was electronically distributed in 13 Arab countries. The responses were received from 29 forensic practitioners from 11 countries. Half of the respondents had a doctorate in forensic medicine and more than half of them are practicing forensic for more than 10 years. Unwilling to complete the questionnaire is specifically defective considering the tendency for non-disclosure that is in concordance with Mansour et al (2020) [17].

Coronavirus is a newly emerging pathogen, its scientific background is not included in the forensic textbooks. The solid facts regarding the management of COVID-19 related deaths are available only through web-based international guidelines and manuals [3–7]. Thus, the knowledge of the forensic practitioners is specifically defective considering COVID-19 related issues in forensic practice. Therefore, it is advisable to circulate updated manuals along with conduction periodic scientific activities to provide forensic teams with necessary COVID-19 related information.

The attitude of forensic practitioners in Arab nations is promising. 85% of participants were concerned about the appropriate management of deaths during a pandemic, 77.8% trusted the decisions of their teams during the current crisis, and 66.7% were willing to share in the formulation of disaster management plans for future hazards. However, only 40% were feeling safe in their workplaces and 25.9% identified only 40% were feeling safe in their workplaces and 25.9% identified unwilling to complete the questionnaire as poor quality and impractical.

4. Discussion

Forensic practitioners are at the frontline of crisis management and their safety is the utmost priority. Thus, handling of any cases must be adherent to the strictest protective measures. Evaluation of forensic practice during the COVID-19 pandemic allows addressing defects and rectifying disaster management actions [16]. Therefore, the current research is concerned with the assessment of the knowledge, attitude, and practice of forensic practitioners regarding the management of post mortem cases in the Arab world during the pandemic.

A thorough questionnaire was constructed according to the international standards of the management of deaths during the pandemic [3–7]. The optimally required knowledge, attitude, and practice of forensic practitioners during the pandemic were formulated in comprehensive questions. Challenges experienced by participants and their perspectives were also considered. The survey was electronically distributed in 13 Arab countries. The responses were received from 29 forensic practitioners from 11 countries. Half of the respondents had a doctorate in forensic medicine and more than half of them are practicing forensic for more than 10 years. Unwilling to complete the questionnaire might be attributed to the lack of interest in the topic of research or the tendency for non-disclosure that is in concordance with Mansour et al (2020) [17].

Coronavirus is a newly emerging pathogen, its scientific background is not included in the forensic textbooks. The solid facts regarding the management of COVID-19 related deaths are available only through web-based international guidelines and manuals [3–7]. Thus, the knowledge of the forensic practitioners is specifically defective considering COVID-19 related issues in forensic practice. Therefore, it is advisable to circulate updated manuals along with conduction periodic scientific activities to provide forensic teams with necessary COVID-19 related information.

The attitude of forensic practitioners in Arab nations is promising. 85% of participants were concerned about the appropriate management of deaths during a pandemic, 77.8% trusted the decisions of their teams during the current crisis, and 66.7% were willing to share in the formulation of disaster management plans for future hazards. However, only 40% were feeling safe in their workplaces and 25.9% identified unwilling to complete the questionnaire as poor quality and impractical.

