



Histopathology laboratory paperwork as a potential risk of COVID-19 transmission among laboratory personnel

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SUMMARY

Background: Healthcare workers have a higher risk of acquiring coronavirus disease 2019 (COVID-19). The process of requesting pathological investigations is usually handled manually through paper-based forms. This study evaluated the potential for paper-based request forms to transmit severe acute respiratory virus coronavirus-2 (SARS-CoV-2) to laboratory staff in order to make recommendations for dealing with hospital paperwork in a post-COVID-19 world.

Methods: Paper-based forms were tracked from the time of test ordering until the release of the pathology report by calculating the time taken for the forms to reach the laboratory, and the exposure of each staff group to forms received from both high and moderate COVID-19 risk areas.

Results: Four hundred and thirty-two (83%) of 520 forms were received in the laboratory within 24 h. The remaining 88 (17%) forms took ≥ 24 h to be handled by laboratory personnel. The mean daily exposure time to the paperwork for various laboratory staff was as follows: receptionists, 2.7 min; technicians, 5.5 min; and pathologists, 54.6 min.

Conclusion: More than 80% of the forms were handled by laboratory personnel within 24 h, carrying a high potential risk for viral transmission. It is recommended that paper-based request forms should be replaced by electronic requests that could be printed in the laboratory if required. Another option would be to sterilize received paperwork to ensure the safety of laboratory personnel. More studies are needed to detect the stability of SARS-CoV-2 on different surfaces and determine the potential risk of COVID-19 transmission via paper.

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Introduction

Coronavirus disease 2019 (COVID-19) is a disease caused by severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2).

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It is most commonly spread by droplets. However, it can also be transmitted indirectly by touching contaminated objects or surfaces, such as computers, tables and doorknobs, and inoculation into nose, mouth or eyes [1]. The disease has been named 'COVID-19' and the novel virus has been named 'SARS-CoV-2' by the International Committee on Taxonomy of Viruses [2].

Back in 2003, SARS-CoV infected 8098 patients, with a mortality rate of 9%, in 26 countries around the world [3]. However, SARS-CoV-2 has already infected more than 4,000,000

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individuals across 210 countries and territories, with more than 250,000 deaths around the world. The higher transmission rate of SARS-CoV-2 compared with SARS-CoV could be due to a genetic recombination event at the S protein in the RBD region of SARS-CoV-2 that may have enhanced its transmission ability [3]. The lower mortality rate of COVID-19, with a higher proportion of infectious patients with mild disease, could also account for the higher and more widespread transmission of this virus.

Healthcare workers (HCWs), including hospital and laboratory staff, have a higher risk of contracting COVID-19. This has been observed consistently since the first reported cases of 15 infected HCWs in Wuhan, China [4]. The presence of SARS-CoV-2 in the air and on surfaces in hospital environments implies a potentially high risk of infection for medical staff and other close contacts [5]. However, histopathological and cytological laboratories cannot stop offering diagnostic services to patients during this outbreak.

The process of requesting laboratory investigations for patients usually occurs manually through paper-based forms. The requesting clinician completes a paper form and hands it to the patient or another HCW in order to deliver the hardcopy manually to the laboratory receptionist, who usually receives the specimen along with its paper-based request form [6]. After registering the case, the form would be handed to a laboratory technician for specimen preparation, and then to a pathologist for testing. In March 2020, van Doremalen *et al.* showed that the half-lives of SARS-CoV and SARS-CoV-2 were similar in aerosols, with median estimates of approximately 1.1 h, but the half-life of SARS-CoV-2 was longer than that of SARS-CoV on cardboard [7]. Duan *et al.* (2003) studied the persistence of SARS-CoV Strain P9 on different types of inanimate surfaces, and reported 4–5 days persistence on paper at room temperature [8]. Lai *et al.* (2005) reported persistence of SARS-CoV Strain GUV6109 on paper for 24 h at room temperature [9]. To the authors' knowledge, no studies to date have assessed the potential risk of exposure from paperwork originating from different hospital departments to the laboratory during the coronavirus pandemic. Many studies have discussed the use and implementation of electronic laboratory request forms, showing a clear advantage in the implementation of electronic forms over manual laboratory request forms with respect to service quality. This study focused on defining the major hospital departments that request histopathology (by frequency and percent), measuring the time between clinical staff handling the form and laboratory personnel handling the form, and comparing the possibility of COVID-19 transmission to laboratory personnel based on exposure times to paperwork.

