

# Learning at a distance: results of an international survey on the adoption of virtual conferences and whole slide imaging by pathologists

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Received 5 April 2023  
Accepted 8 May 2023

## ABSTRACT

**Aims** This study presents the findings of a global survey of pathologists' views of online conferences and digital pathology.

**Methods** An online anonymous survey consisting of 11 questions focusing on pathologists' perceptions of virtual conferences and digital slides was distributed to practising pathologists and trainees across the globe using the authors' social media accounts and professional society connections. Participants were asked to rank their preference for various aspects of pathology meetings on a 5-point Likert scale.

**Results** There were 562 respondents from 79 countries. Several advantages of virtual meetings were recognised, including that they are less expensive to attend than in-person meetings (mean 4.4), more convenient to attend remotely (mean 4.3) and more efficient due to no loss of time for travel (mean 4.3). The lack of networking was reported as the main disadvantage of virtual conferences (mean 4.0). Most respondents (n=450, 80.1%) preferred hybrid or virtual meetings. About two-thirds (n=356, 63.3%) had no concern regarding the use of virtual slides for educational purposes and viewed them as an acceptable substitute for glass slides.

**Conclusions** Online meetings and whole slide imaging are viewed as valuable tools in pathology education. Virtual conferences allow affordable registration fees and flexibility for participants. However, networking opportunities are limited, meaning in-person meetings cannot be entirely replaced by virtual conferences. Hybrid meetings may be a solution to maximise the benefits of both virtual and in-person meetings.

## INTRODUCTION

Until a few years ago, most pathology conferences consisted of face-to-face (also known as in-person or onsite) meetings that included lectures and slide seminars. Traditionally, glass slides and multiheaded microscopes were used in the slide seminar conferences. Unlike other diagnostic modalities, which may require a single static image to arrive at a diagnosis (such as plain films in radiology and ECG in cardiology), histopathologic slide seminars involve the use of glass slides, a more comprehensive source of diagnostic information. Reviewing these slides requires a substantial amount of time, including observation at low power to identify one or several regions of interest, followed by evaluation of these areas at high power, accompanied by real-time discussion with attendees. The global spread of COVID-19 in 2020 resulted in the cancellation or

## WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ The global spread of COVID-19 in 2020 resulted in the cancellation or postponement of international pathology conferences. Most organisations were forced to hold their annual conferences online and adopt digital pathology for slide seminars.

## WHAT THIS STUDY ADDS

⇒ The global pathology community views online meetings and digital pathology as valuable tools in pathology education.

## HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Hybrid meetings may be a solution to maximise the benefits of both virtual and in-person meetings.

postponement of meetings, conferences and tutorials. Most organisations, including the International Academy of Pathology (IAP), the United States and Canadian Academy of Pathology (USCAP), the American Society for Clinical Pathology (ASCP), the College of American Pathologists, the European Society of Pathology and national pathology societies, were forced to hold their annual conferences online. For most, recorded videos and whole-slide images (WSI) were provided, and participants could interact with speakers via a chat box during live sessions. A WSI is a digital copy of an entire histopathological glass slide, made at microscope resolution using slide scanners.<sup>1</sup> Digital slides enable remote viewing of pathological specimens for diagnostic and educational purposes.

Existing literature indicates that learners acknowledge digital pathology as an appropriate method of education. Using digital rather than glass slides results in comparable or superior student performance.<sup>2 3</sup> Moreover, such technology has emerged as a potential tool for pathology conferences, especially during extenuating circumstances such as pandemics. Digital slides offer several benefits over glass slides. First, participants can simultaneously view multiple images. Second, digital slides are accessible from a variety of devices and locations. Third, it is possible to incorporate digital slides into lectures. Lastly, digital slides allow key findings to be annotated.<sup>4</sup> The price of scanning slides is less of a barrier than previously, as the image quality of digital slides created by low-cost scanners is comparable to that of high-cost



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**To cite:** Laohawetwanit T, Gonzalez RS, Bychkov A. *J Clin Pathol* Epub ahead of print: [please include Day Month Year]. doi:10.1136/jcp-2023-208912

scanners.<sup>5</sup> The incorporation of digital slides into the pathology workflow, advanced algorithms and computer-aided diagnostic techniques expand the pathologist's view beyond the microscopic slide and enable true knowledge and expertise integration. The growing interest in the possibilities offered by artificial intelligence and machine learning has resulted in a new field of pathology research.<sup>6</sup>

There are limited data available on preferences and perceptions of online conferences with WSI-based seminars. According to a global survey of radiologists' opinions and preferences, most radiologists favoured attending virtual conferences in the future. Respondents highly valued the ability to rewatch lectures and the flexibility to attend a conference. However, the absence of networking opportunities was noted as a significant disadvantage of virtual meetings.<sup>7</sup> The purpose of this study is to present the findings of a global survey of pathologists' preferences and perceptions regarding online pathology conferences.

