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Update on the current opinion, status and future development of digital pathology in Switzerland in light of COVID-19

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ABSTRACT

Aims The transition from analogue to digital pathology (DP) in Switzerland has coincided with the COVID-19 crisis. The Swiss Digital Pathology Consortium conducted a national survey to assess the experience of pathologists in dealing with the challenges of the pandemic and how this has influenced the outlook and adoption of DP.

Methods A survey containing 20 questions relating to DP, personal experiences and challenges during the pandemic was addressed to Swiss pathologists at different experience stages in private practice, community and university hospitals.

Results All 74 respondents were pathologists, with 81.1% reporting more than 5 years of diagnostic service experience. 32.5% reported having read 100 digital slides or more in a diagnostic context. 39.2% reported using whole slide imaging systems at their primary workplace. Key DP use cases before the COVID-19 lockdown were tumour boards (39.2%), education (60.8%) and research (44.6%), with DP used for primary diagnosis in 13.5%. During the COVID-19 crisis, the use of DP for primary diagnostics more than doubled (30% vs 13.5%), with internal consults as important drivers (22.5% vs 16.5%), while research use (25% vs 44.6%) and external consults (17.5% vs 41.9%) strongly decreased. Key challenges identified included a lack of established standard operating procedures and availability of specialised hardware and software.

Conclusions This survey indicates that the crisis acted as a catalyst in promoting DP adoption in centres where basic workflows were already established while posing major technical and organisational challenges in institutions that were at an early stage of DP implementation.

INTRODUCTION

A previous study conducted in Switzerland by the Swiss Digital Pathology Consortium (SDiPath) suggested that the experiences and perspectives of Swiss pathologists concerning digitalisation are comparable with that of other reporting countries undergoing transitions to digital workflows.[1] Now, 2 years later, and in the midst of a worldwide health crisis, a revised survey was conducted, in particular focusing on how Swiss clinical pathologists have been reacting to the crisis and how their views regarding digital and remote workflows have changed.

The motivation for conducting this survey is surrounded by the notion that digital pathology (DP) diagnostics are especially amenable to remote work. At a time when there are limited pathologists, and with the clinical need to ensure their continued ability to operate without being exposed to contagion risks, a confluence of factors potentially expediting the transition from traditional analogue to digital workflows are present. This survey was thus conducted to better understand if this transition has been hastened, as well as to understand any previously invisible limiting factors or changes in opinion as a result of novel experiences.

METHODS

A survey was developed by AJ, IZ, RG and VHK on behalf of the the SDiPath to include questions to characterise (1) the respondents according to their workplace, general diagnostic experience and experience with DP; (2) the extent of DP infrastructure at baseline, including the utilisation of whole slide imaging systems, image analysis, image management software (IMS) and laboratory information system (LIS) integration and specific use cases; (3) the utilisation of DP infrastructure during the COVID-19 crisis; and (4) specific challenges encountered at a personal, technical and organisational level. Question formats included yes/no answers, multiple choice and additional free-text fields for comments. A copy of the survey can be found in online supplemental material. The survey was implemented in Google Forms and all Swiss Society of Pathology (SSPath) and SDiPath members were notified by email; further, non-members were informed by SSPath and SDiPath members at their local institutions. Data were collected digitally over a 30-day time period starting from 2 June 2020 and continued until 2 July 2020; at that time the data collection phase was determined to be completed.

RESULTS

Survey demographics

A total of 74 responses were received from the online survey, for a total response rate of 12.9% of all 572 staff or resident pathologists registered in Switzerland (18.6% of all 398 members of the SSPath). Of the respondents, 18.9% reported less than 5 years of diagnostic service experience, 23.0% 5–10 years, 24.3% 10–20 years and 33.8% more than 20 years of diagnostic experience. About one-third of the respondents (32.4%) have read more than 100 digital slides in a diagnostic context, with 8.1% reporting having read more than 1000 slides.

Of the respondents, 39.2% indicated that a whole slide imaging system was in operation at their primary workplace, with 75.7% of these in place for less than 1 year in a diagnostic context. Of the respondents, 29.7% worked at a public or private community hospital, 35.1% at a university institute and 31.1% at a private laboratory.

Uses of DP before and during the COVID-19 crisis

The key use cases for DP before the COVID-19 lockdown were reported for tumour boards (39.2%), education (60.8%) and research applications (44.6%), with DP used for primary diagnosis in 13.5%. Further, internal (16.2%) and external (41.9%) consults were common use cases for utilisation of DP. Of the respondents, 68.9% reported the availability of a slide scanner at their institution and the availability of viewing software in 66%. Image analysis for biomarker quantification (eg, breast cancer biomarkers) was used in 16.2% of cases. An IMS and LIS integration was available to 40.5%–50% of the respondents, respectively. In the crisis situation, DP was seen as a key use case for home office scenarios, with 56.8% of the respondents reporting that a home office scenario was considered. Of the respondents, 40.6% reported at least one pathologist at their institution working remotely, with 6.8% reporting more than five pathologists working from home office. In the remote sign-out situation, the use of DP strongly shifted from research, education and tumour board applications to primary diagnosis (30%, up from 13.5%) and internal consults (22.5%, up from 16.5%), while research use (25%, down from 44.6%) and external consults (17.5%, down from 41.9%) were greatly reduced in frequency. To enable remote diagnostics, 13.5% of the respondents reported systemic changes by their respective institutions in how the clinical patient information was accessed and/or integrated with the electronic medical record or the laboratory information system.

Key challenges encountered

A key challenge for enabling remote sign-out was the need for the implementation of standard operating procedures (SOPs) to establish and validate the remote sign-out. Only 20.5% of the respondents using remote DP sign-out indicated that a standardised guideline or operating procedure was followed to self-validate diagnostic use. This lack of self-validation may be a consequence of tight schedules in the face of the pandemic but also the lack of established national guidelines for SOP validation of DP in Switzerland. In cases where no remote sign-out was possible, it was reported that a lack of an established digital workflow (51.4%), a lack of appropriate hardware (23%) and an insufficient network connection (16.2%) were key technical limitations preventing the utilisation of DP during the COVID-19 situation. Interestingly, soft factors such as lack of the usual work environment (21.6%), feeling uncomfortable with remote sign-out (13.5%) and concerns about data privacy and safety (10.8%) were other major reasons listed as keeping pathologists from implementing remote sign-out. To enable home office use, half of the respondents reported modest to strong support by the hospital information technology (IT) department, with over 70% reporting the need for material or set-up changes at the department, including a need for additional scanners (20.3%), high-resolution monitors (36.5%), viewing software (36.5%) and the set-up of virtual private network (VPN) or network connections (39.2%). Only 27% reported that no material or set-up changes would be required. Several solutions were implemented for the transmission of the generated reports into the LIS, including the remote connection to a dictation tool (28.4%), the generation of speech files sent to the dictation pool (17.6%) as well as self-writing of the reports for transfer to the clinicians (28.4%). Individual pathologists also used structured reporting (n=1) or communicated the results directly to the clinician (n=1), indicating that a unified solution was not available on short-term notice.

DISCUSSION

With the unexpected arrival of COVID-19 and its impact on routine pathology workflows, it is not surprising that hospitals worldwide attempted to better leverage DP in attempts at addressing their clinical needs. For example, a survey of tertiary UK hospitals reports[2] indicated an increase in uptake of diagnostic DP during this period, supported by the implementation of remote access solutions and a fast roll-out of emergency guidance on how to risk-assess home reporting of digital slides by the Royal College of Pathologists.[3] Italian regions with particularly severe COVID-19 case loads report the utilisation of DP solutions to support pathology work in the face of severe logistical constraints.[4] It was recognised early that diagnostic delays could lead to a severe impact on public health and that continued operation of diagnostic services was critical to maintain timely diagnosis.[5]

Perhaps surprisingly, during times of crisis, it was indeed possible to compensate for the change in working environments needed using digital solutions. There was a large jump in the number of pathologists employing home office, and the number of primary diagnosis and consultations done via DP significantly rose. This seems to indicate that there is some latent infrastructure already in place at institutions which could support DP workflows. While perhaps no opportune time exists to search out and activate these resources, the observed reductions in case loads and the limited availability of alternative physical slide courier services appear to have strongly motivated their activation. In fact, a limited number of respondents are reporting systemic changes by their respective institutions (13.5%), and yet the overall number of pathologists employing remote sign-outs for diagnostics more than doubled in amount (30%, up from 13.5%). While it may be too early to fathom the long-term effects of the pandemic situation on pathology workflows, some have suggested that these changes may be permanent, introducing a new area of low-contact and high-interconnectivity pathology.[6]

Importantly, when thinking about ways to improve access and utilisation of DP in the future, availability of standards and regulations again appears towards the top of the list. In the crisis situation, national bodies reacted to the short-term need to use DP for routine diagnostics through the development of emergency guidelines[3] or through the relaxation of government enforcement of the Clinical Laboratory Improvement Amendments to facilitate the utilisation of non-certified equipment to support parts of the workflow.[7] In our case, although a majority of the pathologists reported not using SOPs, they still indicated their preference for at least obtaining them. This should not be surprising, especially in a time of crisis, that people forged ahead with their critical work in spite of a lack of definitive guidance, but indicates that as things return to normal and there is an opportunity to reflect on recent lessons, those SOPs should be codified and formally made available. To aid in this process, SDiPath has created a working group specifically for the creation of DP guidelines, including its usage in remote sign-out and consultation, which it intends to also publish and thus aid others in facilitating their own guideline creations.

While respondents generally indicated strong support from their institutions in getting set up to perform their work, technological hurdles did appear, which appeared to represent significant bottlenecks. Interestingly, many of these bottlenecks (eg, VPN connection, viewing software) can likely be easily ameliorated postcrisis with minimal effort.[8] Given the experiences of their colleagues, and via word of mouth, it will be interesting to note in the future if an inflection point has been reached where the adoption of these technologies will be hastened to address potential future crises. Indeed, the lessons learnt from the COVID-19 pandemic underline how quickly the international community can collaborate to share best practices.[3] It remains that additional training and education will likely be needed, not a finding specific to the crisis, but one that has been spoken about numerous times before. Some institutions used the crisis itself as an opportunity to provide such training, leading to the development of model teaching curricula that may lead to an increased exposure of trainees and residents to digital solutions going forward.[9 10]

A point brought out by our own survey and others has noted that DP remains dependent on the support of local IT, histolab, and scanner infrastructure and personnel.[11] It is critical to not look past the fact that digital slides, although virtual, have paired physical samples which have been carefully prepared and manually introduced into the DP pipeline. Taken together, this survey and the opinions and results of other surveys again solidify the notion that DP is a multidisciplinary team endeavour and must be treated as such. In spite of the challenges identified and the bottlenecks encountered, importantly there appears to be an even more growing consensus that DP is a worthwhile investment and may sooner rather than later serve as an inevitable safeguard for future crises.

Take home messages

⇒ The transition from analogue to digital pathology (DP) in Switzerland has coincided with the COVID-19 crisis; hence, the Swiss Digital Pathology Consortium conducted a national survey to assess the experience of pathologists in dealing with the challenges of the pandemic and how this has influenced the outlook and adoption of DP.

⇒ We identify a confluence of factors expediting the transition from traditional analogue to digital workflows in 'early adopter' institutions, with a shift in the distribution of use cases from education and research to primary diagnostic use and consultation.

⇒ At the same time, the crisis posed a major technical and organisational challenge in institutions that were at an early stage of digital pathology implementation, including a lack of established standard operating procedures, digital pathology workflows, and hardware and software equipment.

⇒ This survey motivates the development and implementation of national guidelines led by the SDiPath to catalyse the experiences from the COVID-19 crisis into a safe usage of digital technologies.

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Provenance and peer review Not commissioned; internally peer reviewed.

Data availability statement All data relevant to the study are included in the article or uploaded as supplementary information. The datasets generated during and/or analysed during the current study are available from the corresponding authors upon reasonable request.

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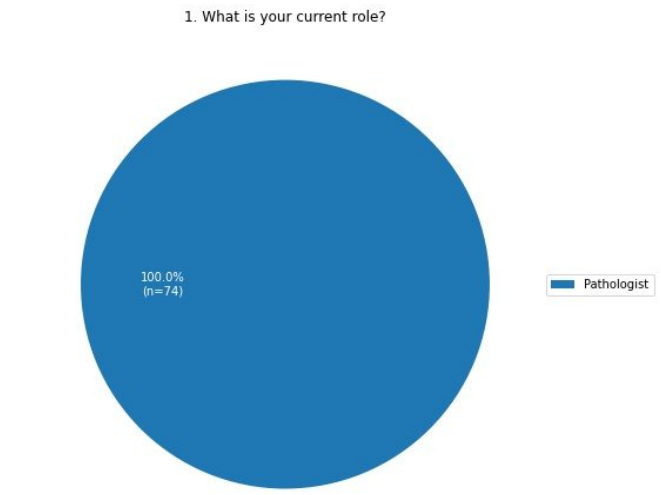
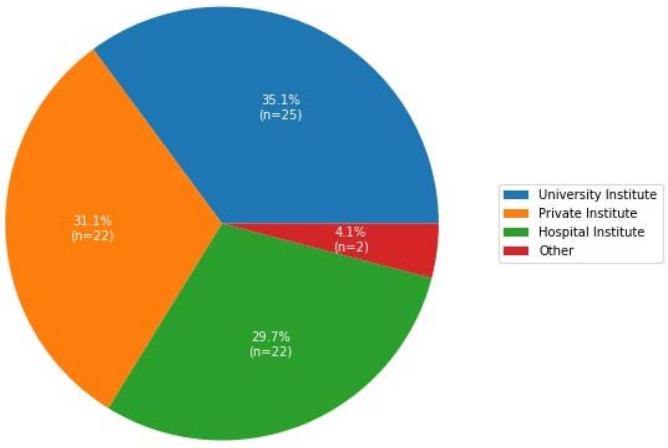
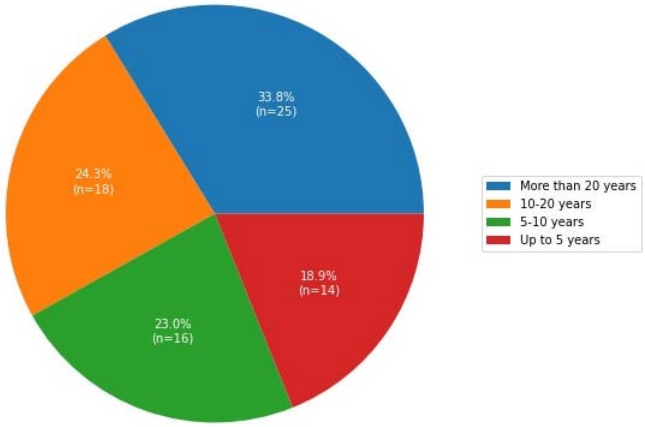
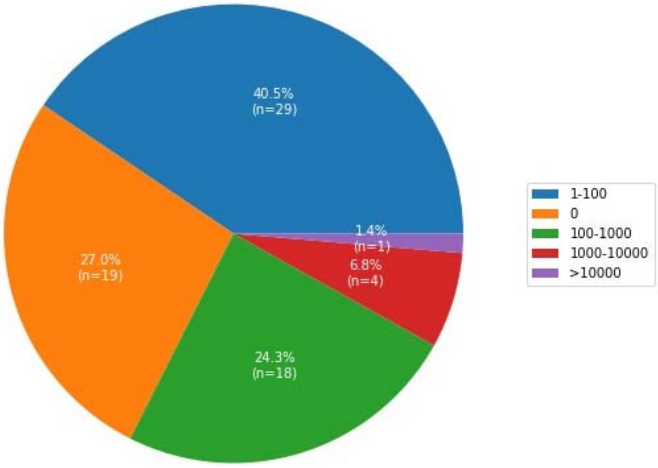
The COVID-19 pandemic and its associated lockdown has invigorated debate regarding the digitalization of pathologist workplaces and home offices. The Swiss Digital Pathology Consortium (SDiPath, sdipath.ch) needs your help to assess the practice, safety, and validity of the use of a “home office” scenario.