Methods

This comparative cross-sectional hospital-based study was performed at Prince Mishari bin Saud Hospital in Saudi Arabia between 3rd March 2020 (1 day after declaration of the first confirmed case in Saudi Arabia) and 10th May 2020. Paper-based request forms (either paper forms with computer-typed data or handwritten requests in addition to any other accompanying paper-based documents) were tracked from the time of writing until release of the pathology report. All histopathological and non-gynaecological cytological cases from all hospital

departments were included. Forms that did not include the time of writing were excluded, as were request forms printed in the laboratory. The total time taken from requesting a test (paper is handled by HCW and exposed to the hospital environment) to receiving the request form (first contact with laboratory personnel) was measured by calculating the difference between the ordering time on the request form and the time of receipt. The cases were divided into two groups: <24 h and ≥24 h (according to the US Centers for Disease Control and Prevention and Guo *et al.* [5], SARS-CoV-2 can remain viable on paper surfaces for up to 24 h).

Requesting departments and units were divided into two groups: high COVID-19 risk areas [which included emergency room (ER), intensive care unit (ICU) and quarantine section] and moderate COVID-19 risk areas [including wards, outpatient department (OPD) and operating rooms (ORs)]. This was based on categorization by the local infection control department and the study by Guo *et al.* [5] which found that COVID-19 contamination is greater in ICUs than general wards.

Laboratory staff were categorized into three groups: receptionists, laboratory technicians and pathologists. Total times of exposure to paperwork were calculated daily, using a stopwatch, for each staff category.

Statistical analysis was performed using Excel 2007 (Microsoft Corp., Redmond, WA, USA). Data are presented as means and standard deviations. Differences between means were tested for significance using *t*-test for differences in time of paper handling, and using analysis of variance for differences in staff exposure.

Ethical approval was granted by the local ethics committee (Number LA3001/2020).

Results

In total, 520 request forms and other accompanying sheets of paper were delivered to the histopathology department in the study period (Figure 1). The sites of origin of the paperwork were as follows: inpatient wards, 227 (43.7%); ORs, 97 (18.7%); OPD, 88 (16.9%); ER, 51 (9.8%); and ICU, 57 (10.9%). According to the risk classification, 108 (20.7%) forms originated from high-risk areas and 412 (79.3%) originated from moderate risk areas. These results are summarized in Table I and Figure 2.

Four hundred and thirty-two (83.1%) forms reached the laboratory within 24 h and were handled by laboratory personnel within a mean time of 5.7 h. The remaining 88 (16.9%) forms took ≥24 h to reach the laboratory and were handled by laboratory personnel within a mean time of 46.6 h. The difference between the two means was significant ($P=0.00001$) (Table II).

During the study period, the mean daily exposure time to the paperwork for various laboratory staff was as follows: receptionists, 2.7 min; technicians, 5.5 min; and pathologists, 54.6 min.

During the 58-day study period, it was found that receptionists were exposed for an average of 2.7 min/day, laboratory technicians were exposed for 5.5 min/day and pathologists were exposed for 54.6 min/day. The differences between these mean exposure times were significant, particularly the difference between pathologists and receptionists/technicians (see Table III).

A

KINGDOM OF SAUDI ARABIA
MINISTRY OF HEALTH

He. [redacted]
Na. [redacted]
Ag. [redacted]
Na. [redacted]
Consultant In-Charge: [redacted]
Dept.: OR Unit: OB

PERINATAL WARD
02/03/2020 10:40:45AM

HISTOPATHOLOGY REQUEST & REPORT نموذج طلب وتقارير تشريح الخلايا

Request [redacted]

Source of Specimen: Endometrial tissue Clinic No.: [redacted] O.R. No.: [redacted] Other: [redacted]
Date & Time Taken: 2/3/2020 8:15 am Lab. No.: [redacted]
Type of Specimen: Endometrial tissue
Frozen Section: ☐ Yes ☒ No

Cilical Date
Clinical Date including important investigations and pervious path No.: [redacted]

Clinical Diagnosis & Problems: [redacted]

Sent By: [redacted]
Name of Physician: [redacted] Signature: [redacted]
Name of Nurse: [redacted] Signature: [redacted]

