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BMJ Open

Efforts to strengthen anatomic pathology diagnostic services for cancer in sub-Saharan Africa: a scoping review protocol

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Keywords:	Quality Improvement, PATHOLOGY, ONCOLOGY

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Manuscripts

Title: Efforts to strengthen anatomic pathology diagnostic services for cancer in sub-Saharan Africa: a scoping review protocol

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ABSTRACT

Introduction: Sub-Saharan Africa bears a disproportionate burden of cancer-related morbidity and mortality compared to high-resource settings. Although pathology services are essential to providing optimal oncologic care, diagnostic capacity in sub-Saharan Africa is insufficient for the cancer burden. This scoping review will be conducted to summarize the current state of practices and evidence for interventions and implementation strategies to improve anatomic pathology services for cancer in the region. The objective of this scoping review is to describe efforts to strengthen capacity for anatomic pathology diagnostic services in sub-Saharan Africa. The information gathered will be used to inform the design of future pathology capacity-building interventions.

Methods and analysis: This study will follow the PRISMA Guidelines for Scoping Reviews. MEDLINE, Embase, Cochrane Central, and African Index Medicus will be searched for articles published in English and Portuguese with no limitations placed on date or publication type. Two independent reviewers will screen all articles, extract data, and complete the descriptive analysis. All discrepancies will be resolved using a third reviewer. The results will be reported using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for scoping reviews (PRISMA-ScR). This review will consider scientific literature from published primary studies as well as scoping and systematic reviews related to capacity building efforts to strengthen anatomic pathology services in any sub-Saharan African country. All study designs will be considered, including quantitative, qualitative, and/or mixed-methods studies.

Ethics and dissemination:

Ethical approval is not required for this study. Dissemination of findings from this work will include the publication of the results in a peer-reviewed journal and presentations at conferences.

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Registration details: Open Science Framework, <https://osf.io/6cmhg>

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ARTICLE SUMMARY

Strengths and limitations of this study

- A systematic and comprehensive search of electronic databases will ensure that all peer-reviewed evidence is identified.
- The scoping review will follow the Joanna Briggs Institute methodology for scoping reviews and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews
- Members of the research team include key stakeholders involved in capacity strengthening of pathology services in sub-Saharan Africa, which will help to strengthen the validity of the findings
- A formal assessment of the quality of evidence will not be performed and may lead to the inclusion of studies with a range of quality.
- Only studies written in English and Portuguese will be included.

Keywords: Africa, Oncology, Pathology, Quality Improvement

INTRODUCTION

Sub-Saharan Africa (SSA) faces a growing burden of cancer with pathology diagnostic services that are inadequately prepared to meet this public health challenge. One of the World Health Organization's (WHO) sustainable development goals is to reduce preventable mortality from non-communicable diseases such as cancer, in low- and middle-income countries (LMICs) by a third by 2030.[1] To achieve this goal, the development and maintenance of high quality anatomic pathology services is required.[2] High quality pathology services are essential to cancer care and are required for accurate and timely diagnosis, prognosis, and selection of optimal treatments. Pathology diagnostics also provide critical data to cancer registries and facilitate clinical research.[3] Although the WHO's list of essential in vitro diagnostics includes tests such as immunohistochemistry and flow cytometry, many of these recommended assays are not widely available in SSA.[4–6] In fact, a recent survey of pathology laboratories in SSA found that only half provided onsite IHC services.[6]

There are numerous barriers to high quality pathology services, including an insufficient number of trained personnel, reagent and equipment shortages, and suboptimal specimen processing.[6] Several groups, including the Lancet Commission on diagnostics and African Strategies for Advancing Pathology, have previously provided roadmaps or suggestions on how to best improve pathology services in SSA.[3,5,7] Recommendations have included conducting situational analyses to determine the current state of pathology practices and to gain a better understanding of the existing capacity, resources, and infrastructure.[3] Additional proposals include interventions that introduce or bolster governance and regulatory frameworks to support quality, provide additional training to increase the number of skilled pathology personnel, and increased investment in pathology infrastructure,

including establishing reliable supply chains, specimen transport processes, specimen reporting, and archiving.[3,5,7–9]