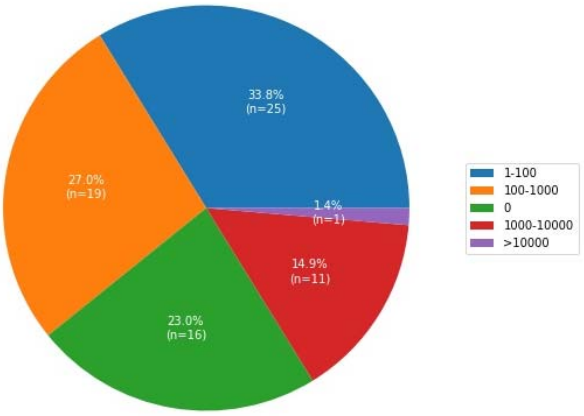
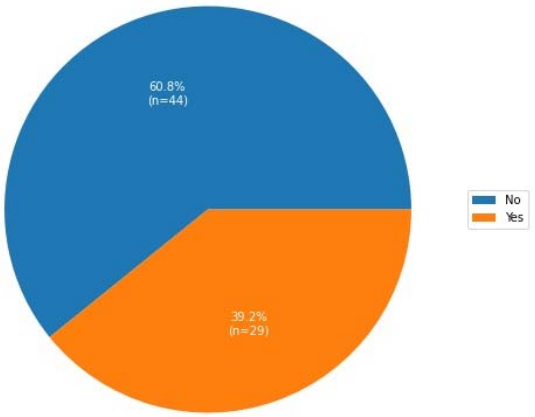
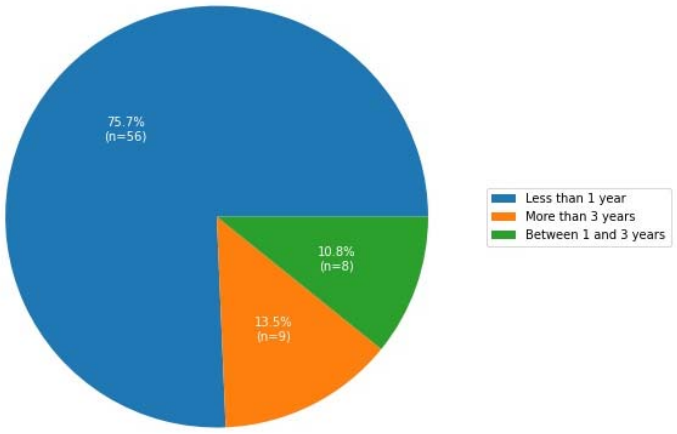
If you plan to, or are currently using, remote sign-out, please participate in the following brief survey. Your experience will help craft federal responses for the promotion of the safe and effective use of this technology beyond the current pandemic. We appreciate your time and look forward to the productive engagement of all pathologists, laboratory and IT professional staff, for the collection of critical real-world data.

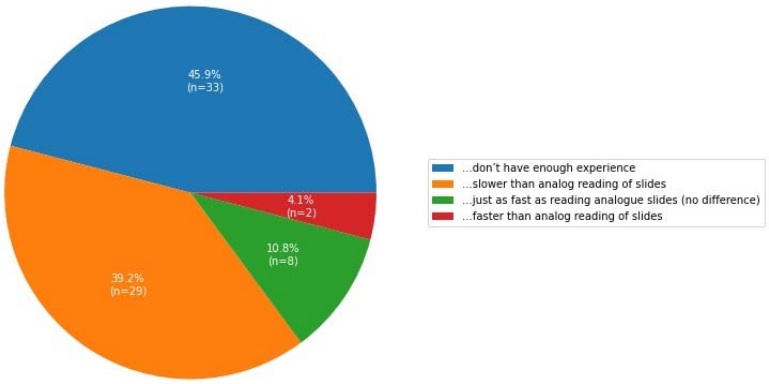
1. What is your current role? • Pathologist • IT • Lab staff • Administrator • Procurement • Other (please specify)	

2. Where do you work? • Hospital institute • University institute • Private institute • Other	

3. How many years have you been practicing (MDs) /involved with (lab staff) pathology? • Up to 5 years • 5-10 years • 10-20 years • More than 20 years	

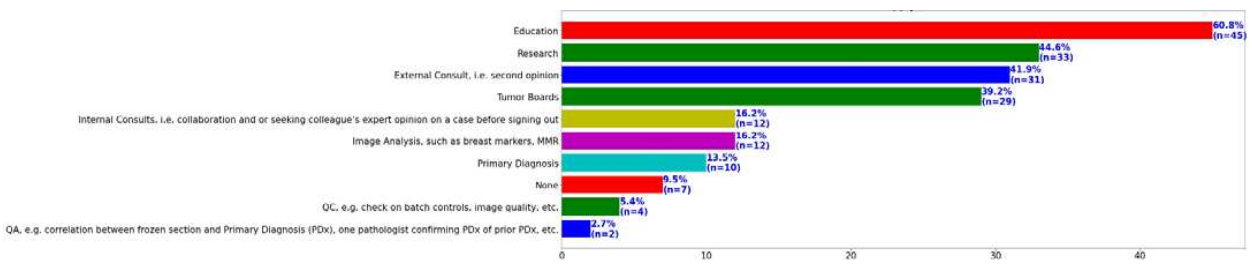
4. How many slides have you read digitally in your career so far in a clinical diagnostics context? • 0 • 1-100 • 100-1000 • 1000-10000 • > 10000	

5. How many slides have you read digitally in your career so far in a research context? • 0 • 1-100 • 100-1000 • 1000-10000 • 10000	
6. Are you currently using Whole Slide Imaging Systems (WSI systems, i.e. scanner, workstation, including display) and/or image analysis algorithms at your primary workplace, i.e. your hospital, lab, reference lab? • Yes • No	
7. If yes, how many years have you been using WSI systems at your primary workplace? • Less than 1 year • Between 1 and 3 years • More than 3 years	

8. After a training phase, would your digital diagnostic workflow (open case/viewing slide/changing slide/ access to clinical information and previous results/ dictating and closing case) be... • ...slower than analog reading of slides • ...faster than analog reading of slides • ...just as fast as reading analogue slides (no difference) • ...don't have enough experience	

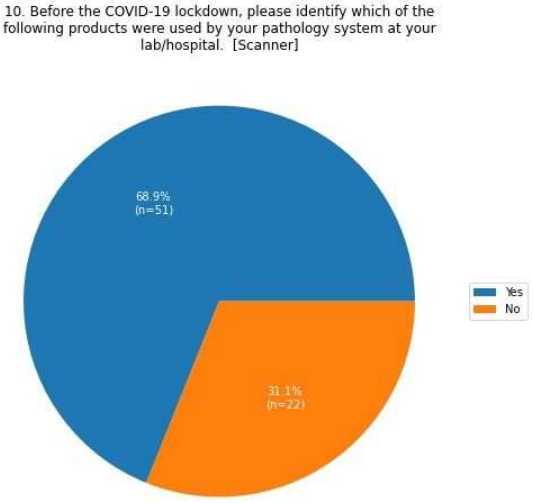
9. Before the COVID lockdown, what WSI use cases were you using at your institution in the last 6 months? (Please select all that apply)

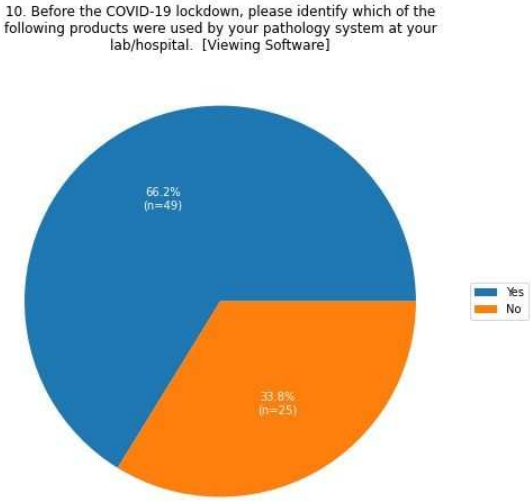
a. Primary Diagnosis
b. External Consult, i.e. second opinion
c. Internal Consults, i.e. collaboration and or seeking colleague's expert opinion on a case before signing out
d. QC, e.g. check on batch controls, image quality, etc.
e. QA, e.g. correlation between frozen section and Primary Diagnosis (PDx), one pathologist confirming PDx of prior PDx, etc.
f. Education
g. Tumor Boards
h. Research
i. Image Analysis, such as breast markers, MMR
j. Other (please specify)

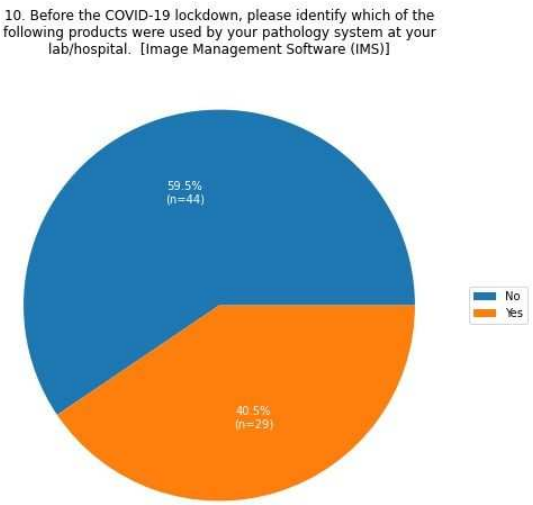


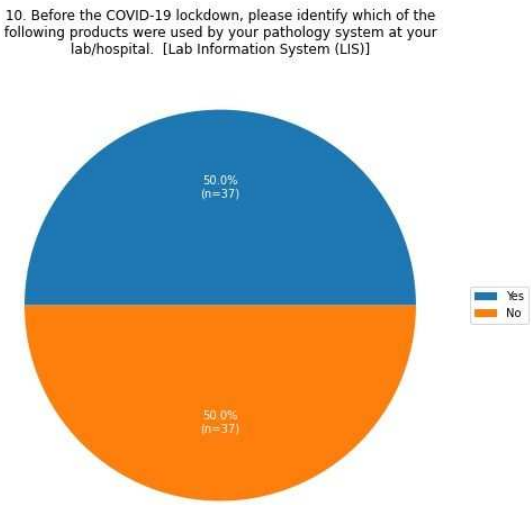
10. Before the COVID-19 lockdown, please identify which of the following products were used by your pathology system at your lab/hospital.

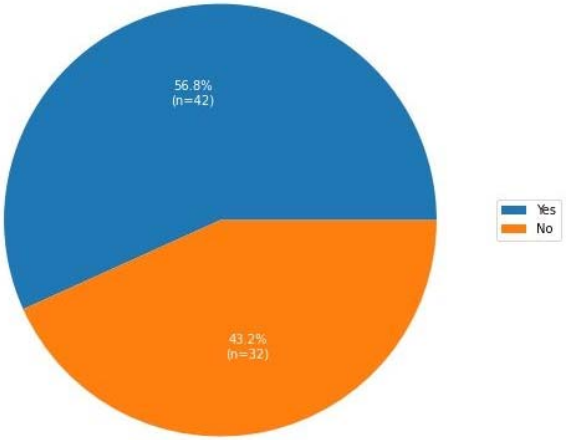
a. Scanner
b. Viewing Software
c. Image Management Software (IMS)
d. Lab Information System (LIS)

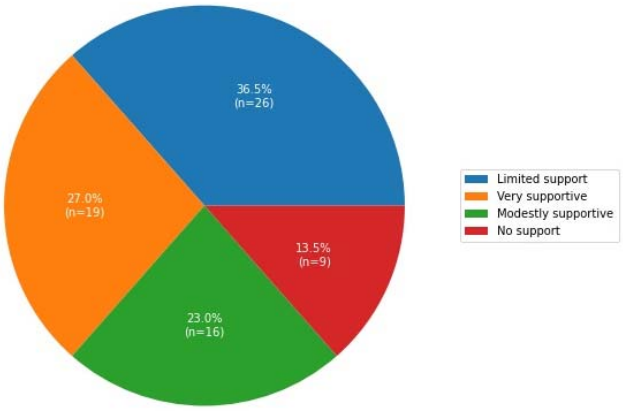








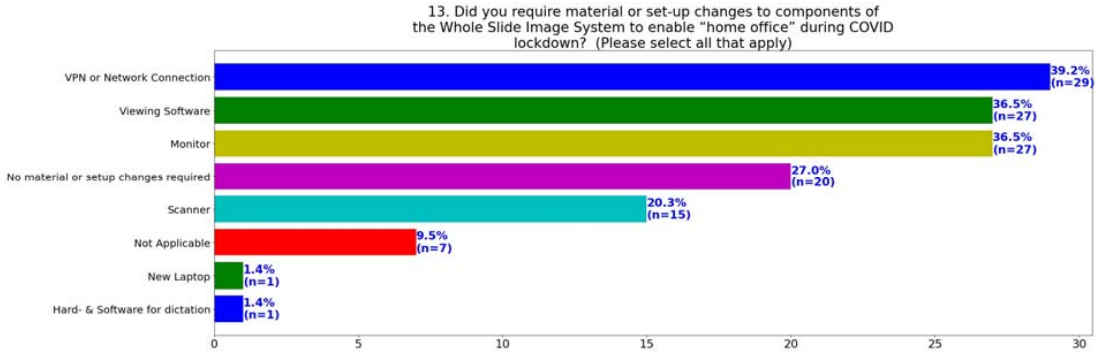
11. During COVID lockdown, did you consider a “home office” scenario for pathologists when the COVID lockdown started? • Yes • No	

12. What level of support did you, or do you believe you would, have received from your IT department and/or system administrator for implementing a “home office”? o very supportive o modestly supportive o limited support o no support	

13. Did you require material or set-up changes to components of the Whole Slide Image System to enable "home office" during COVID lockdown?