## MATERIALS AND METHODS

### Survey questions

The authors, an international group of board-certified pathologists, created an online questionnaire using the SurveyMonkey web platform (SurveyMonkey, San Mateo, California, USA). The anonymous survey consisted of 11 questions about attendees' preferences when comparing in-person and virtual meetings (box 1). It was disseminated to pathologists and residents/fellows using the authors' social media accounts (Twitter, Facebook, LinkedIn and Line) and via pathology societies (ie, several divisions of IAP). Participants must answer every survey question. The survey was administered between July and September 2022.

### Statistical analysis

Each question was formatted with multiple-choice answers (except questions 3, 4 and 11 related to country, ranking and additional comments). A weighted average of each answer choice was calculated for ranking and rating scale questions to capture better and comprehend variation in answer choices. Likert scale values were used to automatically assign weights to each rating scale answer choice. Pearson's  $\chi^2$  test was employed to assess differences in responses due to current position or age group. STATA V.14.0 (StataCorp) was used for statistical analysis, with significance set at  $p < 0.05$ . Additional free-text comments were qualitatively analysed.

## RESULTS

### Respondent characteristics

There were a total of 562 respondents from 79 countries; 199 (35.4%), 198 (35.2%) and 118 (21%) were from North America, Asia and Europe, respectively. Details of the geographical distribution of respondents are summarised in figure 1. Participants were composed of 453 (80.6%) practising pathologists and 109 (19.4%) trainees, including residents and fellows. Of all pathologists, 300 (66.2%) worked in an academic setting. Most respondents ( $n=449$ , 79.9%) were between 30 and 55 years of age.

### Preferences and perceptions of virtual conferences

Participants were asked to rank the degree to which they valued several aspects of pathology meetings or conferences on a Likert scale from 1 to 5. Aspects that were valued most included educational/plenary/oral sessions (mean 4.6), slide seminars (mean 4.5) and keynote speeches (mean 3.7) (figure 2A). Several advantages of virtual meetings were also recognised, including that they are less expensive to attend than in-person meetings (mean 4.4), are

## Box 1 Survey questions

- Your current position
  - Practising pathologist, academic setting.
  - Practising pathologist, non-academic (community setting, private lab, etc).
  - Resident/fellow.
- Age
  - <30 years.
  - 30–40 years.
  - 41–55 years.
  - 56–65 years.
  - >65 years.
- Country of practice or study
- What aspects of a pathology meeting/conference do you value the most? (Ranking question)
  - Keynote.
  - Slide seminars.
  - Educational/plenary/oral sessions.
  - Poster presentations.
  - Q&A opportunities.
  - Social interaction.
- Which of these do you consider advantages of a virtual meeting? (Rating question, 5-point Likert scale)
  - More convenient to attend remotely.
  - Easier to follow particular speaker/subspecialty.
  - Less expensive to attend than in-person meetings.
  - Easy to receive CME.
  - Opportunity to review recordings or access handouts.
  - More efficient, no loss of time (travel, etc.).
  - Better interaction using chat.
- Which of these do you consider disadvantages of virtual meetings? (Rating question, 5-point Likert scale).
  - Lack of networking and direct human contact.
  - Less effective communication with vendors/industry.
  - Suboptimal quality due to technical issues (internet connection, audio, etc).
  - Unfamiliarity with online meeting platform.
  - Poor attention when watching live or recorded videos.
  - Lack of travel opportunity.
- Which of the following describes your preference for a histopathology slide seminar?
  - I don't like virtual slides and strongly favour glass slides.
  - Virtual slides are acceptable, but I would choose glass slides whenever available.
  - I have no problem with virtual slides—they can be easily used as a substitute.
  - I have no experience with virtual slides.
- If different options are available, which format of a meeting would you prefer?
  - Virtual meeting.
  - In-person meeting.
  - Hybrid (combination of both).
- How long should meeting videos be available on a website after the conference ends?
  - 1 month.
  - Up to 6 months.
  - Up to 1 year.
  - Permanently
- Do you think that the registration fee for a virtual meeting should be adjusted compared with in-person meetings?
  - No, should cost around the same