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Table 4

| Practice Questions | Min-Max IQR | Median score | Median score %* | Mean score (SD) | Mean score %** |
|-------------------|-------------|--------------|-----------------|-----------------|----------------|
| P1- Local officials’ instructions and guidelines for management of deaths (n = 29) (/7) | 0-6 3-5.5 | 4 3.96 (1.70) | 57.1% 56.6% | 1.52 (0.63) | 0.59 (4.30) |
| P2- Categories addressed by local officials’ instructions concerning management of deaths. (n = 29) (/7) | 0-7 1-5 | 3 2.89 (1.87) | 42.9% 41.3% | 1.03 (0.75) | 0.34 (1.05) |
| P3- Triage for risk assessment for suspected/confirmed COVID-19 deaths before autopsy. (n = 29) (/7) | 0-7 1-5 | 3 3.10 (2.35) | 42.9% 44.3% | 1.06 (0.59) | 0.54 (1.06) |
| P4- Safety measures in forensic medicine facilities during pandemic (n = 29) (/12) | 0-12 0-5.5 | 0 3.06 (4.18) | 60% 25.5% | 2.59 (0.43) | 0.68 (0.75) |
| P5- Morgues preparedness and available resources during pandemic. (n = 29) (/12) | 0-12 1-6 | 3 3.55 (3.27) | 25% 29.5% | 1.0 (0.85) | 0.68 (0.85) |
| P6- Available of PPE for forensic teams during pandemic. (n = 29) (/15) | 0-13 2.5-9 | 6 6.17 (4.20) | 60% 41.1% | 2.97 (0.98) | 0.7 (0.98) |
| P7- Autopsy alternatives in management of suspected/confirmed cases. (n = 29) (/3) | 0-3 1-1 | 1 1.06 (0.59) | 33.3% 35.3% | 0.58 (0.37) | 0.64 (0.37) |
| P8- Competence of forensic team in routine forensic medicine work before pandemic. (n = 27) (/5) | 2.5 3-5 | 4 4.11 (1.05) | 80% 82% | 2.98 (0.89) | 0.72 (0.89) |
| P9- Clarity of workplace goals and action-plans during pandemic. (n = 27) (/5) | 2.5 3-4 | 3 3.44 (0.75) | 60% 68.8% | 1.49 (0.9) | 0.65 (0.9) |
| P10- Performance of forensic examiners’ team after getting feedback from supervisors. (n = 28) (/5) | 2.5-4 1.5-4 | 4 3.39 (1.03) | 80% 67.8% | 2.33 (1.03) | 0.83 (1.03) |
| P11- Adherence to safety precautions by forensic practitioners during pandemic (n = 14) (/5) | 2.4 3-4 | 3 3.35 (0.63) | 60% 67% | 2.28 (0.63) | 0.8 (0.63) |
| P12- Accessibility of forensic staff to PPE. (n = 29) (/8) | 1-5 2.5-5 | 4 3.58 (1.45) | 80% 71.6% | 3.18 (0.95) | 0.82 (0.95) |
| P13- Adequate training of forensic staff for infection control measures. (n = 29) (/8) | 1-5 1-4 | 3 2.79 (1.52) | 60% 55.8% | 2.6 (0.79) | 0.69 (0.79) |

Note: * Percentage of median value from the maximum (optimum) score of each question.
** Percentage of mean value from the maximum (optimum) score of each question.
***Total score was calculated after excluding P11 (n = 14).

Multiple correct answers in questions from P1 to P7.

5 Point Likert Scale in questions from P8 to P13.

In calculation of total P score, combined agree and strongly agree in 5 of Point Likert Scale represent good practice = 1, any other scores = 0.

SD: Standard deviation.
and resources in Italian forensic facilities could not cope with increasing numbers of COVID-19 related fatalities as reported by Cattaneo (2020) [18]. On the other hand, medicolegal institutes in Germany overcame the challenges and adapted procedures to allow safe handling and dissection of infective bodies as stated by Püschel and Sperhake (2020) [19].

Medicolegal autopsies to suspected/confirmed COVID-19 infected cases have frequently been conducted by the participating forensic

Fig. 2. Comparison of total knowledge, attitude, and practice scores between forensic practitioners with different specialties.

Fig. 3. Comparison of total knowledge, attitude, and practice scores between forensic practitioners at different education levels.
practitioners. The infection of forensic staff members with Coronavirus was reported, however, they no proof that such infection is related to their occupational exposure to infective deaths. Interestingly, the participants exhibited positive perspectives despite these challenges, high percentages of them described the management process in their forensic facilities as useful, reliable, high quality, and cost-effective.

The participating forensic medicine examiners, in the present survey, had higher scores in comparison with other specialties. Also, forensic
practitioners with a doctorate had higher scores in comparison to less scientific degrees. However, there is no enough evidence to prove statistical significance in all studied domains. It is important to consider the presence of obvious clinical significance in absence of evident statistical significance due to the limited sample size [20]. It was found that those with a duration of experience ranged from 10 to 20 years had the highest scores than more senior practitioners. The Coronavirus is a newly emerged hazard and its scientific information is available through websites. Therefore, seniors might be less skillful in access to web-based information than newer generations [21].

Successful disaster management requires administrative skills. Thus, senior and middle managers had higher scores than intermediate managers. The highest median knowledge score was in middle managers because their field practice along with administrative duties keep them updated regarding COVID-19. Whereas, the highest median practice score was in senior managers as their solid administrative background might allow better handling during extraordinary situations.