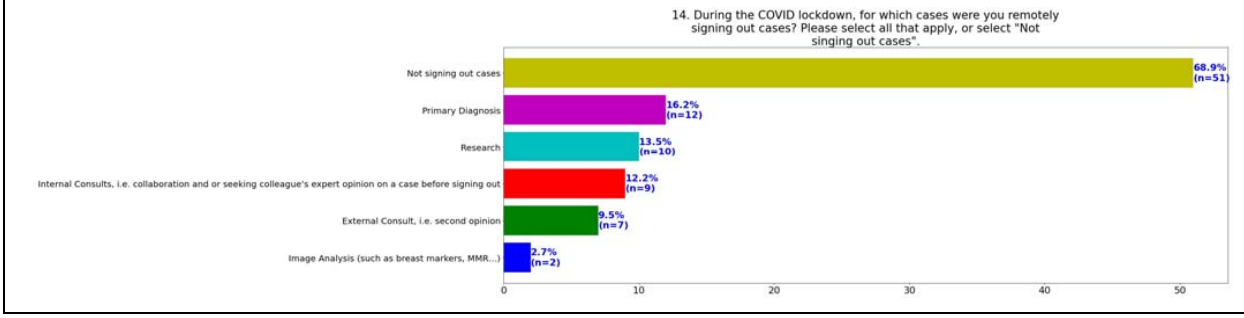
Yes (Please select all that apply)

a. Scanner
b. Monitor
c. Viewing Software
d. VPN or Network Connection
e. Other (please specify) [text response]

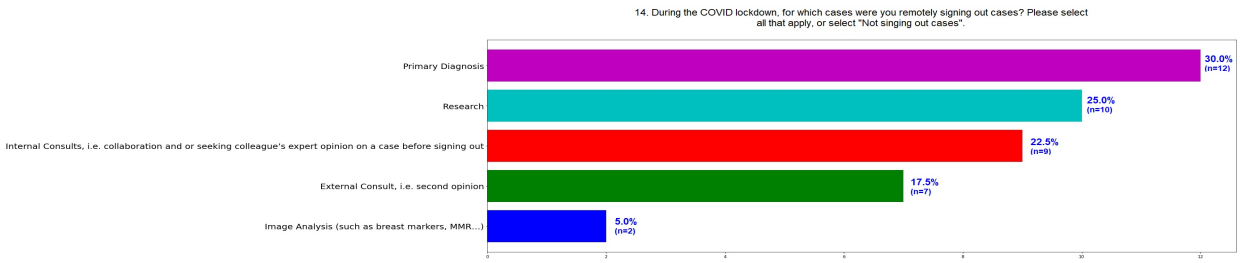


14. During the COVID lockdown, were you remotely signing out cases (Please select all that apply)?

a. Yes, for
    i. Primary Diagnosis
    ii. External Consult, i.e. second opinion
    iii. Internal Consults, i.e. collaboration and or seeking colleague's expert opinion on a case before signing out
    iv. Research
    v. Image Analysis (such as breast markers, MMR…)
b. Not signing out cases

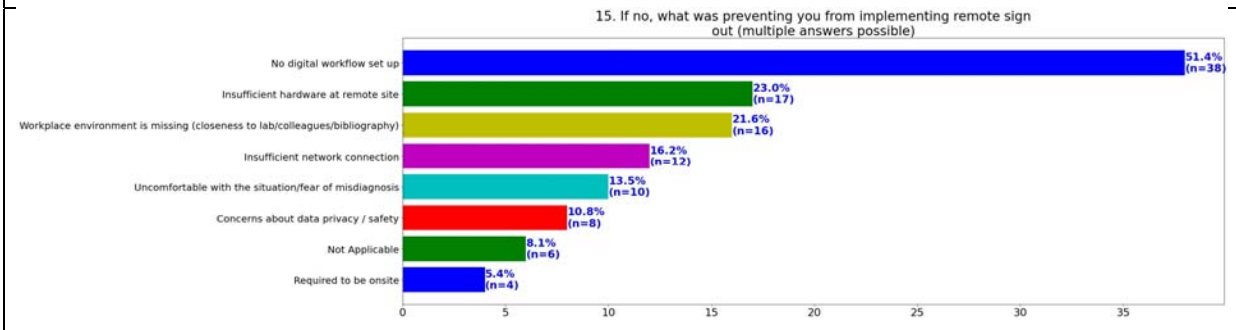


14 a. Subgroup analysis of use cases for pathologists remotely signing out cases during the COVID lockdown:



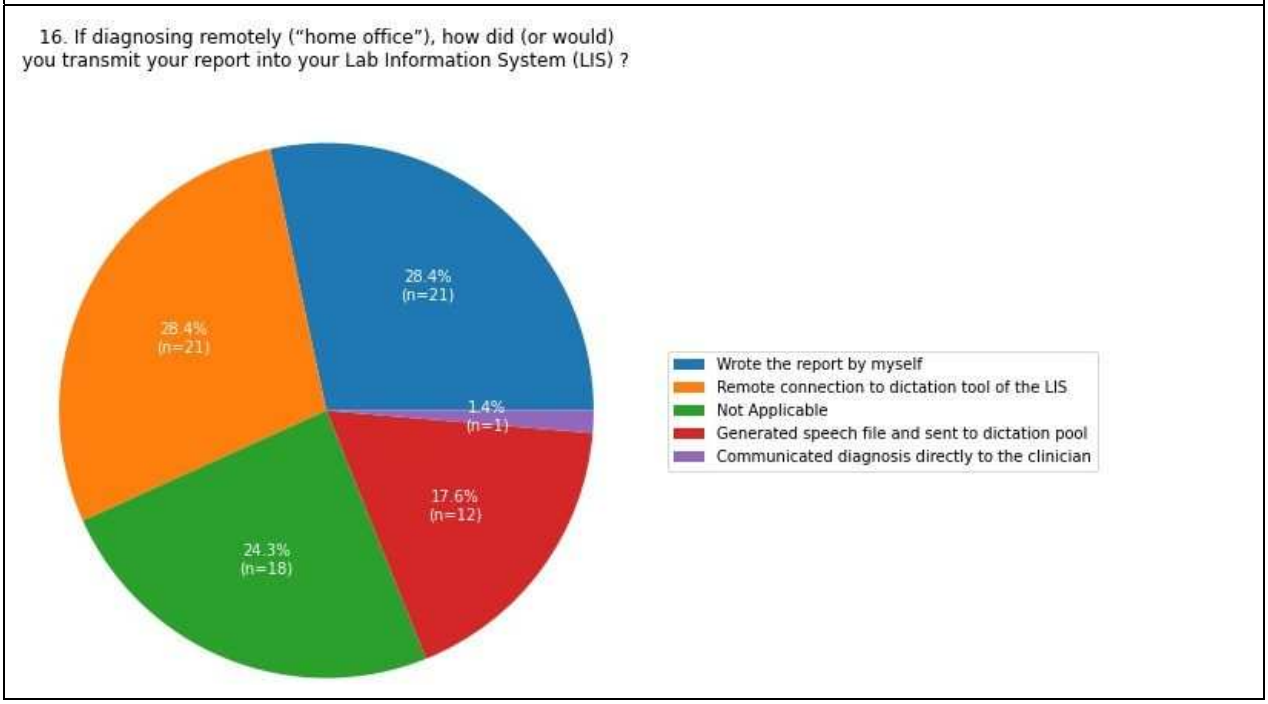
15. If no, what was preventing you from implementing remote sign out (multiple answers possible)?

a. Insufficient hardware at remote site
b. Insufficient network connection
c. Uncomfortable with the situation/fear of misdiagnosis
d. Workplace environment is missing (closeness to lab/colleagues/bibliography)
e. Concerns about data privacy / safety
f. No digital workflow set up
g. Other reason, please specify [text box]
h.



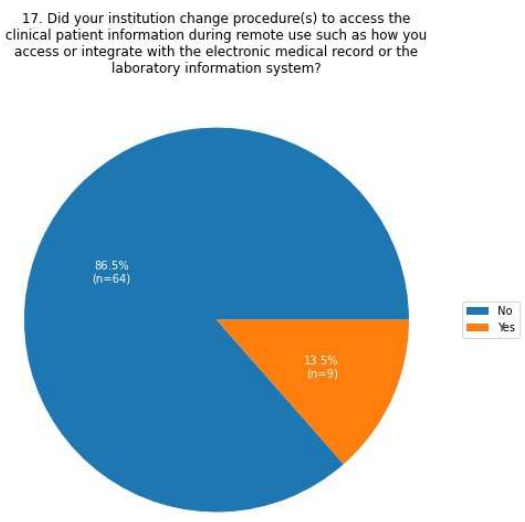
16. If diagnosing remotely (“home office”), how did (or would) you transmit your report into your Lab Information System (LIS) ?

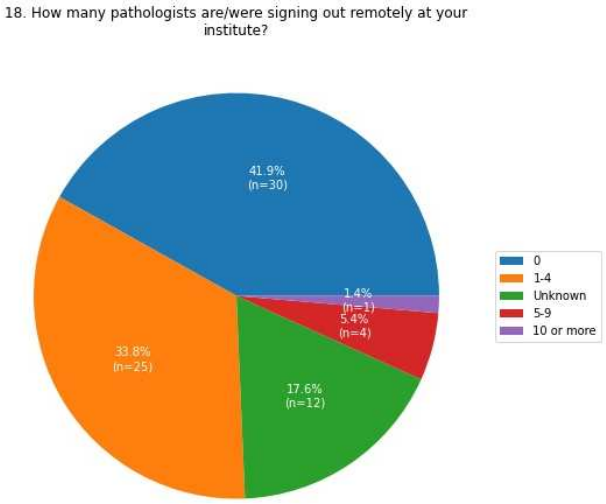
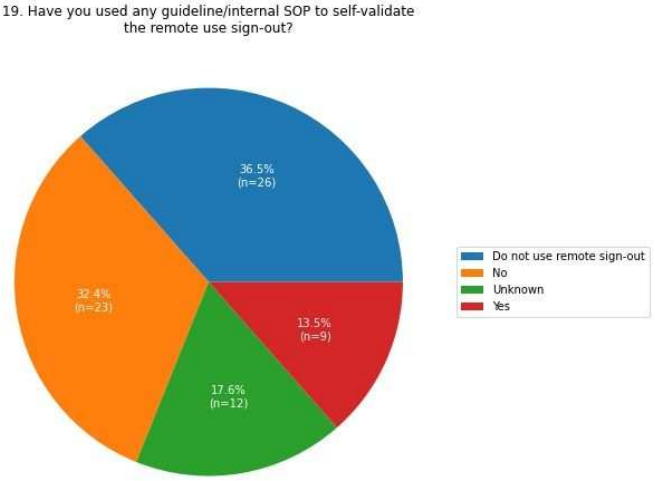
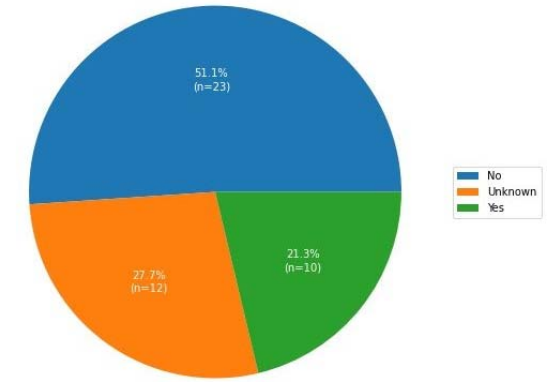
a. Remote connection to dictation tool of the LIS
b. Generated speech file and sent to dictation pool
c. Wrote the report by myself
d. Other: [text]

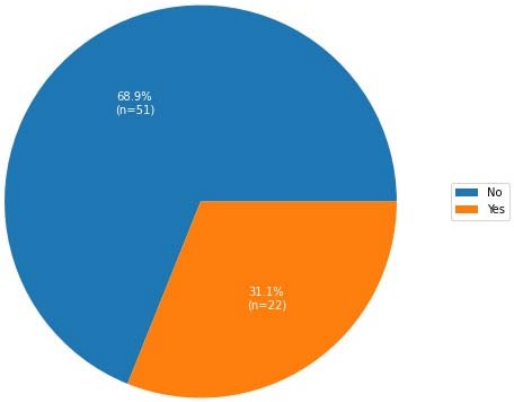


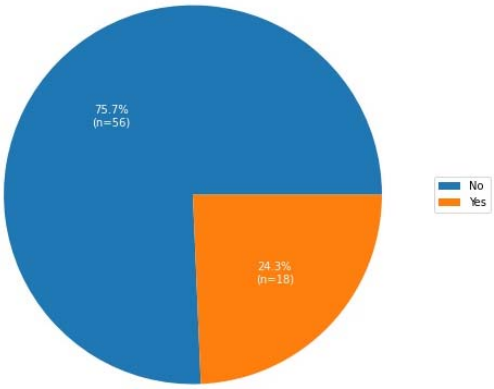
17. Did your institution change procedure(s) to access the clinical patient information during remote use such as how you access or integrate with the electronic medical record or the laboratory information system?

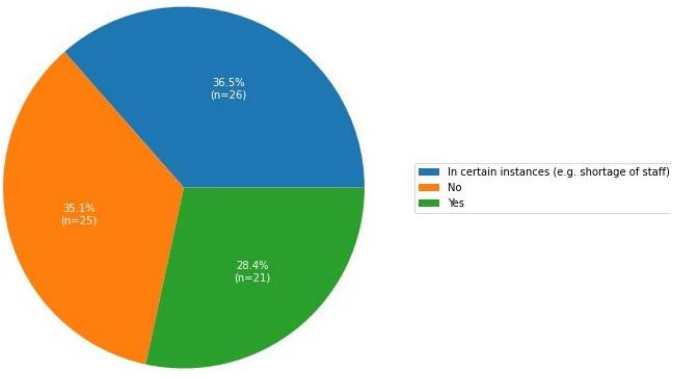
- Yes
- No



18. How many pathologists are/were signing out remotely at your institute? • 0 • 1-4 • 5-9 • 10 or more • Unknown	
19. Have you used any guideline/internal SOP to self-validate the remote use sign-out? • Yes • No • Unknown • Do not use remote sign-out	
19 a. Subgroup analysis of guideline/internal SOP use within the subgroup of pathologists using remote signout? • Yes • No • Unknown	

19b. If yes, is your institution willing to share its validation protocol and results? • Yes • No • Unknown	

20. Has your institution included a quality assurance process such as retrospective review of a percentage of remotely signed out cases in the validation process? • Yes • No	

21. If regulations allowed, does your institution intend to continue to use or set up a remote sign-out (“home office”) following the COVID-19 pandemic? • Yes • In certain instances (e.g. • shortage of staff) • No	

Supplemental material **10.1136/jclinpath-2021-207768**

Objectifs: La transition de la pathologie analogique à la pathologie digitale (DP) en Suisse a coïncidé avec la crise du COVID. Le Consortium suisse de pathologie digitale (SDiPath) a mené une enquête nationale pour évaluer l'expérience des pathologistes face aux défis de la pandémie et comment cela a influencé les perspectives et l'adoption de la DP.

Méthodes: Une enquête contenant 20 questions relatives au DP, aux expériences personnelles et aux défis pendant la pandémie a été adressée à des pathologistes suisses à différents stades d'expérience en pratique privée, dans les hôpitaux communautaires et universitaires.

Résultats : Tous les n=74 répondants étaient des pathologistes, 81,1 % d'entre eux déclarant plus de 5 ans d'expérience en services de diagnostic. 32,5 % ont déclaré avoir lu 100 lames virtuelles ou plus dans un contexte de diagnostic. 39,2 % ont déclaré utiliser des systèmes d'évaluation d'images de lames entières sur leur lieu de travail principal. Les principaux cas d'utilisation du DP avant le confinement dû au COVID étaient les conférences clinico-pathologiques (39,2%), l'éducation (60,8%) et la recherche (44,6%) avec le DP utilisé pour le diagnostic primaire dans 13,5%. Pendant la crise COVID, l'utilisation de la DP pour les diagnostics primaires a plus que doublé (30 % contre 13,5 %), les consultations internes étant des moteurs importants (22,5% contre 16,5 %), tandis que la recherche et les consultations externes (17,5% contre 41,9%) ont fortement diminué. Les principaux défis identifiés comprenaient le manque de procédures opérationnelles standard établies et la disponibilité de matériel et de logiciels spécialisés.

Conclusion: Cette enquête indique que la crise a agi comme un catalyseur en favorisant l'adoption du DP dans les centres où les flux de travail de base étaient déjà établis tout en posant des défis techniques et organisationnels majeurs dans les institutions qui étaient à un stade précoce de la mise en œuvre du DP.

Supplemental material **10.1136/jclinpath-2021-207768**

Ziele: Der Übergang von der analogen zur digitalen Pathologie (DP) in der Schweiz fällt mit der COVID-Krise zusammen. Das *Swiss Digital Pathology Consortium* (SDiPath) führte eine nationale Umfrage durch, um den aktuellen Stand und das Potential für die zukünftige Entwicklung der digitalen Pathologie zu beurteilen.

Methode: Das *Swiss Digital Pathology Consortium* richtete eine Umfrage an Schweizer Pathologen unterschiedlicher Erfahrungsstufen in niedergelassenen, kommunalen und universitären Spitälern, um die verfügbaren Ressourcen, Verwendungszwecke und die Veränderungen der DP in der Krisensituation zu beurteilen.

Ergebnisse: Alle n=74 Befragten waren Pathologen, 81,1% berichteten von mehr als 5 Jahren Erfahrung in der Diagnostik. 32,5 % gaben an, 100 oder mehr digitale Objektträger in einem diagnostischen Kontext beurteilt zu haben. 39,2% gaben an, digitale Diagnostik an ihrem Hauptarbeitsplatz einzusetzen. Wichtige DP Anwendungsfälle vor der COVID-Krise waren Tumorboards (39,2%), Lehre (60,8%) und Forschung (44,6%), wobei DP in 13,5% für die Primärdiagnose verwendet wurde. Während der COVID-Krise hat sich der Einsatz digitaler Lösungen für die Primärdiagnostik mehr als verdoppelt (30 % vs. 13,5%). Interne Konsultationen stellten hierfür einen wichtigen Treiber dar (22,5 % vs. 16,5%), während die Verwendung der DP für Forschungszwecke (25 % vs. 44,6%) und externe Konsile (17,5% vs. 41,9%) stark rückläufig waren. Das Fehlen etablierter Standardarbeitsanweisungen und die Verfügbarkeit von spezialisierter Hard- und Software stellten in der Krise maßgebliche Limitationen für den flächendeckenden Einsatz digitaler diagnostischer Lösungen dar.