Continued

## Box 1 Continued

Yes, 25% less.  
 Yes, 50% less (or more).  
 11. Additional comments/feedback.

more convenient to attend remotely (mean 4.3), allow for review of recordings or access to handouts (mean 4.3), and are more efficient due to no loss of time for travel (mean 4.3) (figure 2B). Most respondents preferred either hybrid conferences (n=323, 57.5%) or virtual meetings (n=127, 22.6%). A minority of respondents (112, 19.9%) favoured solely in-person conferences (figure 2C). There was no statistically significant difference in meeting format preferences between practising pathologists (in both academic and non-academic settings) and trainees.

Most participants (514, 91.5%) suggested that meeting videos should be made available online for several months after a conference ends (figure 2D). Most respondents (n=278, 70.6%) also felt the registration fee for a virtual meeting should be discounted compared with in-person meetings by 50% or more. There was no difference in preferences for discounted registration fees or meeting video expiration among the subgroups.

Respondents indicated the most critical disadvantage of virtual conferences was the lack of networking and direct human contact (mean Likert 4.1). Other drawbacks included less effective communication with vendors/industry, which is usually done at the exhibition area (mean 3.5) and lack of travel opportunities

(mean 3.4). The participants also reported suboptimal lecture quality due to technical issues (mean 3.2), poor attention when watching live or recorded videos (mean 3.0) and unfamiliarity with online meeting platforms (mean 2.5) (figure 2E).

### Preferences and perceptions of slide seminars using digital slides

The majority of respondents (n=356, 63.3%) had no problem with virtual slides and considered them as a substitute for glass slides. WSIs with high resolution would be preferred. Some participants (n=179, 31.9%) indicated that they accept digital slides for educational purposes, but would prefer glass slides whenever available (figure 2F). A minority of respondents (n=20, 3.6%) disliked virtual slides and strongly favoured glass slides. Only a few pathologists and trainees (n=7, 1.2%) had no experience with virtual slides. Six of them were from an academic setting in a developed country. There was no difference in slide seminar format preferences between pathologists and trainees, or within each age group.

### Additional comments

A substantial number of respondents (n=86, 15.3%) provided free-text information regarding their preferences for pathology conferences and slide seminars. They generally communicated that virtual conferences were more convenient, affordable and had less environmental impact than in-person conferences. Moreover, the meeting format lent itself to improved communication of new developments in the field of pathology. Other comments