Histopathology Report:

B

Ministry of Health
General Directorate of Health Affairs in Al-Baha District
Prince Meshari Bin Saud Hospital

Med. Record No.: 370620
Patient Name: [redacted]
Sex: [redacted]
Nationality: Saudi
Unit: EMERGENCYCLINIC

HISTOPATHOLOGY REQUEST FORM

URINE CYTOLOGY

Site: urine
Side: Left
No. of Specimen: 1
Samples: [redacted]
A: 10 [redacted]
Procedure: urination
Relevant clinical history: haematuria
Specimen orientation details:
Diagnosis:
Attending Doctor: [redacted] Bleep Number:
Ordering Doctor: [redacted] Bleep Number:
Order Date: 09/04/2020 09:02:42AM

Figure 1. Two request forms. (A) Manually prepared histopathology request showing the source department (operating room), time of request and time of laboratory receipt beside the barcode (received after 2.5 h). (B) Computerized cytology request showing the source department (emergency room), time of request and time of laboratory receipt beside the barcode (received within <1 h).

Table I

Frequency and percentage of request forms sent to the histopathology department from different hospital departments

Unit	Number of request forms	%
Intensive care unit	57	10.9
Emergency room	51	9.8
Outpatient department	88	16.9
Operating rooms	97	18.7
Inpatient wards	227	43.7
Total	520	100

Discussion

Further to Middle East respiratory syndrome coronavirus and SAR-CoV, SARS-CoV-2 is the third highly pathogenic coronavirus to emerge in the last two decades. Person-to-person transmission has been described in both hospital and family settings [10].

SARS-CoV-2 may be present in samples from patients without known COVID-19, such as pre-symptomatic patients, undiagnosed patients, minimally symptomatic patients, asymptomatic patients, and convalescent patients who could still be shedding the virus [11].

Frequently touched surfaces in healthcare settings represent potential sources of viral transmission. Studies have documented the presence of SARS-CoV on non-viable material and paper for up to 9 days and 1–5 days, respectively; SARS-CoV-2 is expected to behave in a similar fashion [12]. Request forms are the most commonly received paperwork in the pathology laboratory. Dealing with paper-based request forms in the histopathology department remains routine practice in

Table II

Frequencies, mean values, *t*-values and *P*-values of time from completion of a request form until receipt in the histopathology department

Statistics	≥24 h	<24 h
Frequency	88 (16.9%)	432 (83.1%)
Mean	46.6 h	5.7 h
Statistic <i>t</i> -value	51.098	51.098
Critical <i>t</i> -value	1.965	1.965
<i>P</i> -value	<0.00001	<0.00001

most laboratories, regardless of whether they have laboratory information systems [13].

Pathologists and other laboratory personnel deal with paperwork daily, mainly originating from various hospital departments within a short period of time. The main problem with paper-based work is that the virus can be viable for >24 h at room temperature. It is difficult to sterilize every sheet of paper without compromising its content.

This research was undertaken to report an observation in relation to the current COVID-19 pandemic. Laboratory receptionists were found to be potentially exposed to SARS-CoV-2 by touching request forms for a mean of 2.7 min/day, compared with 5.5 min/day for laboratory technicians and 54.6 min/day for pathologists. It is noteworthy that all three staff groups are exposed to the virus within its viable interval.

Approximately 21% of the observed paper forms originated in high-risk departments (ICU and ER), and 79% originated in moderate-risk departments. More than 80% of paper forms reached their final destination in the laboratory (i.e. pathologist)