Schlussfolgerung: Diese Umfrage zeigt, dass die Krise als Katalysator der Einführung von digitalen Lösungen in Zentren gewirkt hat, in denen grundlegende Arbeitsabläufe bereits etabliert waren. In Einrichtungen, die sich in einem frühen Stadium der Digitalisierung befanden, stellte die Krisensituation hingegen eine große technische und organisatorische Herausforderung dar.

Supplemental material **10.1136/jclinpath-2021-207768**

Obiettivi: Il passaggio da patologia analogica a patologia digitale (PD) in Svizzera ha coinciso con la crisi del COVID. Il *Swiss Digital Pathology Consortium* (SDiPath) ha condotto un'indagine nazionale per valutare l'esperienza dei patologi nell'affrontare le sfide della pandemia e come ciò abbia influenzato le prospettive e l'adozione della DP.

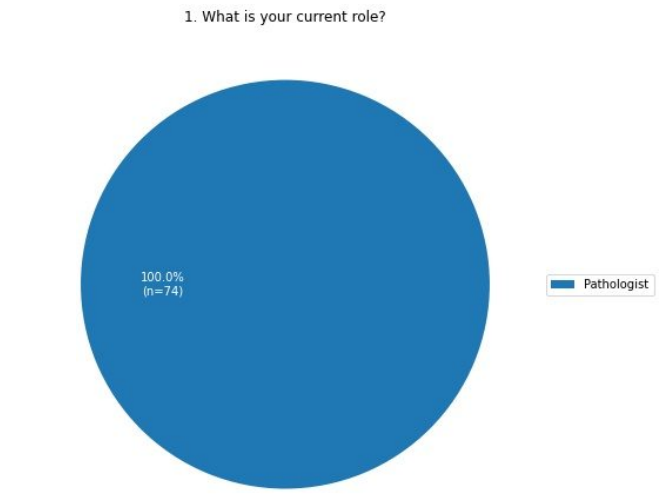
Metodi: Un sondaggio contenente 20 domande relative alla PD, esperienze personali e sfide durante la pandemia è stato rivolto a patologi svizzeri in diverse fasi dell'esperienza in studi privati, ospedali comunitari e ospedali universitari.

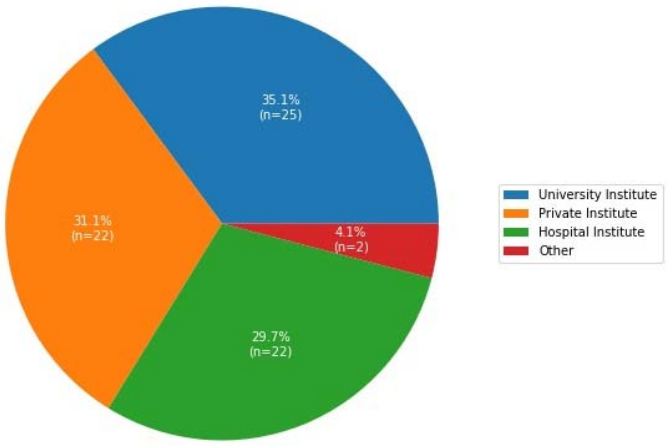
Risultati: Tutti i n=74 intervistati erano patologi, ~~con~~ l'81,1% dei quali con più di 5 anni di esperienza nel servizio diagnostico. Il 32,5% ha riferito di aver letto 100 preparati digitali o più in un contesto diagnostico. Il 39,2% ha riferito di utilizzare sistemi di imaging di interi vetrini nel luogo di lavoro principale. I principali casi d'uso della PD prima del blocco COVID erano le consulenze sui tumori (39,2%), l'istruzione (60,8%) e la ricerca (44,6%) con la PD utilizzata per la diagnosi primaria nel 13,5%. Durante la crisi COVID, l'uso della PD per la diagnostica primaria è più che raddoppiato (30% contro 13,5%) con i consulti interni come driver importante (22,5% contro 16,5%), mentre l'uso per ricerca (25% contro 44,6%) e le consulenze esterne (17,5% vs 41,9%) sono fortemente diminuiti. Le sfide chiave identificate includevano la mancanza di procedure operative standard ben definite e la disponibilità di hardware e software specializzati.

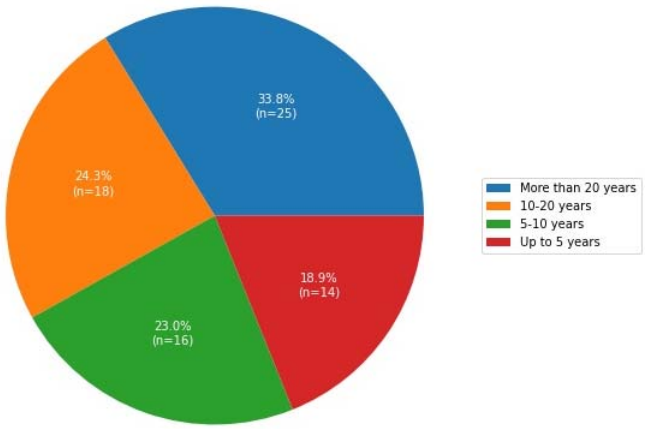
Conclusione: Questo sondaggio indica che la crisi ha agito da catalizzatore nel promuovere l'adozione della PD nei centri in cui i flussi di lavoro di base erano già consolidati, ponendo al contempo grandi sfide tecniche e organizzative alle istituzioni che erano in una fase iniziale dell'implementazione della PD.

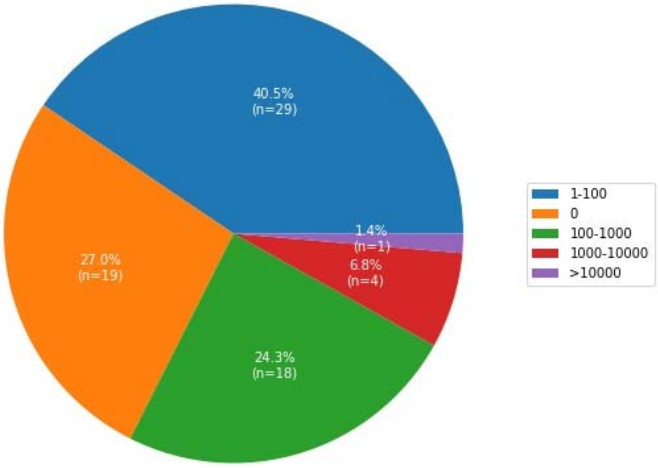
The COVID-19 pandemic and its associated lockdown has invigorated debate regarding the digitalization of pathologist workplaces and home offices. The Swiss Digital Pathology Consortium (SDiPath, sdipath.ch) needs your help to assess the practice, safety, and validity of the use of a “home office” scenario.

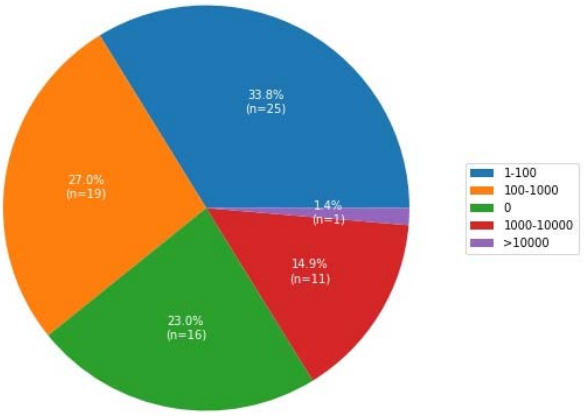
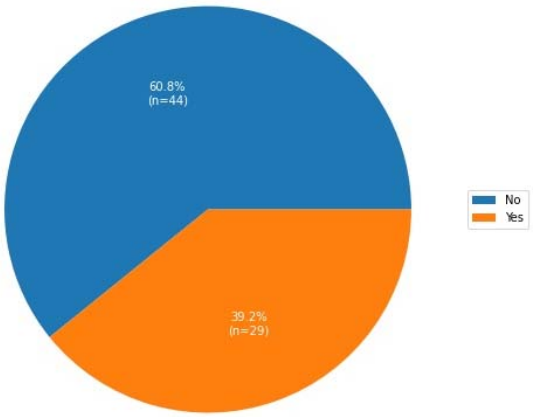
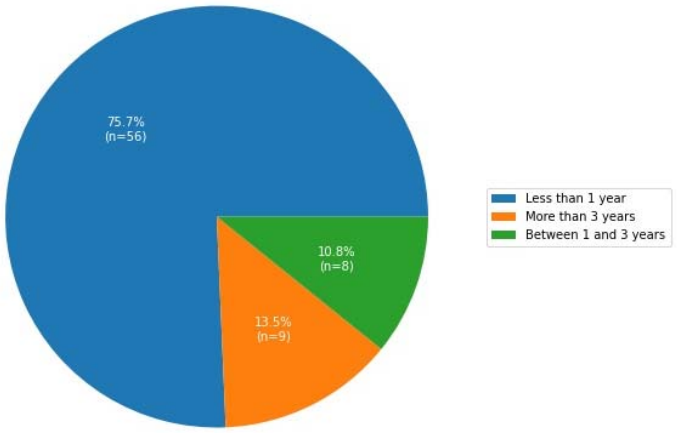
If you plan to, or are currently using, remote sign-out, please participate in the following brief survey. Your experience will help craft federal responses for the promotion of the safe and effective use of this technology beyond the current pandemic. We appreciate your time and look forward to the productive engagement of all pathologists, laboratory and IT professional staff, for the collection of critical real-world data.

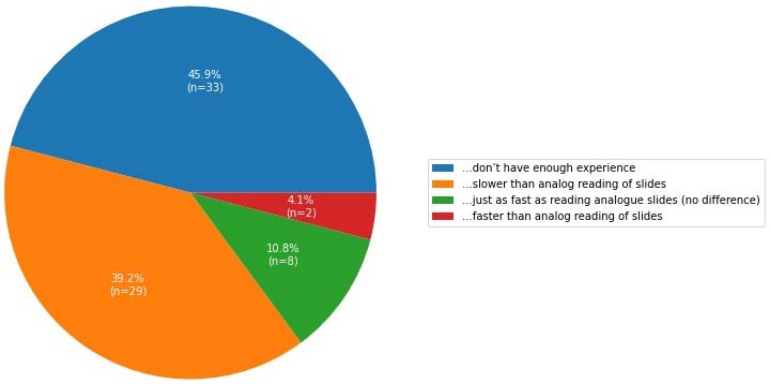
1. What is your current role? • Pathologist • IT • Lab staff • Administrator • Procurement • Other (please specify)	

2. Where do you work? • Hospital institute • University institute • Private institute • Other	

3. How many years have you been practicing (MDs) /involved with (lab staff) pathology? • Up to 5 years • 5-10 years • 10-20 years • More than 20 years	

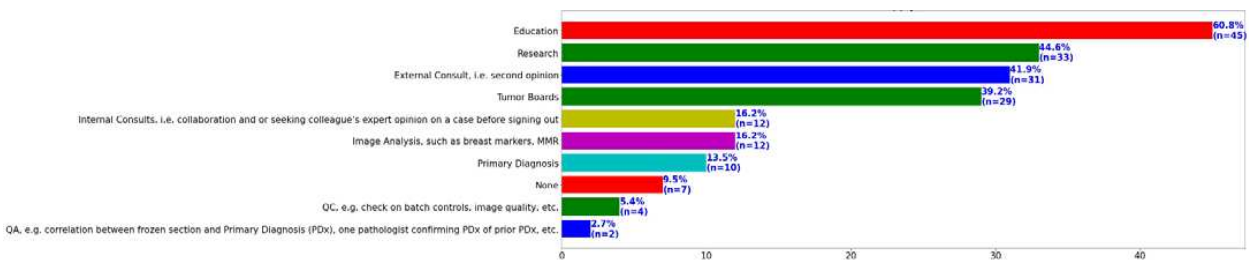
4. How many slides have you read digitally in your career so far in a clinical diagnostics context? • 0 • 1-100 • 100-1000 • 1000-10000 • > 10000	

5. How many slides have you read digitally in your career so far in a research context? • 0 • 1-100 • 100-1000 • 1000-10000 • 10000	
6. Are you currently using Whole Slide Imaging Systems (WSI systems, i.e. scanner, workstation, including display) and/or image analysis algorithms at your primary workplace, i.e. your hospital, lab, reference lab? • Yes • No	
7. If yes, how many years have you been using WSI systems at your primary workplace? • Less than 1 year • Between 1 and 3 years • More than 3 years	

8. After a training phase, would your digital diagnostic workflow (open case/viewing slide/changing slide/ access to clinical information and previous results/ dictating and closing case) be... • ...slower than analog reading of slides • ...faster than analog reading of slides • ...just as fast as reading analogue slides (no difference) • ...don't have enough experience	

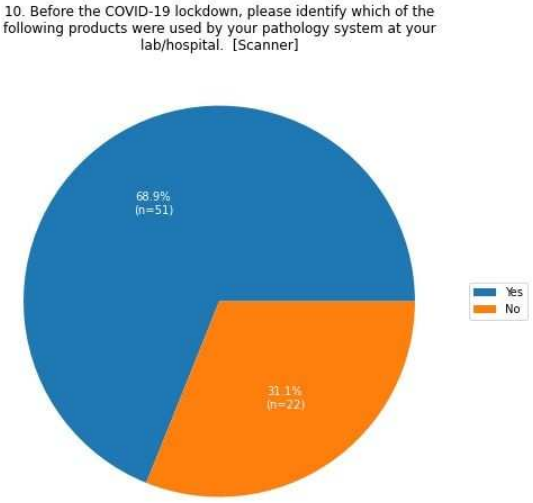
9. Before the COVID lockdown, what WSI use cases were you using at your institution in the last 6 months? (Please select all that apply)

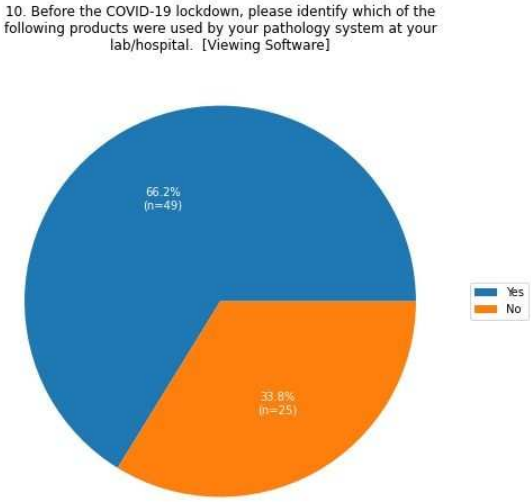
a. Primary Diagnosis
b. External Consult, i.e. second opinion
c. Internal Consults, i.e. collaboration and or seeking colleague's expert opinion on a case before signing out
d. QC, e.g. check on batch controls, image quality, etc.
e. QA, e.g. correlation between frozen section and Primary Diagnosis (PDx), one pathologist confirming PDx of prior PDx, etc.
f. Education
g. Tumor Boards
h. Research
i. Image Analysis, such as breast markers, MMR
j. Other (please specify)

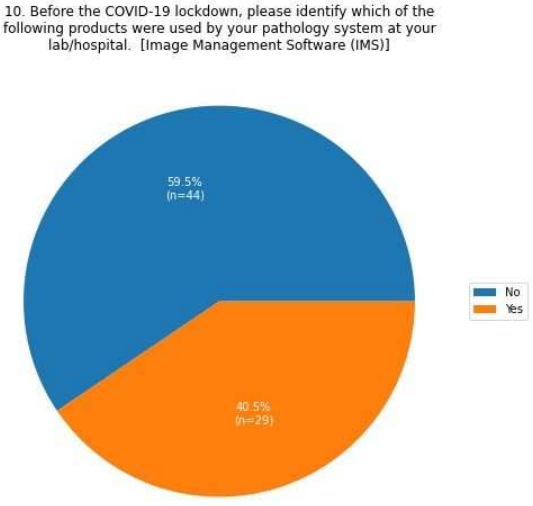


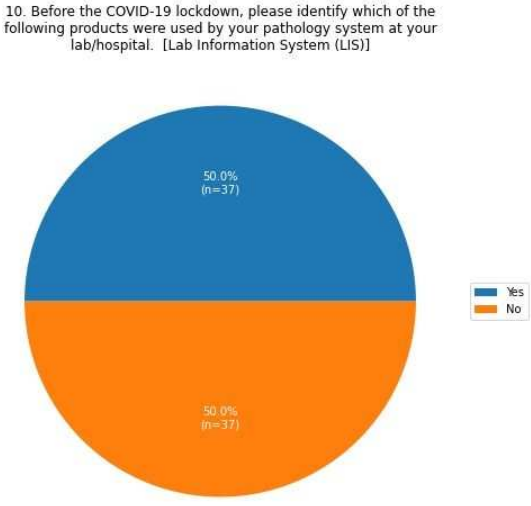
10. Before the COVID-19 lockdown, please identify which of the following products were used by your pathology system at your lab/hospital.