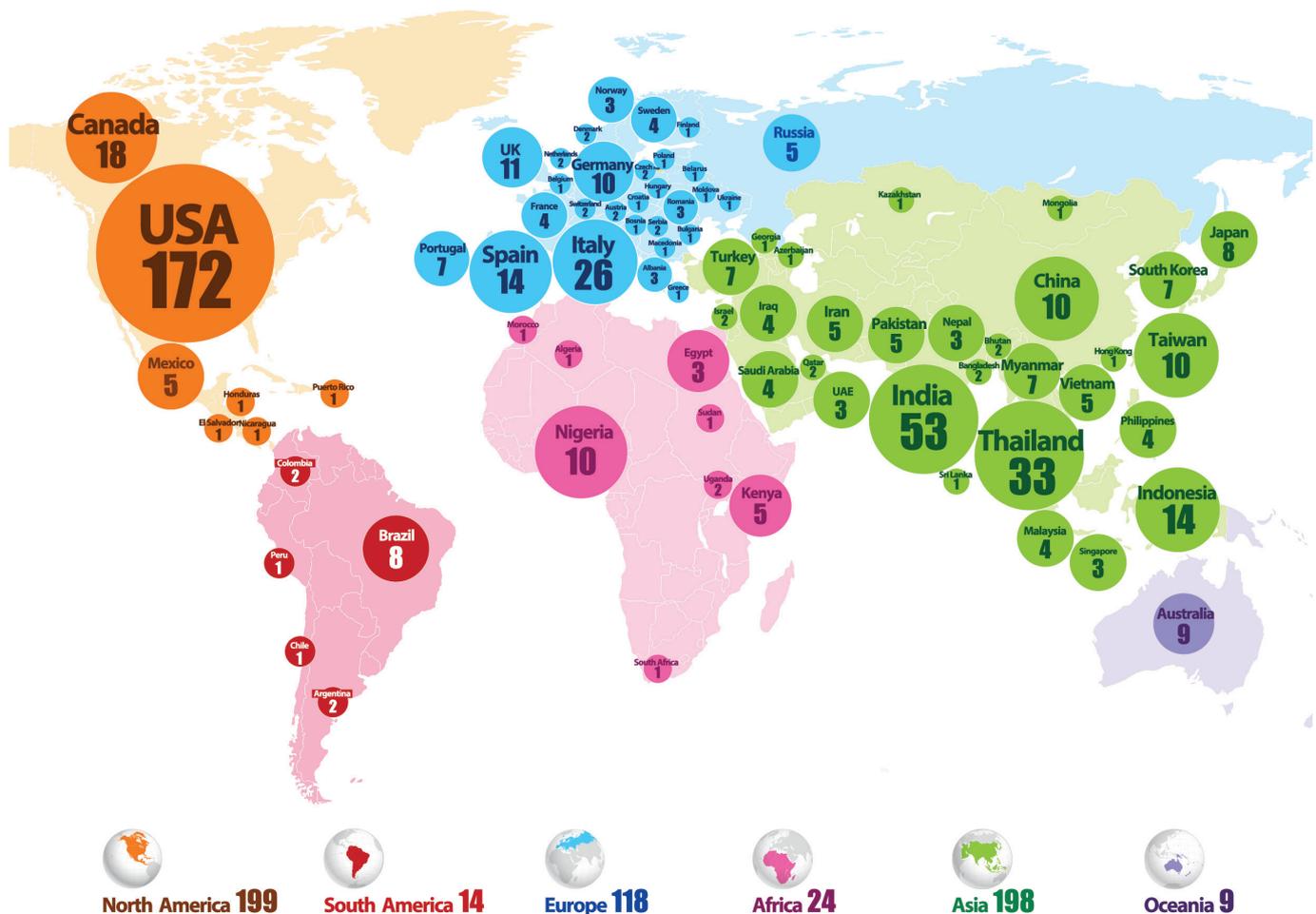
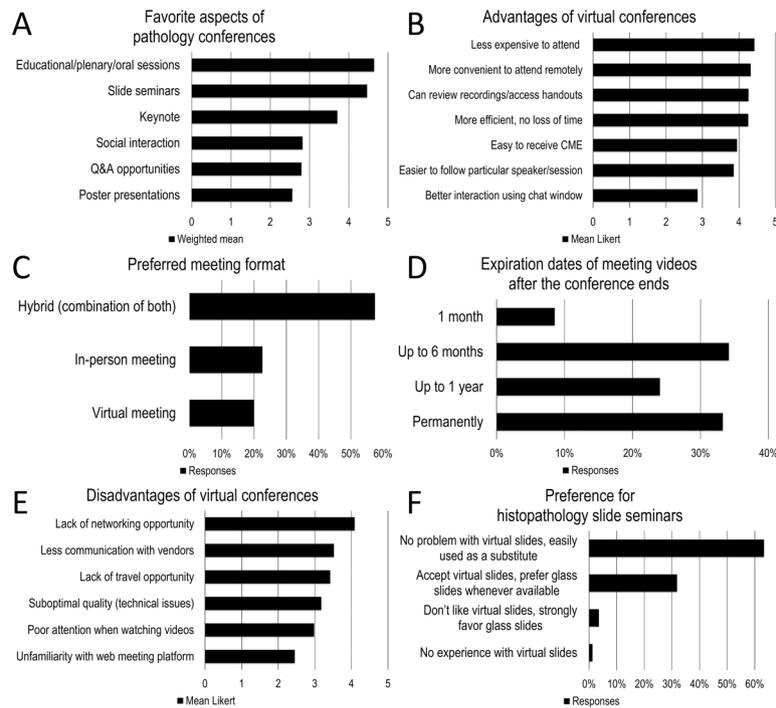


Figure 1 The geographical distribution of respondents.