Forensic practitioners in Gulf Arabian countries had the highest median knowledge and practice scores than those working in other areas in the Arab world. Gulf Arabian countries had a better economic state with subsequent better infrastructures and resources in their forensic facilities. Besides, the Gulf region has an efficient disaster management policy as it is accustomed to deal with millions during the annual Hajj pilgrimage [22]. Also, the response of Gulf countries to the Coronavirus-19 pandemic might be governed by the experience learned from the Middle East respiratory syndrome coronavirus (MERS-CoV) epidemic in 2012 [23]. Such preparedness and experience in disaster management might contribute to more professional forensic practice during the current pandemic.

It is worth mentioning that, in the Arab region, forensic medicine practice is deep-rooted. Thus, the origin and development of forensic medicine in Egypt and the Kingdom of Saudi Arabia were reviewed in the literature [8,9,24]. It was noticed that medicolegal practices in Arabian societies are greatly influenced by the local religious and cultural norms of each society [10–12,25]. In 2015, Al-Waheeb et al. reviewed the history and practice of forensic autopsies in few Arab countries and compare it with Western countries. They were concerned with differences in organizational structure and the job description of forensic practitioners within different medicolegal systems [26]. However, to date, no previous studies were conducted to address forensic practitioners’ responses in Arab nations in relation to the international standards either before or during the COVID-19 pandemic.

At the level of Islamic countries, Malaysia provided an inspiring model for the successful management of deaths during the COVID-19 crisis as mentioned by Khoo et al. (2020) [27]. At the international level, there is a reluctance to the conduction of autopsies to COVID-19-related deaths in the initial phase of the pandemic for fear of infection of forensic teams. The different medicolegal institutes worldwide had advised against autopsies [28]. Nevertheless, international health organizations such as the World Health Organization (WHO) [3], College of American Pathologists [4], International Committee of the Red Cross (ICRC) [5], Centers for Disease Control and Prevention (CDC) [6] issued guidelines considering the requirements for safe handling of infective deaths.

The published literature on COVID-19 autopsies could be used as an indicator of the autopsy practices in different countries. Germany, Italy, Switzerland, UK, USA, and Austria are performing full autopsies to suspected/confirmed COVID-19 deaths for medicolegal and research purposes. On the other hand, Brazil and China are more likely to perform a minimally invasive autopsy [29]. It seems that Europe, America, and Australia have well-equipped forensic facilities along with proper disaster management procedures that ensure the safety of forensic teams and enable the conduction of high-risk autopsies. Nevertheless, countries with limited infrastructures and resources such as Brazil and China tend to perform less invasive techniques [30,31].

The improvement of crisis management starts with the readjusting of policy procedures and action plans. Furthermore, Enforcement of infection control measures is mandatory to fulfill the recommended
international standards [32]. Besides, proper infrastructure along with appropriate resources is essential to support safe and competent forensic practice during outbreaks. In the fact, the cost for the construction of BSL-3 and BSL-4 facilities is burdensome, especially for developing countries. However, there is a necessity to build, operate, and maintain morgues to function at BSL-3 and BSL-4 standards. The well-equipped morgues could maintain a safe forensic practice in the presence of highly infective pathogens either during routine work or outbreaks of infectious diseases [33,34].

Although the current research was restricted to a limited number of forensic practitioners, it serves as valuable reference data that reflect the response of forensic teams in the Arab world during the COVID-19 crisis. The results will be useful to further monitor the progress of knowledge attitude and practice of forensic staff members in the Arab world during the current pandemic and any similar and disasters.

5. Conclusions

This study elucidated responses from the forensic practitioners in the Arab world during the pandemic regarding the management of post mortem cases. The better knowledge scores are related to triage for risk assessment and routes of exposure to Coronavirus during the management of deaths, whereas, least scores were related to criteria and aim of ventilation and negative pressure system in forensic facilities. Most of the participants had an inspiring positive attitude and perspectives. The better practice scores are related to the competence of forensic teams, whereas, least scores were related to the implementation of the ideal safety measures. Challenges mentioned by participants were staff infection, limited resources, and infrastructure issues. This survey guides readjusting of procedures and future preparedness for similar disasters in the Arab world.

Interestingly, the present study adopted a comprehensive questionnaire that fulfills the international standards for the management of deaths during the COVID-19 pandemic and outbreaks of infectious diseases. The provided questionnaire could be used in initial and periodic assessments in any medicolegal institute worldwide. Also, it could support postmortem projects and disaster management plans.

Declaration of Competing Interest

No conflict of interest.

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