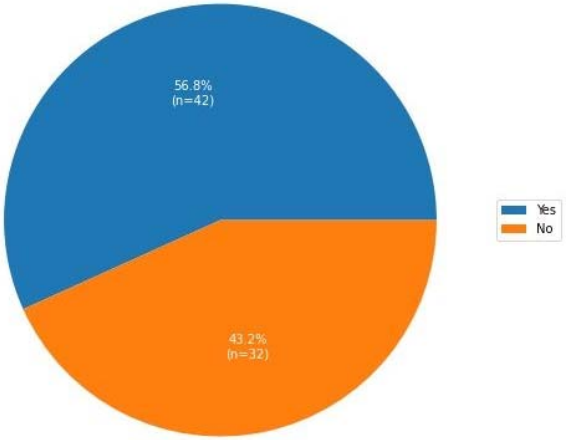
a. Scanner
b. Viewing Software
c. Image Management Software (IMS)
d. Lab Information System (LIS)

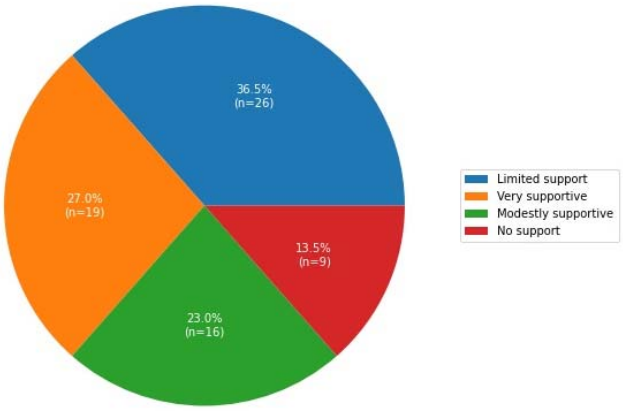








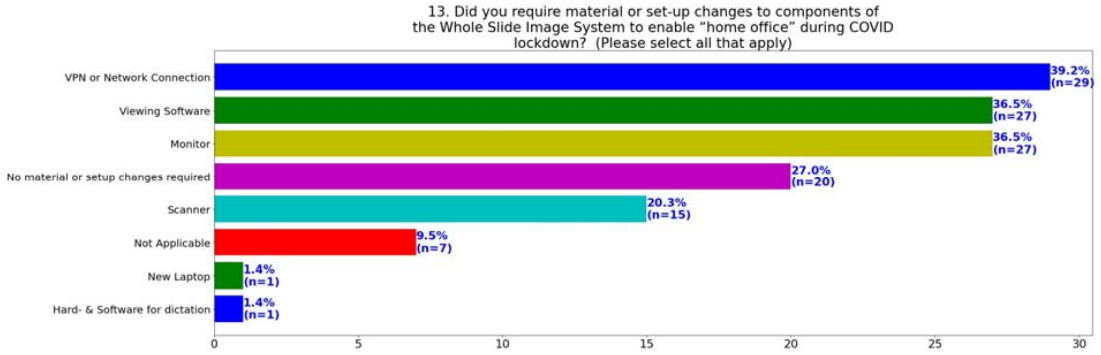
11. During COVID lockdown, did you consider a “home office” scenario for pathologists when the COVID lockdown started? • Yes • No	

12. What level of support did you, or do you believe you would, have received from your IT department and/or system administrator for implementing a “home office”? o very supportive o modestly supportive o limited support o no support	

13. Did you require material or set-up changes to components of the Whole Slide Image System to enable "home office" during COVID lockdown?

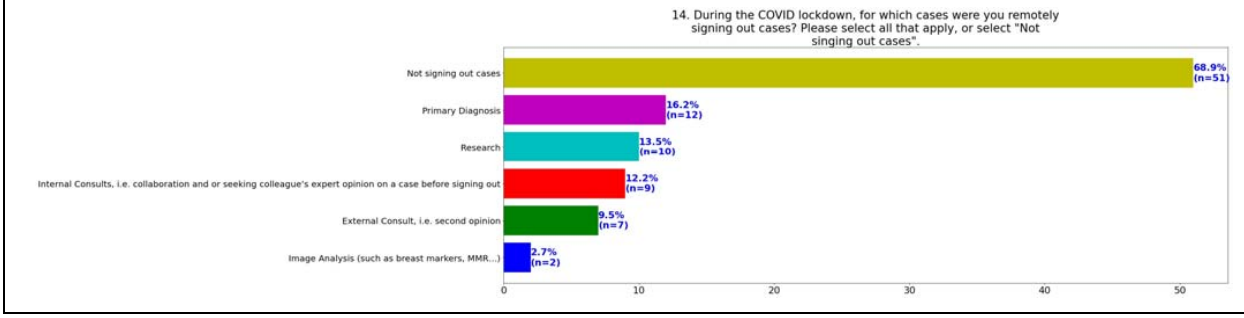
Yes (Please select all that apply)

a. Scanner
b. Monitor
c. Viewing Software
d. VPN or Network Connection
e. Other (please specify) [text response]

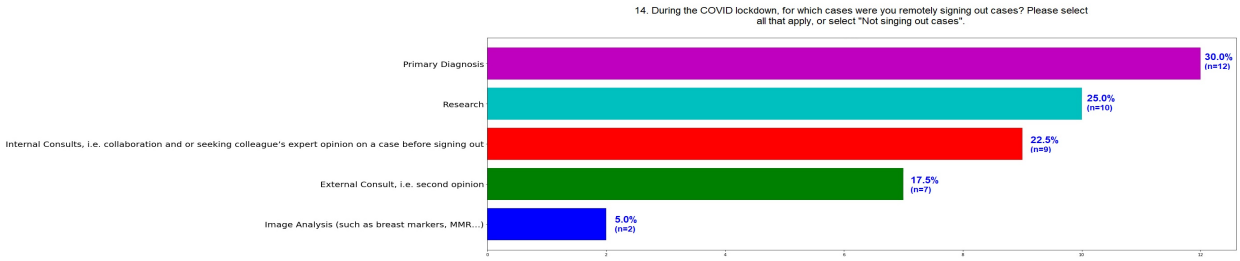


14. During the COVID lockdown, were you remotely signing out cases (Please select all that apply)?

a. Yes, for
    i. Primary Diagnosis
    ii. External Consult, i.e. second opinion
    iii. Internal Consults, i.e. collaboration and or seeking colleague's expert opinion on a case before signing out
    iv. Research
    v. Image Analysis (such as breast markers, MMR…)
b. Not signing out cases

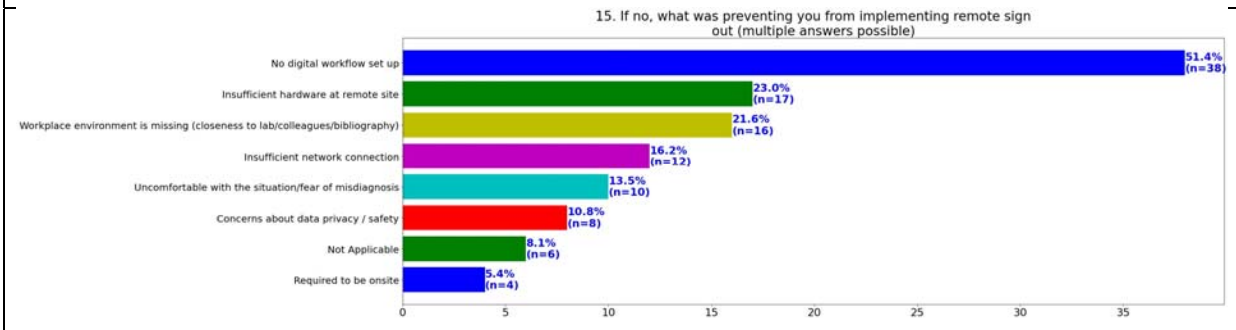


14 a. Subgroup analysis of use cases for pathologists remotely signing out cases during the COVID lockdown:



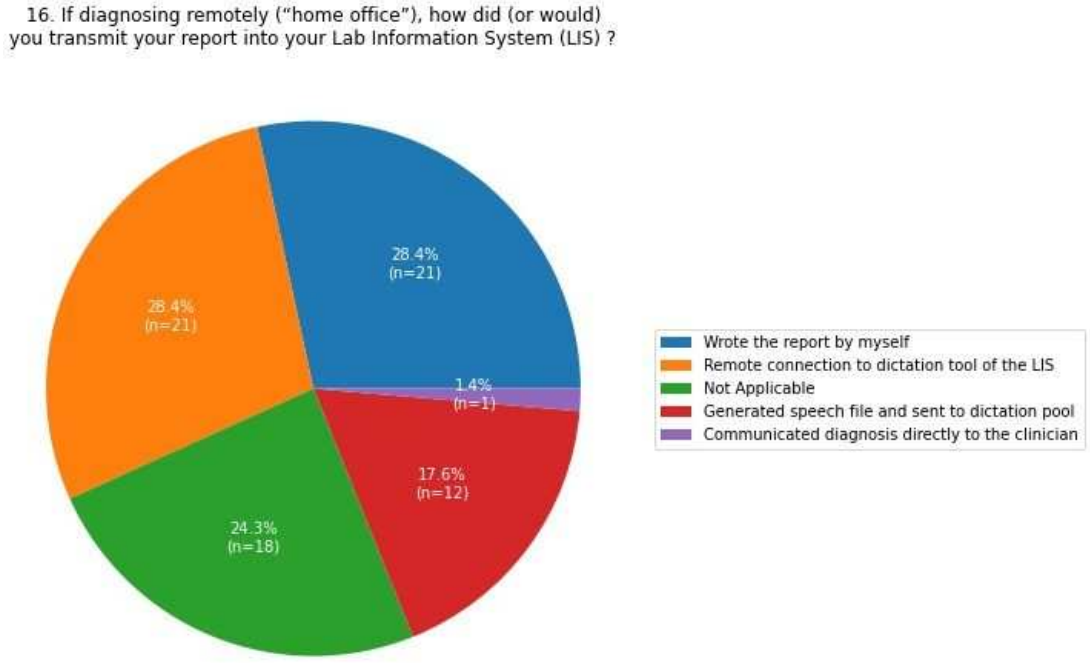
15. If no, what was preventing you from implementing remote sign out (multiple answers possible)?

a. Insufficient hardware at remote site
b. Insufficient network connection
c. Uncomfortable with the situation/fear of misdiagnosis
d. Workplace environment is missing (closeness to lab/colleagues/bibliography)
e. Concerns about data privacy / safety
f. No digital workflow set up
g. Other reason, please specify [text box]
h.



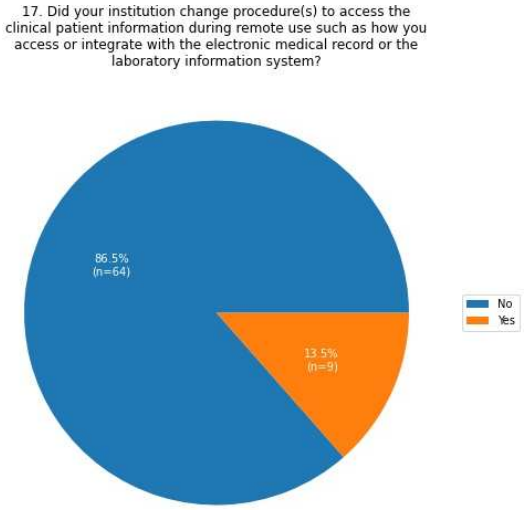
16. If diagnosing remotely (“home office”), how did (or would) you transmit your report into your Lab Information System (LIS) ?

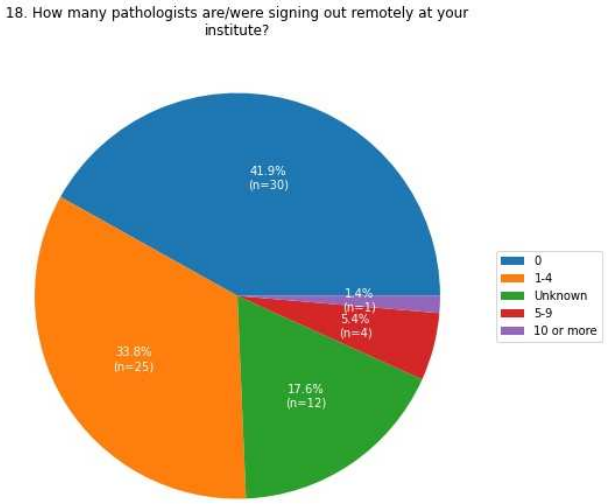
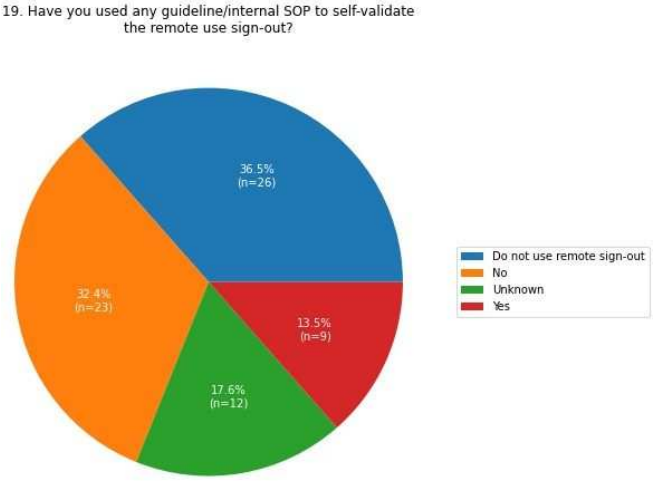
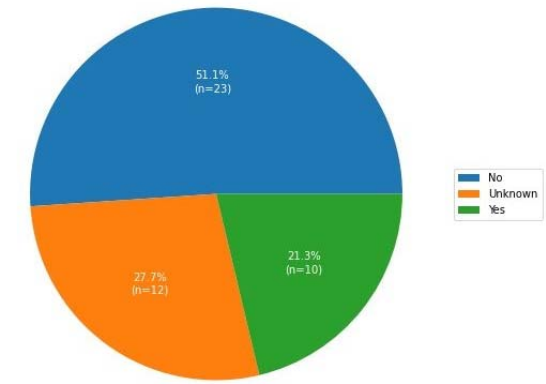
a. Remote connection to dictation tool of the LIS
b. Generated speech file and sent to dictation pool
c. Wrote the report by myself
d. Other: [text]

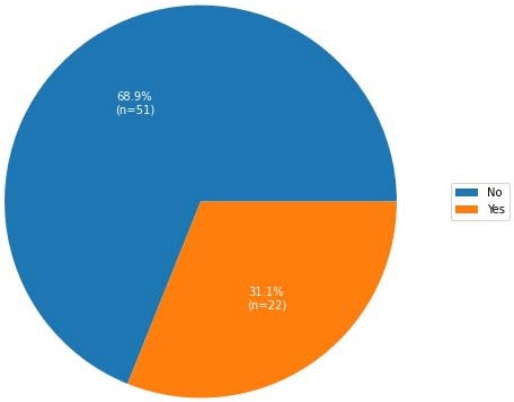
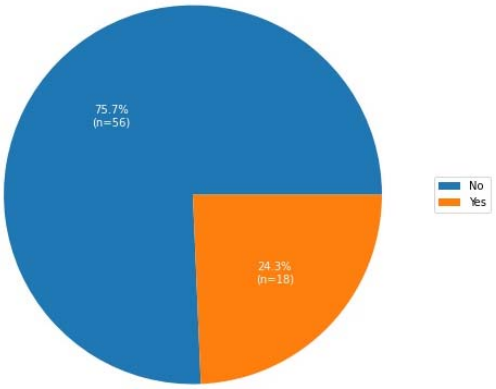
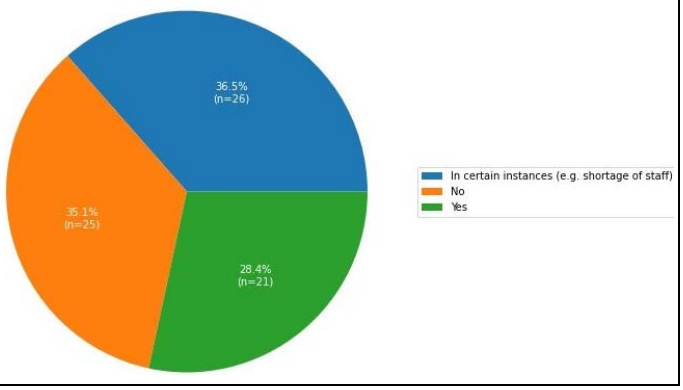


17. Did your institution change procedure(s) to access the clinical patient information during remote use such as how you access or integrate with the electronic medical record or the laboratory information system?