**Figure 2** Responses to survey questions. (A) Favourite aspects of pathology conferences; (B) advantages of virtual conferences; (C) preferred meeting format; (D) meeting video expiration after conference; (E) disadvantages of virtual conferences; (F) preference for histopathology slide seminars.

suggested that organisers might consider providing downloadable meeting videos or use open web platforms (such as YouTube or Vimeo) so that storage space would not be needed. Handouts of presentations should also be made universally available to decrease the study time for participants. Overall, virtual meetings were felt to provide more educational opportunities for the worldwide pathology community. However, discussions arising organically during networking, considered one of the essential parts of a conference, might not be available in virtual meetings. Therefore, the advantages of both virtual and in-person conferences could be achieved by hybrid meetings. Selected free-text comments from respondents are provided in table 1.

## DISCUSSION

Our survey revealed that after experiencing 2 years of virtual meetings, most pathologists and trainees perceived online pathology conferences as a powerful tool for pathology education. Virtual conferences allow participants flexibility and offer reduced registration fees compared with in-person conferences. Respondents believed that slide scanners could produce WSIs of quality comparable to that of glass slides, and they also accepted slide seminars using a digital modality. The main critical limitation of online conferences was the lack of networking opportunities.

Conferences generally play an essential role in pathologists' professional lives, particularly for junior academics and early career researchers.<sup>8</sup> However, pathologists with limited resources or numerous commitments may not be able to regularly attend traditional face-to-face conferences. These meetings also contribute to the large carbon footprint associated with national and international flights. Academic pathologists are increasingly considered global nomads, travelling by flights and trains between international conferences, seminars and meetings. While it is rarely acknowledged, the intensive professional mobility of scientists has ecological consequences. It has been

estimated that professors emit 11 tons of carbon dioxide (CO<sub>2</sub>) annually, while students emit 4 tons.<sup>9</sup> During the COVID-19 pandemic, many international face-to-face pathology conferences were cancelled, creating short-term obstacles but long-term potential.<sup>10</sup> Many pathologists were deprived of the opportunity to show their work, network and build their profiles in onsite meetings. These difficulties hastened the search for an alternative to traditional face-to-face meetings. Because of technological advancements (such as high-speed internet connection, live-streaming and online meeting platforms), many organisations were able to shift their meetings online. This adoption allowed the entire pathology community to learn and explore diverse pathology fields from anywhere, at any time and on any device.

Several formats of online pathology activities became increasingly recognised during the COVID-19 pandemic. Live-streaming capabilities and social media usage have improved current pathology practices and professional networking.<sup>11</sup> PathCast, a comprehensive and efficient open-access online remote learning tool for pathologists, live-streams lectures worldwide via Facebook and YouTube.<sup>12 13</sup> Furthermore, pathologists are becoming increasingly active on Twitter and Facebook, with real-time interactions between experts and trainees resulting in knowledge sharing, consulting and research collaborations.<sup>14</sup> Additionally, preprints in pathology research are now common in pathology journals. These facilitate the rapid dissemination of knowledge and help scientists contribute to the profession.<sup>15</sup> However, obstacles persist in using social media as an educational tool, including restrictive institutional policies and governmental guidelines such as the Health Insurance Portability and Accountability Act enforced by the US Department of Health and Human Services.<sup>16</sup>

Prior to our study, there were limited data available on the preferences and perceptions of participants in pathology conferences. Such limitations might result from contextual differences among each specialty. Similar to this study, an international