To help better inform future guidelines and interventions, a rigorous review of the literature is needed to give an overview of the extent and range of the available pathology capacity across SSA, including strategies to improve anatomic pathology services as well as descriptions of the most common barriers and gaps of prior interventions and their short term and long term implementation and service outcomes.[10,11] This review will focus on anatomic pathology services, which is defined as examinations of organs and tissues for the purpose of diagnosing cancer, and includes tests such as histopathology, immunohistochemistry, molecular assays, and flow cytometry, among others. While clinical pathology services, such as clinical chemistry and microbiology, are related and critical to cancer care, the challenges, gaps in practice, and interventions to address those gaps may be markedly different than those seen in anatomic pathology. A preliminary search of MEDLINE and PROSPERO was conducted, and no other scoping reviews on the topic were identified as in progress. Overall, the data on successful capacity-building interventions in particular have not been well-described. Therefore, this scoping review will provide insight into the current state of pathology services for cancer care in SSA, as well as previously tested capacity-building interventions and their outcomes.

METHODS AND ANALYSIS

The proposed scoping review will be conducted in accordance with Joanna Briggs Institute (JBI) methodology for scoping reviews and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR).[12,13] The

protocol was registered on the Open Science Framework (<https://osf.io/6cmhg>). The study is planned to begin in January 2024 and is planned to end by December 2024.

Review questions

What interventions have been implemented to improve anatomic pathology services in SSA?

The following sub-questions will be addressed:

1. What is the documented state of anatomic pathology services in SSA?
2. What are the primary gaps in anatomic pathology services in SSA?
3. What interventions have been tested in SSA, their implementation strategies, and their outcomes?
4. What were the contexts, barriers, and facilitators of these interventions?

Inclusion criteria

Participants

The review will focus on interventions to improve anatomic pathology services, including interventions targeting individual-, organizational-, or system-level changes. Therefore, the range in participants may be broad and may include healthcare providers--including laboratory staff--hospital administrators, and ministries of health. Interventions that do not specifically focus on improving the anatomic pathology laboratory in sub-Saharan Africa will be excluded.

Concept

Interventions that explicitly aimed to improve tissue-based cancer diagnostic services and laboratories in SSA will be included in the analysis. Efforts that included pathology services but did not specifically aim to improve diagnostic pathology services for patient care, such as cancer control plans, screening programs, or the development of laboratories exclusively for research, will be excluded. Initiatives which aimed to improve clinical pathology services

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2
3 will also be excluded. Clinical pathology services include the fields of blood banking,
4
5 microbiology, hematology, and clinical chemistry and typically perform tests on body fluids.
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8 **Context**

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10 Studies that focus on anatomic pathology services, such as infrastructure, workflows,
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12 diagnostic assays, personnel, supply chains, and quality assurance/quality improvement
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14 initiatives, such as laboratory accreditation programs, will be included. We will consider
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16 studies done in SSA and those that target capacity-building for anatomic pathology services
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18 in SSA.
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21 **Types of sources**

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23 Articles will be identified through a comprehensive search of electronic databases and
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25 reference scanning of relevant studies. All study designs will be considered, including
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27 quantitative, qualitative, and/or mixed methods studies. Reviews of the scientific literature,
28
29 such as scoping and systematic reviews, will also be included. Opinion pieces (e.g.,
30
31 editorials, commentaries, letters to the editor) and document reviews will be excluded. In all
32
33 databases, results will be limited to items in English and Portuguese, which are the languages
34
35 that the review teams are fluent in. No limitations will be placed on date or publication type.
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40 **Search strategy**