- Yes
- No



18. How many pathologists are/were signing out remotely at your institute? • 0 • 1-4 • 5-9 • 10 or more • Unknown	
19. Have you used any guideline/internal SOP to self-validate the remote use sign-out? • Yes • No • Unknown • Do not use remote sign-out	
19 a. Subgroup analysis of guideline/internal SOP use within the subgroup of pathologists using remote signout? • Yes • No • Unknown	

19b. If yes, is your institution willing to share its validation protocol and results? • Yes • No • Unknown	
20. Has your institution included a quality assurance process such as retrospective review of a percentage of remotely signed out cases in the validation process? • Yes • No	
21. If regulations allowed, does your institution intend to continue to use or set up a remote sign-out (“home office”) following the COVID-19 pandemic? • Yes • In certain instances (e.g. • shortage of staff) • No	

Supplemental material **10.1136/jclinpath-2021-207768**

Objectifs: La transition de la pathologie analogique à la pathologie digitale (DP) en Suisse a coïncidé avec la crise du COVID. Le Consortium suisse de pathologie digitale (SDiPath) a mené une enquête nationale pour évaluer l'expérience des pathologistes face aux défis de la pandémie et comment cela a influencé les perspectives et l'adoption de la DP.

Méthodes: Une enquête contenant 20 questions relatives au DP, aux expériences personnelles et aux défis pendant la pandémie a été adressée à des pathologistes suisses à différents stades d'expérience en pratique privée, dans les hôpitaux communautaires et universitaires.

Résultats : Tous les n=74 répondants étaient des pathologistes, 81,1 % d'entre eux déclarant plus de 5 ans d'expérience en services de diagnostic. 32,5 % ont déclaré avoir lu 100 lames virtuelles ou plus dans un contexte de diagnostic. 39,2 % ont déclaré utiliser des systèmes d'évaluation d'images de lames entières sur leur lieu de travail principal. Les principaux cas d'utilisation du DP avant le confinement dû au COVID étaient les conférences clinico-pathologiques (39,2%), l'éducation (60,8%) et la recherche (44,6%) avec le DP utilisé pour le diagnostic primaire dans 13,5%. Pendant la crise COVID, l'utilisation de la DP pour les diagnostics primaires a plus que doublé (30 % contre 13,5 %), les consultations internes étant des moteurs importants (22,5% contre 16,5 %), tandis que la recherche et les consultations externes (17,5% contre 41,9%) ont fortement diminué. Les principaux défis identifiés comprenaient le manque de procédures opérationnelles standard établies et la disponibilité de matériel et de logiciels spécialisés.

Conclusion: Cette enquête indique que la crise a agi comme un catalyseur en favorisant l'adoption du DP dans les centres où les flux de travail de base étaient déjà établis tout en posant des défis techniques et organisationnels majeurs dans les institutions qui étaient à un stade précoce de la mise en œuvre du DP.

Supplemental material **10.1136/jclinpath-2021-207768**

Ziele: Der Übergang von der analogen zur digitalen Pathologie (DP) in der Schweiz fällt mit der COVID-Krise zusammen. Das *Swiss Digital Pathology Consortium* (SDiPath) führte eine nationale Umfrage durch, um den aktuellen Stand und das Potential für die zukünftige Entwicklung der digitalen Pathologie zu beurteilen.

Methode: Das *Swiss Digital Pathology Consortium* richtete eine Umfrage an Schweizer Pathologen unterschiedlicher Erfahrungsstufen in niedergelassenen, kommunalen und universitären Spitälern, um die verfügbaren Ressourcen, Verwendungszwecke und die Veränderungen der DP in der Krisensituation zu beurteilen.

Ergebnisse: Alle n=74 Befragten waren Pathologen, 81,1% berichteten von mehr als 5 Jahren Erfahrung in der Diagnostik. 32,5 % gaben an, 100 oder mehr digitale Objektträger in einem diagnostischen Kontext beurteilt zu haben. 39,2% gaben an, digitale Diagnostik an ihrem Hauptarbeitsplatz einzusetzen. Wichtige DP Anwendungsfälle vor der COVID-Krise waren Tumorboards (39,2%), Lehre (60,8%) und Forschung (44,6%), wobei DP in 13,5% für die Primärdiagnose verwendet wurde. Während der COVID-Krise hat sich der Einsatz digitaler Lösungen für die Primärdiagnostik mehr als verdoppelt (30 % vs. 13,5%). Interne Konsultationen stellten hierfür einen wichtigen Treiber dar (22,5 % vs. 16,5%), während die Verwendung der DP für Forschungszwecke (25 % vs. 44,6%) und externe Konsile (17,5% vs. 41,9%) stark rückläufig waren. Das Fehlen etablierter Standardarbeitsanweisungen und die Verfügbarkeit von spezialisierter Hard- und Software stellten in der Krise maßgebliche Limitationen für den flächendeckenden Einsatz digitaler diagnostischer Lösungen dar.

Schlussfolgerung: Diese Umfrage zeigt, dass die Krise als Katalysator der Einführung von digitalen Lösungen in Zentren gewirkt hat, in denen grundlegende Arbeitsabläufe bereits etabliert waren. In Einrichtungen, die sich in einem frühen Stadium der Digitalisierung befanden, stellte die Krisensituation hingegen eine große technische und organisatorische Herausforderung dar.

Supplemental material **10.1136/jclinpath-2021-207768**

Obiettivi: Il passaggio da patologia analogica a patologia digitale (PD) in Svizzera ha coinciso con la crisi del COVID. Il *Swiss Digital Pathology Consortium* (SDiPath) ha condotto un'indagine nazionale per valutare l'esperienza dei patologi nell'affrontare le sfide della pandemia e come ciò abbia influenzato le prospettive e l'adozione della DP.

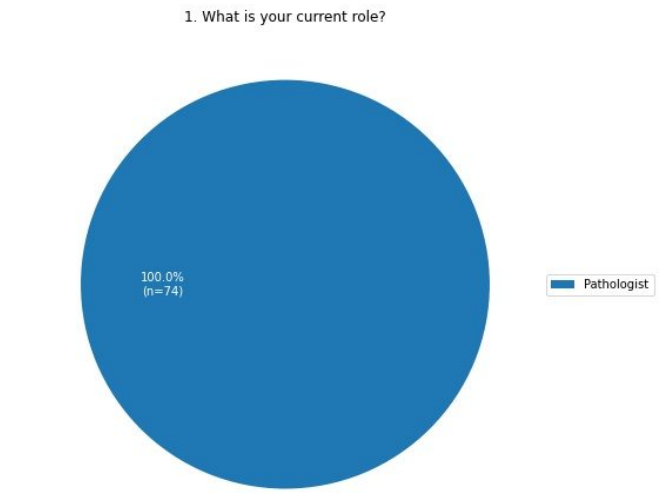
Metodi: Un sondaggio contenente 20 domande relative alla PD, esperienze personali e sfide durante la pandemia è stato rivolto a patologi svizzeri in diverse fasi dell'esperienza in studi privati, ospedali comunitari e ospedali universitari.

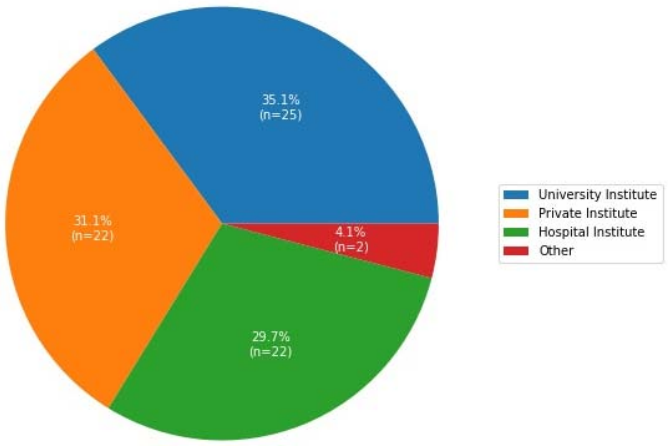
Risultati: Tutti i n=74 intervistati erano patologi, ~~con~~ l'81,1% dei quali con più di 5 anni di esperienza nel servizio diagnostico. Il 32,5% ha riferito di aver letto 100 preparati digitali o più in un contesto diagnostico. Il 39,2% ha riferito di utilizzare sistemi di imaging di interi vetrini nel luogo di lavoro principale. I principali casi d'uso della PD prima del blocco COVID erano le consulenze sui tumori (39,2%), l'istruzione (60,8%) e la ricerca (44,6%) con la PD utilizzata per la diagnosi primaria nel 13,5%. Durante la crisi COVID, l'uso della PD per la diagnostica primaria è più che raddoppiato (30% contro 13,5%) con i consulti interni come driver importante (22,5% contro 16,5%), mentre l'uso per ricerca (25% contro 44,6%) e le consulenze esterne (17,5% vs 41,9%) sono fortemente diminuiti. Le sfide chiave identificate includevano la mancanza di procedure operative standard ben definite e la disponibilità di hardware e software specializzati.

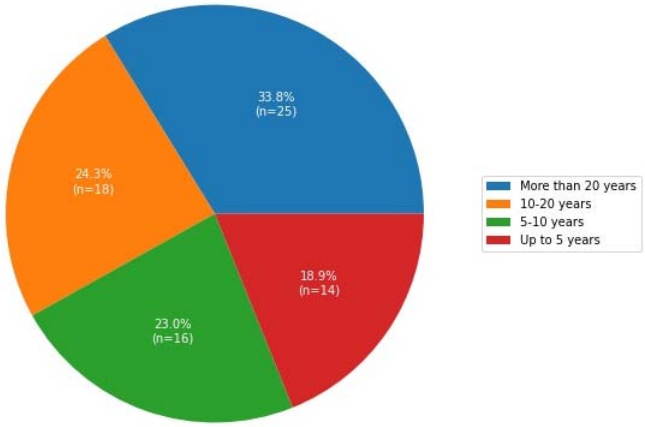
Conclusione: Questo sondaggio indica che la crisi ha agito da catalizzatore nel promuovere l'adozione della PD nei centri in cui i flussi di lavoro di base erano già consolidati, ponendo al contempo grandi sfide tecniche e organizzative alle istituzioni che erano in una fase iniziale dell'implementazione della PD.

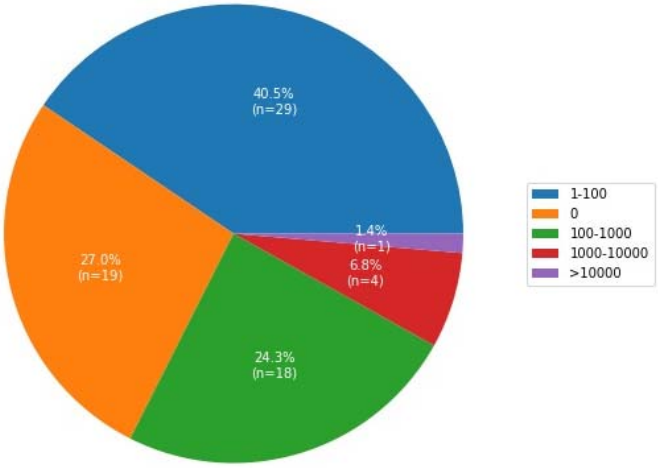
The COVID-19 pandemic and its associated lockdown has invigorated debate regarding the digitalization of pathologist workplaces and home offices. The Swiss Digital Pathology Consortium (SDiPath, sdipath.ch) needs your help to assess the practice, safety, and validity of the use of a “home office” scenario.

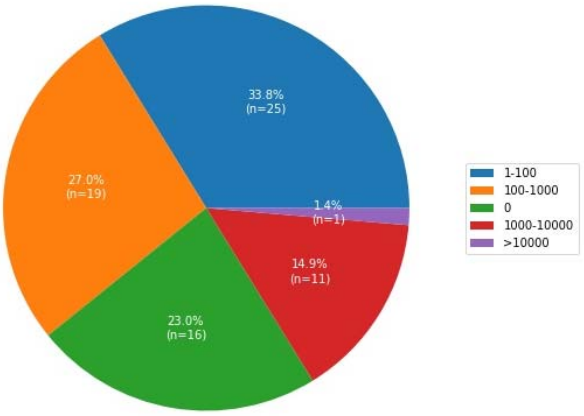
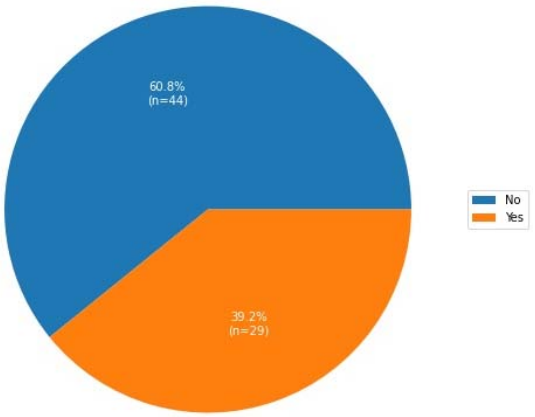
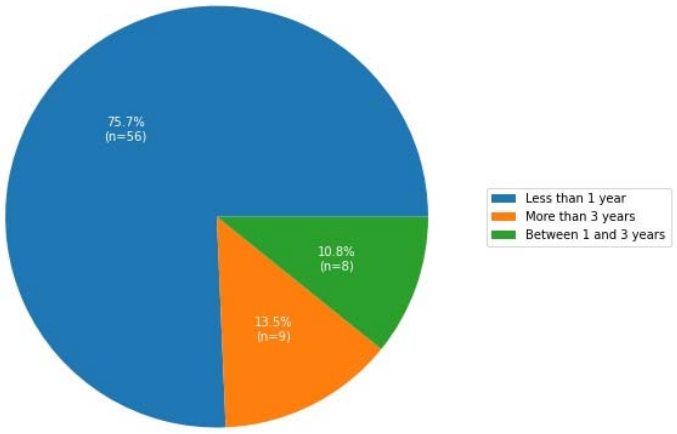
If you plan to, or are currently using, remote sign-out, please participate in the following brief survey. Your experience will help craft federal responses for the promotion of the safe and effective use of this technology beyond the current pandemic. We appreciate your time and look forward to the productive engagement of all pathologists, laboratory and IT professional staff, for the collection of critical real-world data.