**Table 1** Additional comments

Topic	Respondent	Comment
<b>Virtual conferences</b>		
More convenient	Respondent 1 (PA)	'I strongly favour virtual meetings, because they are very convenient and we can choose to listen to the lectures any time we are available to do so. It is very difficult to take time-off from our work to attend the entire USCAP meeting, as we have to cover the work and duties in our department. Every year, only few pathologists in our department have the opportunity to attend the USCAP meeting, not to mention the time we spend for travelling, and the cost of the trip and the hotel.'
More educational opportunities	Respondent 2 (PA)	'Virtual meetings helps to take more courses around the year.'
Quick update	Respondent 3 (PC)	'Virtual meetings are great for getting quick up to date info about entities, new classifications, tips for common difficult differentials, news about immunos, you can listen from your workplace and you can screenshot the most informative slides, it's really a great teaching tool.'
More affordable	Respondent 4 (T)	'For example, residents at the beginning of their career can have a hard time participating in international courses mainly for money reasons. It is a limited number of courses we can invest in and attend, and we would participate in many more. I feel that online courses and discounts for residents are a very good thing, we are just starting to build our life/homes/families and financially speaking it can be a challenge sometimes.'
	Respondent 5 (T)	'Virtual meetings and webinars have opened up the opportunity for pathologists to increase their knowledge and skills in developing and underdeveloped countries to a very great extent.'
Less environmental impact	Respondent 6 (PA)	'One additional perk of virtual meetings not touched on in the above is that there is a significant carbon footprint involved in hosting a live meeting, which for particularly large meetings will involve international travel from thousands of attendees as well as printing of hundreds of posters. Virtual meetings are far more eco-friendly.'
	Respondent 7 (PA)	'I think the pandemic taught us great lessons about the value of virtual meetings. I am surprised that the 'lack of travel opportunity' is considered a disadvantage in this questionnaire - for me this is the huge advantage of virtual meetings. And now that we are facing the challenges of a global climate crisis: Isn't it our duty towards society and the next generation of pathologists to avoid travelling whenever possible? Virtual meetings are a great option to stay connected!'
<b>Face-to-face conferences</b>		
Networking opportunities	Respondent 8 (PA)	'The discussions during networking are often the most important part of the meetings.'
	Respondent 9 (T)	'Virtual conferences offer more advantages when it comes to oral sessions, however when it comes to events that requires more interaction with each other (slide seminars, networking events, poster and paper presentations) in person conferences are better.'
<b>Hybrid conferences</b>		
Advantages of both virtual and in-person meetings	Respondent 10 (PA)	'Hybrid is a nice option because you can attend the meeting in person and come back and watch things you didn't get a chance to see or re-review educational materials later.'
	Respondent 11 (PA)	'Virtual meetings have their benefits and they have been proven to work, but in-person contact and networking is invaluable. In my opinion, the future for all meetings should be a hybrid format, especially for people who cannot or wish not to travel.'
More expense for organisers	Respondent 12 (PA)	'There is an incurred cost for setting up both physical and virtual venues.'
Sparse attendance at in-person sessions	Respondent 13 (PA)	'One problem with hybrid meetings that I noticed at ASC 2021 and USCAP 2022 is the sparse attendance at the in-person sessions. Speaking to (or sitting as an audience member of) a large auditorium with just a handful of participants felt somewhat disappointing.'
<b>Slide seminars</b>		
Digital slides	Respondent 14 (PC)	'The practice of surgical pathology is slowly but surely moving towards WSI sign out. Having WSI learning available as part of virtual meetings helps us old-timers become comfortable with the eventual use of WSI for actual sign out.'
Glass slides	Respondent 15 (PC)	'Digital slide quality is still vastly below that of in-person real-time physical microscopic slide quality. The in-person microscopy sessions at USCAP are excellent—all other digital slide programs I have seen are mediocre at best.'
PA, pathologist from academic setting; PC, pathologist from non-academic setting; T, trainee (resident/fellow); USCAP, United States and Canadian Academy of Pathology; WSI, whole-slide image.		

survey on radiologists' preferences and perspectives showed that most respondents favoured online conferences.<sup>7</sup> Moreover, the pandemic also affected medical education by means of a rapid transition from traditional to online learning processes, including for medical students.<sup>17</sup> In fact, many preclinical students prefer online learning to be included in the curriculum in upcoming academic years.<sup>18</sup>

The COVID-19 pandemic accelerated the adoption of digital pathology for education. Such technology benefits pathologists at several phases of professional development, including trainees and practising pathologists. High-quality digital pathology tools and online presentation software were used in several international meetings, out of necessity.<sup>4</sup> Most respondents in this study agreed that digital slides can be considered a substitute of glass slides for educational purposes. Surprisingly, six out of seven

respondents without experience with digital slides were from developed countries. Therefore, it could be inferred that WSI is widely available in the global pathology community regardless of socioeconomic status. However, such widespread use should not be overemphasised. For instance, cytology is less well suited to WSI than histopathology samples due to technical challenges (eg, focusing on three-dimensional cell groups).<sup>19</sup>