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42 The search strategy will aim to identify published studies. An initial limited search of Ovid
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44 Medline ALL and was undertaken to identify articles on the topic.
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47 A medical librarian (JG) will design the scoping review search in Ovid Medline ALL.
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49 Subject headers and keywords reflecting three topics—pathology, SSA, and capacity-
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51 building—were combined using Boolean and adjacency operators. A second librarian will
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53 perform a PRESS review of the search, which will then translate to Embase (Elsevier) and
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55 Cochrane Central Register of Controlled Trials (Wiley) with the help of the Systematic
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57 Review Accelerator's Polyglot Tool.[14,15] In Medline and Embase, the Cochrane filter for
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human studies will be utilized.[16] A simplified version of the search, using only keywords relating to pathology, will be developed in African Index Medicus (<https://search.bvvsalud.org/aimafro/>). View the complete search strategies for all databases in Appendix 1. The reference list of all included sources of evidence will be screened for additional studies.

Study/Source of evidence selection

Following the search, all identified citations will be imported into the systematic review management tool Covidence (Veritas Health Innovation, Melbourne, Australia), which will remove duplicates. Titles and abstracts will then be screened by 2 independent reviewers for assessment against the inclusion criteria for the review. Potentially relevant sources will be retrieved in full, with citation details imported into Covidence. The full text of selected citations will be assessed in detail against the inclusion criteria by 2 independent reviewers. Reasons for exclusion of sources of evidence at full text that do not meet the inclusion criteria will be recorded and reported in the scoping review. Any disagreements that arise between the reviewers at each stage of the selection process will be adjudicated by a third reviewer and/or further discussion among the review team. The results of the search and the study inclusion process will be reported in full in the final scoping review and presented in a PRISMA-ScR flow diagram. [12]

Data extraction

Two independent reviewers will extract data from relevant articles using a data extraction tool developed by the review team. A draft data extraction form is presented in Appendix 2. The initial draft of the data extraction tool is based on the tool developed by Ashoor, et al. and Proctor's framework on implementation research outcomes. [10,17]

The data extraction tool will be modified and revised as needed during the data extraction process. Modifications will be detailed in the scoping review. Any disagreements that arise

between the reviewers will be resolved through discussion or with a third reviewer. Where required, authors of papers will be contacted to request missing or additional data.

Data analysis and presentation

The data extracted from each included article will be presented in a tabular or diagrammatic format. Descriptive frequencies, counts, and thematic analysis will be included along with the tabulated results and will describe how the results relate to the objectives of the review. Gaps in the literature, effective implementation strategies, and areas of further research in how to effectively improve pathology services in SSA will be identified.

Patient and public involvement

There will be no patient or public involvement in this study.

ETHICS AND DISSEMINATION

Ethical approval is not required for the planned scoping review. All data will be obtained from publicly available documents, and no primary data will be generated. The findings from this work includes publication of the results in a peer-reviewed journal and presentations at conferences.

FUNDING

Members of the research team receive support from the Fogarty International Center and National Cancer Institute Award Number D43TW011598 (AHK, EJM, KVL), the NCI Award Number K08CA263299 (DLN); Cancer Center Support Grant (P30 CA008748) and from the University of California, San Francisco (UCSF) Helen Diller Family Comprehensive Cancer Center (BPM, ZI, PMI, KVL). The content is solely the responsibility of the authors and does not necessarily represent the official views of the U.S. National Institutes of Health.

AUTHOR CONTRIBUTIONS

All authors conceptualized and designed on the review. DLN wrote the protocol. All authors were involved in the review and editing of the manuscript. JG developed the search. All authors read the manuscript and agree to its contents.

COMPETING INTERESTS

The authors have no conflicts of interest to disclose.