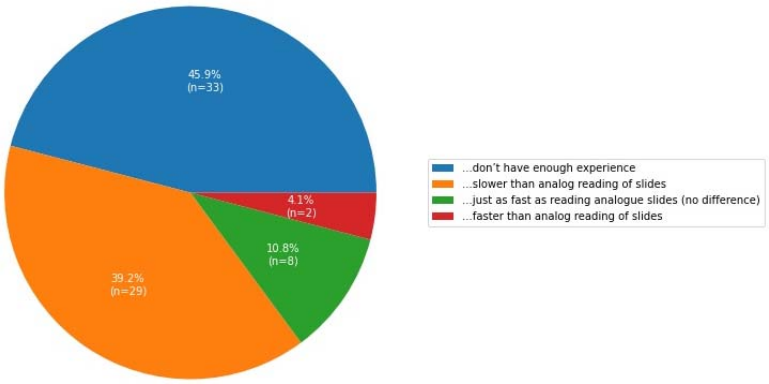
1. What is your current role? • Pathologist • IT • Lab staff • Administrator • Procurement • Other (please specify)	

2. Where do you work? • Hospital institute • University institute • Private institute • Other	

3. How many years have you been practicing (MDs) /involved with (lab staff) pathology? • Up to 5 years • 5-10 years • 10-20 years • More than 20 years	

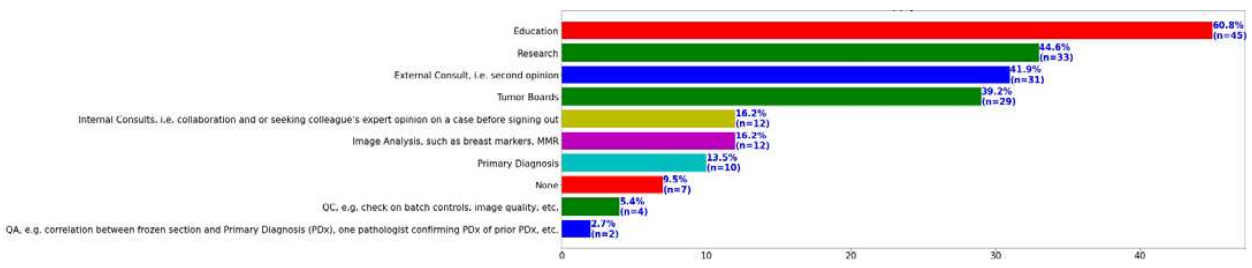
4. How many slides have you read digitally in your career so far in a clinical diagnostics context? • 0 • 1-100 • 100-1000 • 1000-10000 • > 10000	

5. How many slides have you read digitally in your career so far in a research context? • 0 • 1-100 • 100-1000 • 1000-10000 • 10000	
6. Are you currently using Whole Slide Imaging Systems (WSI systems, i.e. scanner, workstation, including display) and/or image analysis algorithms at your primary workplace, i.e. your hospital, lab, reference lab? • Yes • No	
7. If yes, how many years have you been using WSI systems at your primary workplace? • Less than 1 year • Between 1 and 3 years • More than 3 years	

8. After a training phase, would your digital diagnostic workflow (open case/viewing slide/changing slide/ access to clinical information and previous results/ dictating and closing case) be... • ...slower than analog reading of slides • ...faster than analog reading of slides • ...just as fast as reading analogue slides (no difference) • ...don't have enough experience	

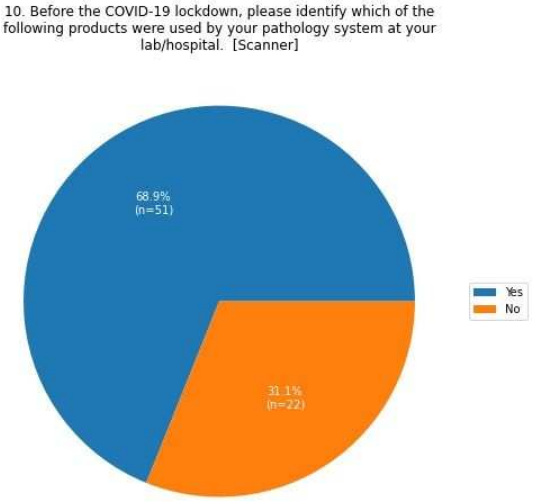
9. Before the COVID lockdown, what WSI use cases were you using at your institution in the last 6 months? (Please select all that apply)

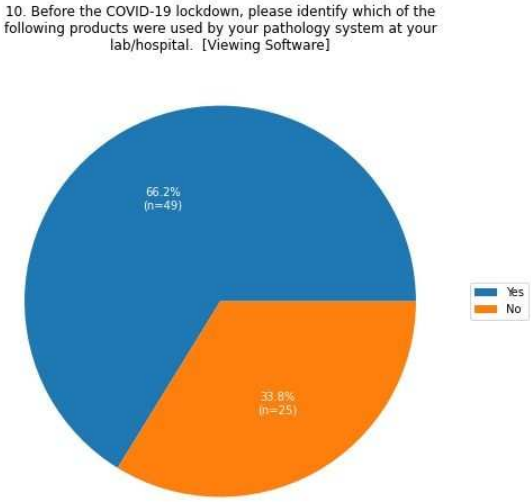
a. Primary Diagnosis
b. External Consult, i.e. second opinion
c. Internal Consults, i.e. collaboration and or seeking colleague's expert opinion on a case before signing out
d. QC, e.g. check on batch controls, image quality, etc.
e. QA, e.g. correlation between frozen section and Primary Diagnosis (PDx), one pathologist confirming PDx of prior PDx, etc.
f. Education
g. Tumor Boards
h. Research
i. Image Analysis, such as breast markers, MMR
j. Other (please specify)

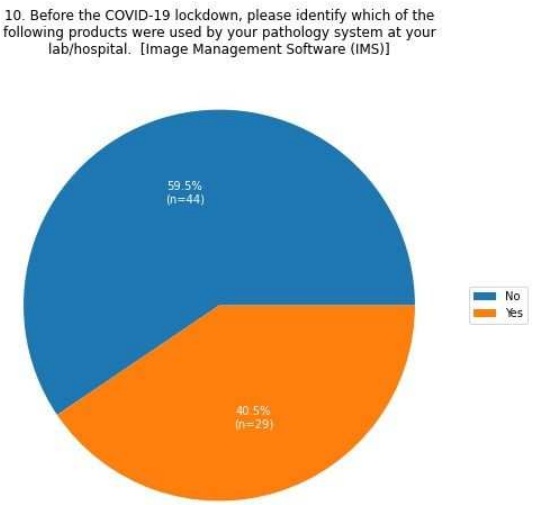


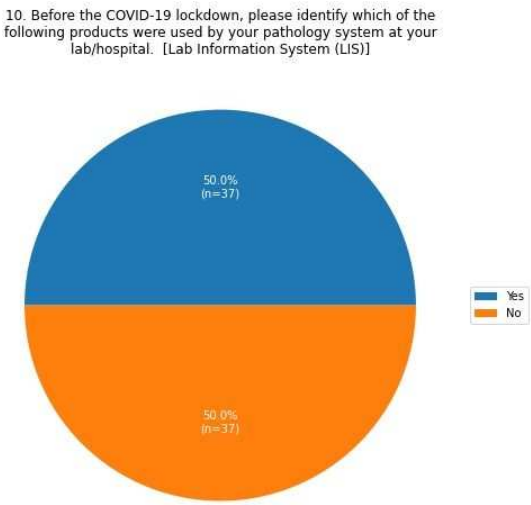
10. Before the COVID-19 lockdown, please identify which of the following products were used by your pathology system at your lab/hospital.

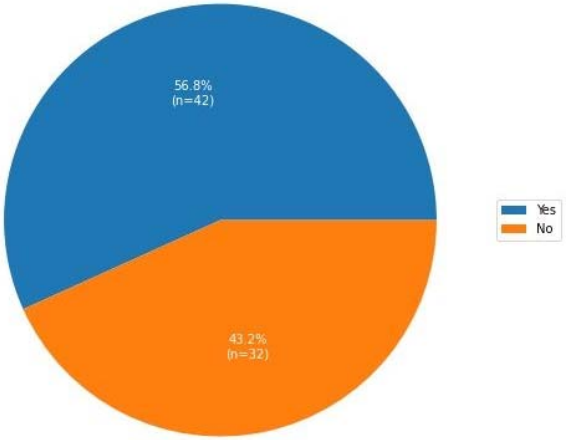
a. Scanner
b. Viewing Software
c. Image Management Software (IMS)
d. Lab Information System (LIS)

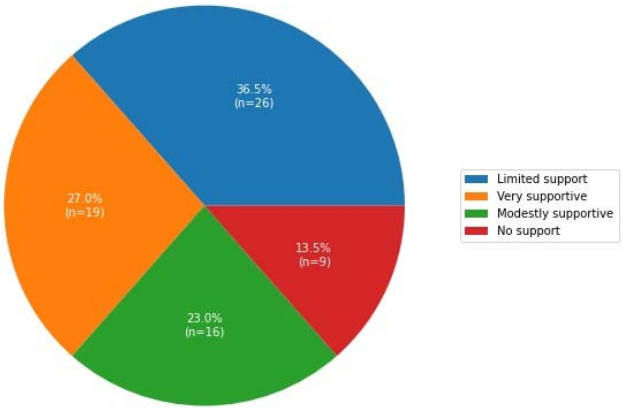








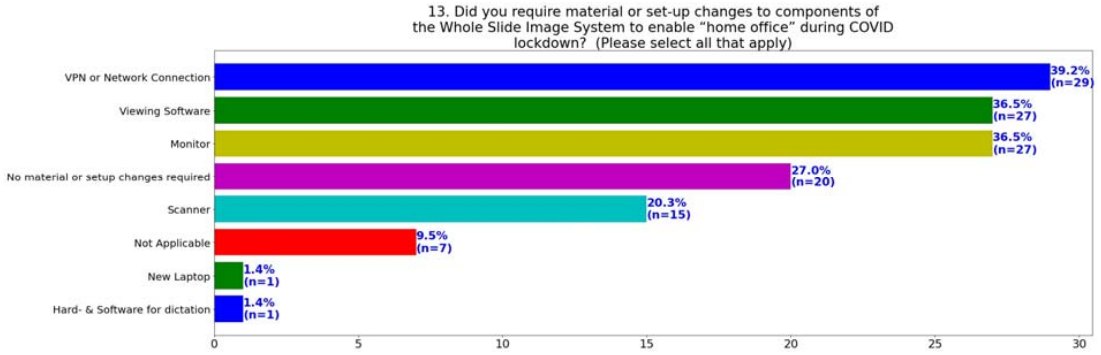
11. During COVID lockdown, did you consider a “home office” scenario for pathologists when the COVID lockdown started? • Yes • No	

12. What level of support did you, or do you believe you would, have received from your IT department and/or system administrator for implementing a “home office”? o very supportive o modestly supportive o limited support o no support	

13. Did you require material or set-up changes to components of the Whole Slide Image System to enable "home office" during COVID lockdown?

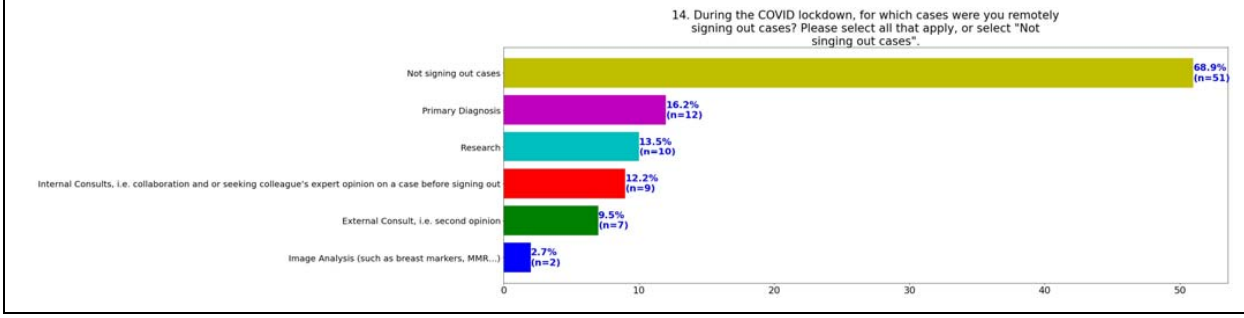
Yes (Please select all that apply)

a. Scanner
b. Monitor
c. Viewing Software
d. VPN or Network Connection
e. Other (please specify) [text response]

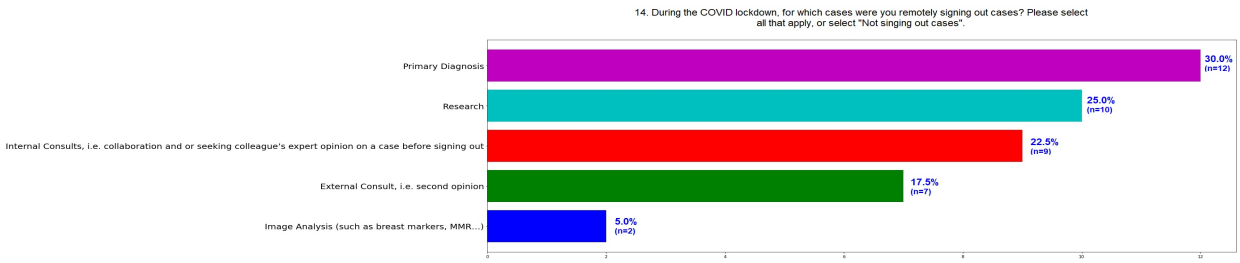


14. During the COVID lockdown, were you remotely signing out cases (Please select all that apply)?

a. Yes, for
    i. Primary Diagnosis
    ii. External Consult, i.e. second opinion
    iii. Internal Consults, i.e. collaboration and or seeking colleague's expert opinion on a case before signing out
    iv. Research
    v. Image Analysis (such as breast markers, MMR…)
b. Not signing out cases

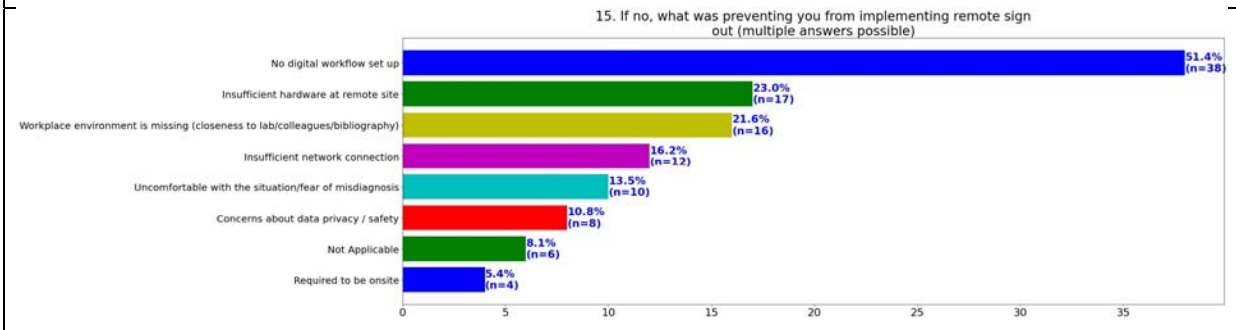


14 a. Subgroup analysis of use cases for pathologists remotely signing out cases during the COVID lockdown:



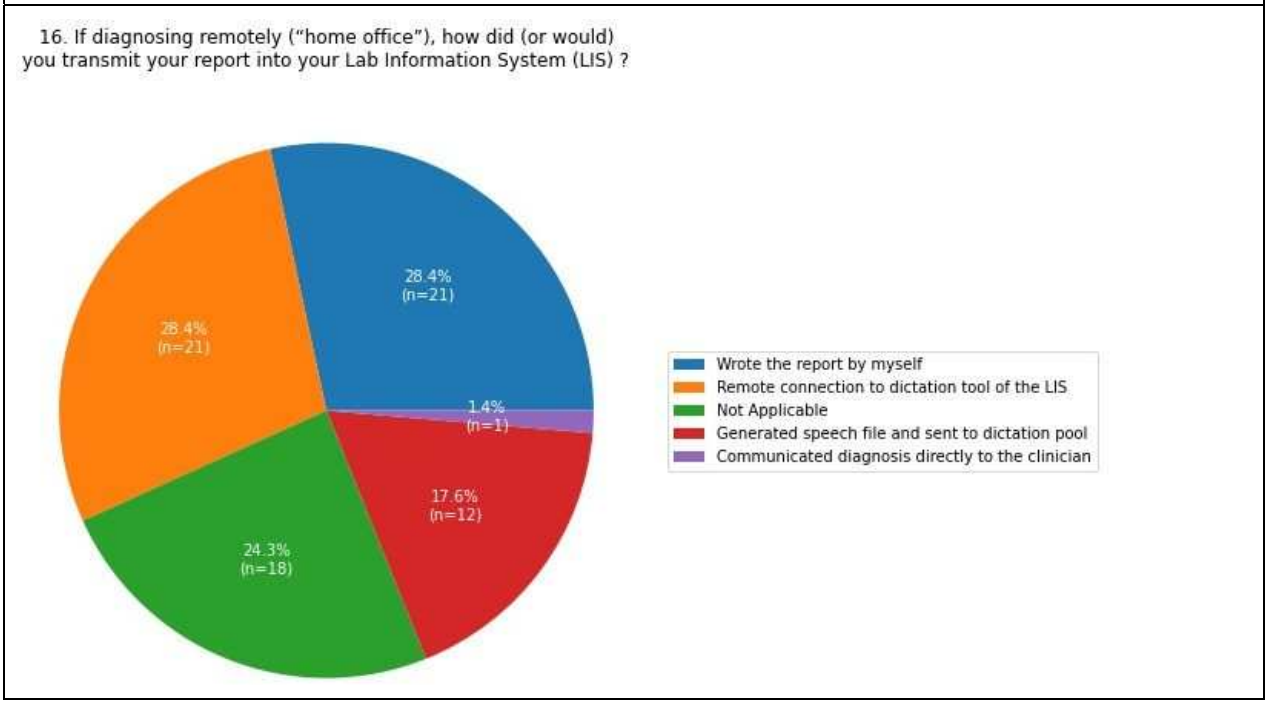
15. If no, what was preventing you from implementing remote sign out (multiple answers possible)?

a. Insufficient hardware at remote site
b. Insufficient network connection
c. Uncomfortable with the situation/fear of misdiagnosis
d. Workplace environment is missing (closeness to lab/colleagues/bibliography)
e. Concerns about data privacy / safety
f. No digital workflow set up
g. Other reason, please specify [text box]
h.



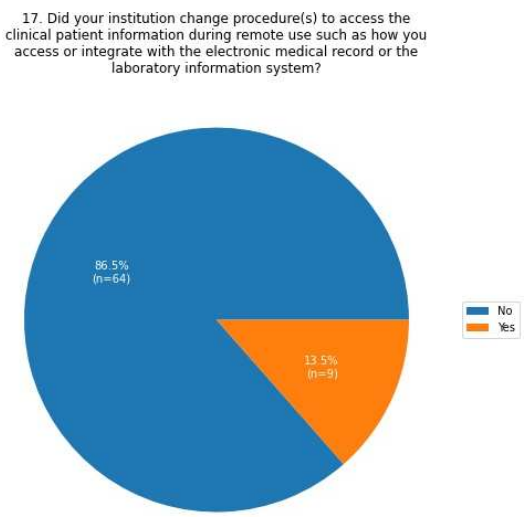
16. If diagnosing remotely (“home office”), how did (or would) you transmit your report into your Lab Information System (LIS) ?

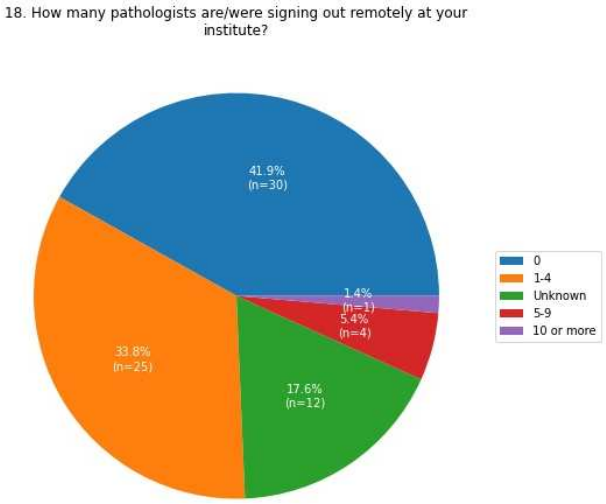
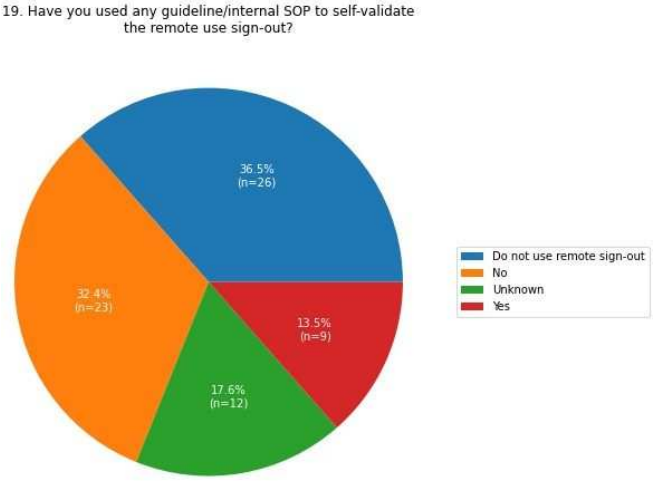
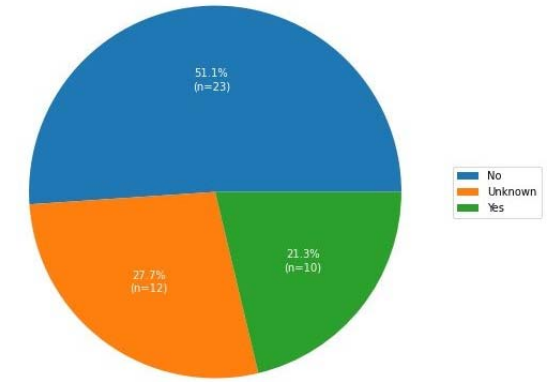
a. Remote connection to dictation tool of the LIS
b. Generated speech file and sent to dictation pool
c. Wrote the report by myself
d. Other: [text]

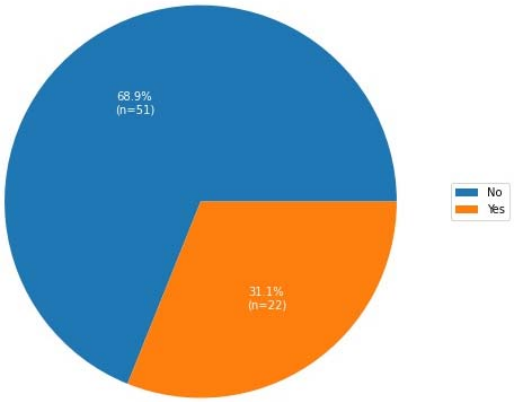


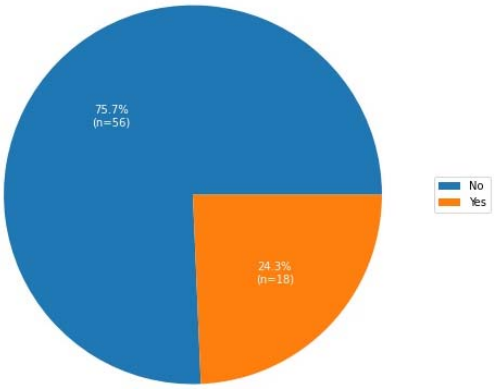
17. Did your institution change procedure(s) to access the clinical patient information during remote use such as how you access or integrate with the electronic medical record or the laboratory information system?

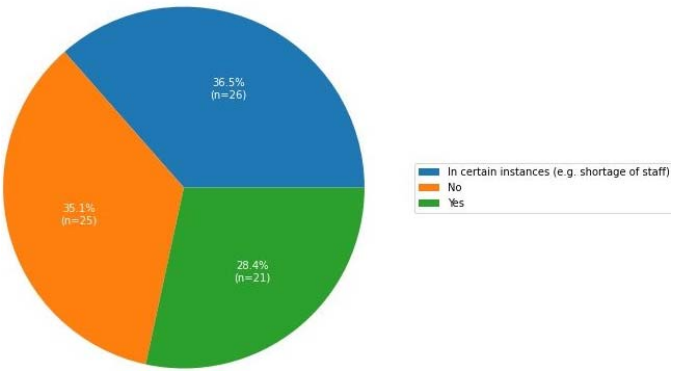
- Yes
- No



18. How many pathologists are/were signing out remotely at your institute? • 0 • 1-4 • 5-9 • 10 or more • Unknown	
19. Have you used any guideline/internal SOP to self-validate the remote use sign-out? • Yes • No • Unknown • Do not use remote sign-out	
19 a. Subgroup analysis of guideline/internal SOP use within the subgroup of pathologists using remote signout? • Yes • No • Unknown	

19b. If yes, is your institution willing to share its validation protocol and results? • Yes • No • Unknown	

20. Has your institution included a quality assurance process such as retrospective review of a percentage of remotely signed out cases in the validation process? • Yes • No	

21. If regulations allowed, does your institution intend to continue to use or set up a remote sign-out (“home office”) following the COVID-19 pandemic? • Yes • In certain instances (e.g. • shortage of staff) • No	

Supplemental material **10.1136/jclinpath-2021-207768**

Objectifs: La transition de la pathologie analogique à la pathologie digitale (DP) en Suisse a coïncidé avec la crise du COVID. Le Consortium suisse de pathologie digitale (SDiPath) a mené une enquête nationale pour évaluer l'expérience des pathologistes face aux défis de la pandémie et comment cela a influencé les perspectives et l'adoption de la DP.

Méthodes: Une enquête contenant 20 questions relatives au DP, aux expériences personnelles et aux défis pendant la pandémie a été adressée à des pathologistes suisses à différents stades d'expérience en pratique privée, dans les hôpitaux communautaires et universitaires.

Résultats : Tous les n=74 répondants étaient des pathologistes, 81,1 % d'entre eux déclarant plus de 5 ans d'expérience en services de diagnostic. 32,5 % ont déclaré avoir lu 100 lames virtuelles ou plus dans un contexte de diagnostic. 39,2 % ont déclaré utiliser des systèmes d'évaluation d'images de lames entières sur leur lieu de travail principal. Les principaux cas d'utilisation du DP avant le confinement dû au COVID étaient les conférences clinico-pathologiques (39,2%), l'éducation (60,8%) et la recherche (44,6%) avec le DP utilisé pour le diagnostic primaire dans 13,5%. Pendant la crise COVID, l'utilisation de la DP pour les diagnostics primaires a plus que doublé (30 % contre 13,5 %), les consultations internes étant des moteurs importants (22,5% contre 16,5 %), tandis que la recherche et les consultations externes (17,5% contre 41,9%) ont fortement diminué. Les principaux défis identifiés comprenaient le manque de procédures opérationnelles standard établies et la disponibilité de matériel et de logiciels spécialisés.

Conclusion: Cette enquête indique que la crise a agi comme un catalyseur en favorisant l'adoption du DP dans les centres où les flux de travail de base étaient déjà établis tout en posant des défis techniques et organisationnels majeurs dans les institutions qui étaient à un stade précoce de la mise en œuvre du DP.

Supplemental material **10.1136/jclinpath-2021-207768**

Ziele: Der Übergang von der analogen zur digitalen Pathologie (DP) in der Schweiz fällt mit der COVID-Krise zusammen. Das *Swiss Digital Pathology Consortium* (SDiPath) führte eine nationale Umfrage durch, um den aktuellen Stand und das Potential für die zukünftige Entwicklung der digitalen Pathologie zu beurteilen.

Methode: Das *Swiss Digital Pathology Consortium* richtete eine Umfrage an Schweizer Pathologen unterschiedlicher Erfahrungsstufen in niedergelassenen, kommunalen und universitären Spitälern, um die verfügbaren Ressourcen, Verwendungszwecke und die Veränderungen der DP in der Krisensituation zu beurteilen.

Ergebnisse: Alle n=74 Befragten waren Pathologen, 81,1% berichteten von mehr als 5 Jahren Erfahrung in der Diagnostik. 32,5 % gaben an, 100 oder mehr digitale Objektträger in einem diagnostischen Kontext beurteilt zu haben. 39,2% gaben an, digitale Diagnostik an ihrem Hauptarbeitsplatz einzusetzen. Wichtige DP Anwendungsfälle vor der COVID-Krise waren Tumorboards (39,2%), Lehre (60,8%) und Forschung (44,6%), wobei DP in 13,5% für die Primärdiagnose verwendet wurde. Während der COVID-Krise hat sich der Einsatz digitaler Lösungen für die Primärdiagnostik mehr als verdoppelt (30 % vs. 13,5%). Interne Konsultationen stellten hierfür einen wichtigen Treiber dar (22,5 % vs. 16,5%), während die Verwendung der DP für Forschungszwecke (25 % vs. 44,6%) und externe Konsile (17,5% vs. 41,9%) stark rückläufig waren. Das Fehlen etablierter Standardarbeitsanweisungen und die Verfügbarkeit von spezialisierter Hard- und Software stellten in der Krise maßgebliche Limitationen für den flächendeckenden Einsatz digitaler diagnostischer Lösungen dar.

Schlussfolgerung: Diese Umfrage zeigt, dass die Krise als Katalysator der Einführung von digitalen Lösungen in Zentren gewirkt hat, in denen grundlegende Arbeitsabläufe bereits etabliert waren. In Einrichtungen, die sich in einem frühen Stadium der Digitalisierung befanden, stellte die Krisensituation hingegen eine große technische und organisatorische Herausforderung dar.

Supplemental material **10.1136/jclinpath-2021-207768**

Obiettivi: Il passaggio da patologia analogica a patologia digitale (PD) in Svizzera ha coinciso con la crisi del COVID. Il *Swiss Digital Pathology Consortium* (SDiPath) ha condotto un'indagine nazionale per valutare l'esperienza dei patologi nell'affrontare le sfide della pandemia e come ciò abbia influenzato le prospettive e l'adozione della DP.

Metodi: Un sondaggio contenente 20 domande relative alla PD, esperienze personali e sfide durante la pandemia è stato rivolto a patologi svizzeri in diverse fasi dell'esperienza in studi privati, ospedali comunitari e ospedali universitari.

Risultati: Tutti i n=74 intervistati erano patologi, ~~con~~ l'81,1% dei quali con più di 5 anni di esperienza nel servizio diagnostico. Il 32,5% ha riferito di aver letto 100 preparati digitali o più in un contesto diagnostico. Il 39,2% ha riferito di utilizzare sistemi di imaging di interi vetrini nel luogo di lavoro principale. I principali casi d'uso della PD prima del blocco COVID erano le consulenze sui tumori (39,2%), l'istruzione (60,8%) e la ricerca (44,6%) con la PD utilizzata per la diagnosi primaria nel 13,5%. Durante la crisi COVID, l'uso della PD per la diagnostica primaria è più che raddoppiato (30% contro 13,5%) con i consulti interni come driver importante (22,5% contro 16,5%), mentre l'uso per ricerca (25% contro 44,6%) e le consulenze esterne (17,5% vs 41,9%) sono fortemente diminuiti. Le sfide chiave identificate includevano la mancanza di procedure operative standard ben definite e la disponibilità di hardware e software specializzati.

Conclusione: Questo sondaggio indica che la crisi ha agito da catalizzatore nel promuovere l'adozione della PD nei centri in cui i flussi di lavoro di base erano già consolidati, ponendo al contempo grandi sfide tecniche e organizzative alle istituzioni che erano in una fase iniziale dell'implementazione della PD.