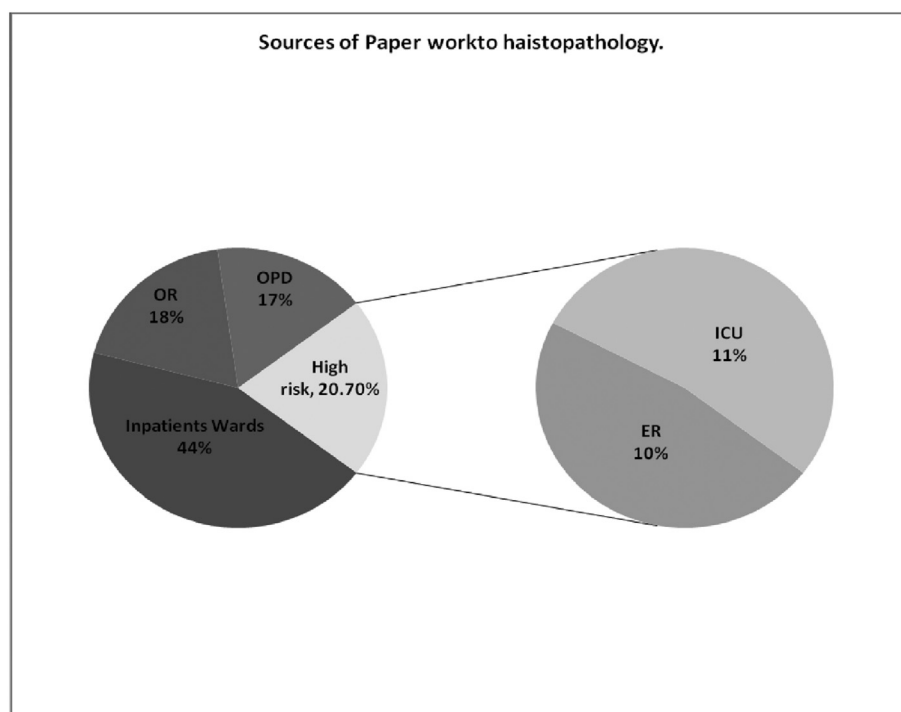


Figure 2. Sources of paperwork sent from different hospital departments to the histopathology department. The high-risk departments are also shown in the right-hand pie chart. Only one-fifth of forms originated from the high-risk units. OR, operating rooms, OPD, outpatient department; ER, emergency room, ICU, intensive care unit.

Table III

Summary of analysis of variance results between the mean exposure times of receptionists, laboratory technicians and pathologists during the study

Slide no.	Exposure time (min)		
	Receptionists	Technicians	Pathologists
Sum	158	316.5	3169
Mean (min)	2.7	5.5	54.6
Count (days)	58		
Overall mean (min)	20.9		
Group number	3		
Critical <i>F</i> -value	3.05		
Calculated <i>F</i> -value	8699.28		
<i>P</i> -value	<0.00001		

within 24 h (mean 5 h, 42 min), and this raises the possibility of contact with a viable coronavirus.

Forae and Obaseki (2017) studied pathology request forms to evaluate the adequacy of the clinical information provided, and reported that 1382 forms (83.3%) were sent by surgeons while 277 (16.7%) were sent by physicians [14].

Establishment of an electronic request and handling system for pathology laboratories is fundamental to ensure the safety of staff, particularly during such a public health crisis [15]. It is recommended that hospital information systems and laboratory information systems should be implemented, with all requests made electronically through the system, and the World Health Organization's guide to laboratory safety [16] and good clinical practice [17] should be followed to ensure non-contamination from infected papers. Moreover, methods such as ultraviolet light irradiation to sterilize paper forms received in the laboratory without affecting the content should be investigated [18]. More studies are required to determine the stability of SARS-CoV-2 on paper surfaces and other surfaces, and the potential risk of COVID-19 transmission via paper and card.

Study limitations

This study was concerned about paper as a potential risk for coronavirus transmission, and incorporated a suitable sample size (520 paper forms); however, these forms were not tested for the presence of SARS-CoV-2.

In conclusion, 80% of paper request forms were found to reach the pathology laboratory from other departments within 24 h, when the virus may remain viable. All pathology personnel are susceptible to contamination from paperwork. It is recommended that personnel should stop handling paper request forms originating in high- and moderate-risk areas of the hospital, and that paper forms should be replaced by electronic requesting. Where paper forms are unavoidable, the authors suggest finding a way to sterilize them alongside the application of strict and clear laboratory precautions to ensure the safety of staff in the pathology laboratory. More studies are required to determine the stability of SARS-CoV-2 on different surfaces, and the potential risk of COVID-19 transmission via paper.

Author contribution

A. Hasan: Conceptualization, Methodology, Literature search& clinical studies, Manuscript preparation, Manuscript editing and submission. **K. Nafie:** Definition of intellectual content, Clinical& experimental studies, Manuscript preparation and final revision. **O. Abbadi:** Data curation, Design, Experimental studies, Statistical analysis, Manuscript editing and revision.

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Conflict of interest statement

None declared.

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