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APPENDIX

Appendix 1: Search strategy

Ovid Medline ALL

1	exp "Clinical Laboratory Services"/ or "Clinical Laboratory Techniques"/ or Cytodiagnosis/ or Decalcification technique/ or exp Dissection/ or Fluorescent antibody technique/ or Fluorescent antibody technique, direct/ or Fluorescent antibody technique, indirect/ or Histochemistry/ or Histocytological preparation techniques/ or Histological techniques/ or Immunohistochemistry/ or In situ hybridization, fluorescence/ or exp Laboratories/ or Lymph node ratio/ or exp "Medical Laboratory Personnel"/ or Microdissection/ or exp microtomy/ or exp molecular diagnostic techniques/ or Neuropathology/ or exp Pathologists/ or Pathology/ or exp "Pathology, Clinical"/ or "Pathology, Molecular"/ or "Pathology, Surgical"/ or periodic acid-schiff reaction/ or prussian blue reaction/ or silver staining/ or specimen handling/ or "staining and labeling"/ or Telepathology/ or exp tissue embedding/ or tissue fixation/ or tissue preservation/ or Acid-Schiff*.ti,ab,kf. or Antigen retrieval*.ti,ab,kf. or Clinicopathology.ti,ab,kf. or Clinico-pathology.ti,ab,kf. or Clinicopathologist*.ti,ab,kf. or Cryomicrotom*.ti,ab,kf. or Cytochemist*.ti,ab,kf. or Cyto-chemist*.ti,ab,kf. or Cytodiagnos*.ti,ab,kf. or Cyto-diagnos*.ti,ab,kf. or Cytology.ti,ab,kf. or Cytologist*.ti,ab,kf. or Cytopathology.ti,ab,kf. or Cyto-pathology.ti,ab,kf. or Cytopathologist*.ti,ab,kf. or Decalcification.ti,ab,kf. or De-calcification.ti,ab,kf. or Diagnostic facility.ti,ab,kf. or Diagnostic facilities.ti,ab,kf. or Fluorescent Antibody Technique*.ti,ab,kf. or Histochemist*.ti,ab,kf. or Histo-chemist*.ti,ab,kf. or Histochemistry*.ti,ab,kf. or Histo-cytochemist*.ti,ab,kf. or Histocytolog*.ti,ab,kf. or Histologist*.ti,ab,kf. or Histopathology.ti,ab,kf. or Histo-pathology.ti,ab,kf. or Histopathologist*.ti,ab,kf. or Histotechnolog*.ti,ab,kf. or Histo-technolog*.ti,ab,kf. or Immunochemist*.ti,ab,kf. or Immuno-chemist*.ti,ab,kf. or Immunocytochemist*.ti,ab,kf. or Immunohistochemist*.ti,ab,kf. or Immunohistolog*.ti,ab,kf. or Immuno-histolog*.ti,ab,kf. or Immunoperoxidase.ti,ab,kf. or Immuno-peroxidase.ti,ab,kf. or Immunophosphatase.ti,ab,kf. or Immuno-phosphatase.ti,ab,kf. or LNR.ti,ab,kf. or LNRS.ti,ab,kf. or Lymph* node* ratio*.ti,ab,kf. or Medical technologist*.ti,ab,kf. or Microdissect*.ti,ab,kf. or Micro-dissect*.ti,ab,kf. or Microsection*.ti,ab,kf. or Micro-section*.ti,ab,kf. or Microtome*.ti,ab,kf. or Microtomy.ti,ab,kf. or Molecular diagnos*.ti,ab,kf. or Neuropathology.ti,ab,kf. or Neuro-pathology.ti,ab,kf. or Neuropathologist*.ti,ab,kf. or Oncopathology.ti,ab,kf. or Onco-pathology.ti,ab,kf. or Oncopathologist*.ti,ab,kf. or Pathologist*.ti,ab,kf. or Paraffin* Embedd*.ti,ab,kf. or Prussian Blue.ti,ab,kf. or Silver Stain*.ti,ab,kf. or Telepat hol*.ti,ab,kf.
2	((Lab or Labs or Laborator*) adj3 (Clinic* or Diagnos* or Facility or Facilities or Health* or Medical or Medicine or Network* or Professional* or Report* or Result or Results or Service* or System or Systems)).ti,ab,kf.