Virtual conferences have several advantages that face-to-face meetings cannot provide.<sup>20</sup> First, all participants can tailor their own environment, whether it is their office or home, to make virtual attendance more comfortable. Second, the cost of attending an online meeting is significantly reduced because registration prices are generally lower than their onsite counterparts. Additionally, the cost of airfare, hotel stays and in-person dining are eliminated. Therefore, the actual costs of attending virtual conferences are

overall much lower than onsite seminars.<sup>21</sup> Participation costs have been estimated to be 75%–90% less than in-person attendance.<sup>22</sup> As a result, trainees or pathologists in low-income settings can attend high-quality international conferences on equal footing with others. Third, after meetings conclude, asynchronous online learning is facilitated, as online lectures are usually recorded whereas in-person lectures often are not. Pathologists on service during a conference can watch the recorded videos later. Fourth, virtual conferences significantly reduced CO<sub>2</sub> emissions. Participants mostly fly nationally or internationally to attend scientific meetings. Attendance at conferences accounts for 35% of a researcher's lifetime carbon footprint. When people fly to conferences, their travels produce a lot of CO<sub>2</sub> emissions, the same as the amount of CO<sub>2</sub> emitted by each person in many countries every year. Conferences also produce large volumes of trash, in forms such as discarded promotional products.<sup>23</sup>

The survey results are consistent with existing literature in identifying some drawbacks of virtual conferences.<sup>20,21</sup> The most significant is a lack of networking opportunities, especially for individuals in early-stage careers whose network is still being developed. However, this issue may benefit (or at least not concern) pathologists who may prefer a chat box over a face-to-face discussion. Vendors also may have difficulty interacting with participants via virtual live chat. The other disadvantage is technological difficulties at several points along the digital delivery pipeline, such as the meeting platform, meeting provider and the participant's internet connectivity.

Although the cost of organising an onsite event is significantly higher than that of an online conference,<sup>24</sup> the system is well arranged by years of dedicated service providers. There were several challenges to holding an online conference at the beginning of the COVID-19 pandemic, particularly technical difficulties such as the lack of proper infrastructure and technological setup. However, these difficulties were solved and adopted over time. Unlike a virtual conference, a hybrid meeting incurs combined costs because it requires infrastructure for both onsite activities and web meetings (ie, reliable web connection, good-quality broadcasting and audio-video support). While this may negatively impact small-scale and low-budget events, it should not be an obstacle for major conferences organised by large societies. In fact, in 2023, we are witnessing an obvious trend of holding major annual meetings organised by USCAP, ASCP, ESP and others in hybrid mode with an available on-demand package.

There were several drawbacks to this study. First, out of the global community of over 100 000 pathologists, less than 1% participated in our survey.<sup>25</sup> Second, selection bias may affect the final results due to the distribution of survey questions via the author's social media accounts, though we made multiple attempts to reach pathologists in various practice settings. Such dissemination may result in an over-representation of pathologists familiar with advances in technology. There is a relative lack of input from senior pathologists, who are more experienced and more likely to be involved in organising events but are less represented on social media, hence less approachable with our survey methodology. Moreover, vendors and business-people who continually support academic conferences were not included in the survey. Third, the period in which the online questionnaire was distributed (ie, right after the lockdown) could affect participants' answers. Despite these drawbacks, our study is not only timely but also is the first to evaluate preferences and perceptions of online conferences with broad coverage of pathologists from more than 70 countries.

In conclusion, pathologists worldwide recognise that virtual conferences provide several advantages that are not available in

traditional, face-to-face conferences. Our findings could help inform key stakeholders, such as professional societies and other conference organisers, about the target audience's preferences. Several international pathology organisations have switched to hybrid conferences, which seems to support the attitude prevalent in our survey that such conferences combine the best aspects of online and in-person meetings.

**Handling editor** Runjan Chetty.

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**Acknowledgements** We would like to express our sincere gratitude to Dr Gennaro D'Anna (ASST Ovest Milanese, Legnano, Italy) for inspiring this project through their model study in radiology domain.

**Contributors** TL: design, data acquisition, formal analysis, investigation, writing-original, review, and editing. RSG: design, data acquisition, writing-review. AB: conception and design, data acquisition, writing-review, and editing. All authors read and approved the final manuscript. AB is the guarantor for this work.

**Funding** The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

**Map disclaimer** The depiction of boundaries on this map does not imply the expression of any opinion whatsoever on the part of BMJ (or any member of its group) concerning the legal status of any country, territory, jurisdiction or area or of its authorities. This map is provided without any warranty of any kind, either express or implied.

**Competing interests** None declared.

**Patient consent for publication** Not applicable.

**Ethics approval** This study involves human participants but the Human Research Ethics Committee of Thammasat University (Medicine) No. of COA: 263/2022 exempted this study. Consent is not required for online survey questions.

**Provenance and peer review** Not commissioned; externally peer reviewed.

**Data availability statement** Data are available on reasonable request.

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