3	((Biopsy or Biopsies or Section or Sections or Smear* or Specimen* or Tissue*) adj2 (Affix* or Embed* or Fixat* or Frozen or Gross or Handl* or Microarray* or Microarray* or Preparation* or Prepare* or Prepared or Preserv* or React* or Stain* or Technique* or Test or Tests or Tested or Testing)).ti,ab,kf.
4	((Histology or Pathology) adj2 (Anatomic* or Center or Centers or Centre or Centres or Clinical or Department* or Diagnos* or Digital* or Education* or Facility or Facilities or General* or Lab or Labs or Laborator* or Medical or Molecular or Network* or Personnel* or Profession* or Program* or Report* or Result or Results or Service* or Tech or Technician* or Train* or Unit*)).ti,ab,kf.
5	((Histology or Lab or Labs or Laborator* or Pathology) adj (Assistant* or Attending* or Personnel* or Scientist* or Tech or Techs or Technician* or Staff)).ti,ab,kf.
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7	Africa/ or African People/ or exp "Africa South of the Sahara"/ or "Mauritius"/ or "Reunion"/ or exp "Sub-Saharan African People"/ or Angola*.ti,ab,kf,cp,ia. or Basotho*.ti,ab,kf. or Benin*.ti,ab,kf,cp,ia. or Bissau*.ti,ab,kf,cp,ia. or Botswana*.ti,ab,kf,cp,ia. or Burkina*.ti,ab,kf,cp,ia. or Burundi*.ti,ab,kf,cp,ia. or Cameroon*.ti,ab,kf,cp,ia. or Cabo Verde*.ti,ab,kf,cp,ia. or Cape Verde*.ti,ab,kf,cp,ia. or Central Africa*.ti,ab,kf,cp,ia. or Chad.ti,ab,kf,cp,ia. or Chadian*.ti,ab,kf. or Comorian*.ti,ab,kf. or Comoros.ti,ab,kf,cp,ia. or Congan*.ti,ab,kf. or Congo.ti,ab,kf,cp,ia. or Congolese.ti,ab,kf. or Cote d'Ivoire*.ti,ab,kf,cp,ia. or Djibouti*.ti,ab,kf,cp,ia. or East* Africa*.ti,ab,kf. or Equatoguinean*.ti,ab,kf. or Eritrea*.ti,ab,kf,cp,ia. or Eswatini*.ti,ab,kf,cp,ia. or Ethiopia*.ti,ab,kf,cp,ia. or Gabon*.ti,ab,kf,cp,ia. or Gambia.ti,ab,kf,cp,ia. or Gambian*.ti,ab,kf,cp,ia. or Ghana*.ti,ab,kf,cp,ia. or Guinea*.ti,ab,kf,cp,ia. or Ivorian*.ti,ab,kf. or Ivory Coast*.ti,ab,kf,cp,ia. or Kenya*.ti,ab,kf,cp,ia. or Lesotho*.ti,ab,kf,cp,ia. or Liberia*.ti,ab,kf,cp,ia. or Madagascas*.ti,ab,kf,cp,ia. or Mahore*.ti,ab,kf,cp,ia. or Malawi*.ti,ab,kf,cp,ia. or Mali.ti,ab,kf,cp,ia. or Malian*.ti,ab,kf. or Mauritania*.ti,ab,kf,cp,ia. or Mauriti*.ti,ab,kf,cp,ia. or Mayotte*.ti,ab,kf,cp,ia. or Mosotho*.ti,ab,kf. or Mozambi*.ti,ab,kf,cp,ia. or Namibia*.ti,ab,kf,cp,ia. or Niger*.ti,ab,kf,cp,ia. or (Nonmediterranean adj2 Africa*).ti,ab,kf. or (Non-Mediterranean adj2 Africa*).ti,ab,kf. or (Reunion adj2 (Department or Island or Region)).ti,ab,kf,cp,ia. or Reunionese.ti,ab,kf. or Rwanda*.ti,ab,kf,cp,ia. or Sahara.ti,ab,kf,cp,ia. or Saharan.ti,ab,kf,cp,ia. or Sahel*.ti,ab,kf. or Santomean*.ti,ab,kf. or (Sao Tome adj Principe*).ti,ab,kf,cp,ia. or Senegal*.ti,ab,kf,cp,ia. or Seychell*.ti,ab,kf,cp,ia. or Sierra Leone*.ti,ab,kf,cp,ia. or Somali*.ti,ab,kf,cp,ia. or South* Africa*.ti,ab,kf,cp,ia. or Subsahara*.ti,ab,kf,cp,ia. or Sudan*.ti,ab,kf,cp,ia. or Swaziland*.ti,ab,kf,cp,ia. or Tanzania*.ti,ab,kf,cp,ia. or Togo*.ti,ab,kf,cp,ia. or Uganda*.ti,ab,kf,cp,ia. or West* Africa*.ti,ab,kf. or Zambia*.ti,ab,kf,cp,ia. or Zimbabwe*.ti,ab,kf,cp,ia.
8	exp "Capacity Building"/ or "Cost-Effectiveness Analysis"/ or "Delayed Diagnosis"/ or exp "Education, Distance"/ or exp "Education, Professional"/ or "Financing, Organized"/ or "Financing, Government"/ or "Health Impact Assessment"/ or exp "Inservice Training"/ or exp "International Educational Exchange"/ or "Mentoring"/ or "Mentors"/ or "Needs Assessment"/ or exp "Professional Competence"/ or exp "Program Development"/

	or exp "Program Evaluation"/ or "Quality of Health Care"/ or "Quality Improvement"/ or "Quality Indicators, Health Care"/ or "Strategic Planning"/ or "Telepathology"/ or "Workflow"/ or exp "Workforce"/ or "Workload"/ or Benchmark*.ti,ab,kf. or Bench mark*.ti,ab,kf. or (Diagnos* adj2 (Delay* or Speed or Timely)).ti,ab,kf. or Infrastructur*.ti,ab,kf. or Infra-structur*.ti,ab,kf. or Mentor*.ti,ab,kf. or Mentee*.ti,ab,kf. or Needs assess*.ti,ab,kf. or (Need* adj2 (Meet* or Met or Unmet)).ti,ab,kf. or Professional Development.ti,ab,kf. or Self-sufficien*.ti,ab,kf. or Self-support*.ti,ab,kf. or Strategic plan*.ti,ab,kf. or Syllabi.ti,ab,kf. or Syllabus*.ti,ab,kf. or Telecytol*.ti,ab,kf. or Tele-cytol*.ti,ab,kf. or Telemed*.ti,ab,kf. or Tele-med*.ti,ab,kf. or Telepathol*.ti,ab,kf. or Tele-pathol*.ti,ab,kf. or Turnaround*.ti,ab,kf. or Turn-around*.ti,ab,kf. or Wait time*.ti,ab,kf. or Workaround*.ti,ab,kf. or Work around*.ti,ab,kf. or Workflow*.ti,ab,kf. or Work flow*.ti,ab,kf. or Workload*.ti,ab,kf. or Work load*.ti,ab,kf.
9	((Advisor* or Capacit* or Coalition* or Facility or Facilities or Financ* or Fund or Funded or Funding or Funds or Intercontinent* or Inter-continent* or Intergovernment* or Inter-government* or Institution* or International* or Laborator* or Leader* or Monetary or National* or Pathology or Personnel* or Program* or Regional* or Service* or Technician* or Work force* or Workforce* or Workgroup* or Work group* or Working group*) adj3 (Access or Accredite* or Adequa* or Availab* or Barrier* or Build* or Built or Capabil* or Capabl* or Credential* or Centralis* or Centraliz* or Coach* or Competen* or Decentrali* or Discrepen* or Disincentiv* or Efficien* or Enhanc* or Equipp* or Equip* or Expand* or Expansion* or Framework* or Frame work* or Impact* or Implement* or Improve* or Improving or Inadequa* or Incentiv* or Inefficien* or Initiativ* or Innovat* or Insufficient* or Limited* or Network or Networks or Optimisa* or Optimise* or Optimisi* or Optimiz* or Outreach* or Partner* or Performance* or Rebuil* or Reenhanc* or Reimplement* or Reimprov* or Reform* or Reinnovat* or Reorganis* or Reorganiz* or Rescale* or Rescaling or Resource* or Restrengthen* or Restructure* or Retain* or Retention or Scal* up or Shortage* or Shortcoming* or Short-coming* or Strengthen* or Sufficient* or Success* or Sustain* or Unsuccess* or Uptake*)).ti,ab,kf.
10	((Lab or Labs or Laborator* or Facility or Facilities or Histology or Histologist* or Pathology or Pathologist*) adj2 (Capacit* or Establish* or Knowledge or Reestablish* or Remote* or Skill* or Virtual* or Quality)).ti,ab,kf.
11	((Documentation or Report* or Form or Forms) adj3 (Appropriate* or Complet* or Correct or Error* or Incorrect or Inappropriat* or Incomplete* or Insufficient or Nonstandard* or Quality or Sufficient or Standard*)).ti,ab,kf.
12	((Class or Classes or Course* or Curricul* or Didactic or Educat* or Lecture* or Learn* or Module* or Pedagog* or Practicum* or Seminar* or Teach* or Train* or Tutorial* or Workshop* or Work shop*) adj3 (Asynchronous or Competenc* or Distance or Global or Hands-on or In-country or In-person or Inperson or Inservice or In-service or International or Local or Online or Onsite or On-site or Outreach* or Patholog* or Professional or Program* or Regional or Synchronous or Vocational)).ti,ab,kf.
13	or/8-12

14	6 and 7 and 13
15	14 and (English or Portuguese).lg.
16	15 not (exp animals/ not humans.sh.)
17	remove duplicates from 16

Embase (Elsevier)

'antigen retrieval'/de OR 'aspiration cytology'/de OR 'brain histology'/de OR 'cancer cytodiagnosis'/de OR 'cancer detection kit'/exp OR 'cancer prognostic test kit'/exp OR 'clinical laboratory personnel'/de OR 'clinical laboratory service'/de OR 'cytochemistry'/exp OR 'cytodiagnosis'/de OR 'cytology'/de OR 'cytopathology'/de OR 'cytometry'/de OR 'digital pathology'/de OR 'direct fluorescent antibody technique'/de OR 'dna microarray kit'/exp OR 'embedding'/exp OR 'fluorescence histochemistry'/de OR 'fluorescence in situ hybridization'/de OR 'fluorescence in situ hybridization kit'/exp OR 'fluorescent antibody technique'/de OR 'frozen section'/de OR 'general pathology'/de OR 'histological techniques equipment and supplies'/de OR 'immunocytochemistry'/de OR 'immunohistochemistry'/de OR 'immunohistology'/de OR 'immunoperoxidase staining'/de OR 'immunophosphatase technique'/de OR 'indirect fluorescent antibody technique'/de OR 'laboratory'/exp OR 'laboratory technique'/de OR 'lymph node ratio'/de OR 'microdissection'/de OR 'microtomy'/exp OR 'molecular diagnostics'/de OR 'molecular pathology'/de OR 'neuropathology'/de OR 'pathological anatomy'/de OR 'pathologist'/exp OR 'pathology'/de OR 'periodic acid-schiff stain'/de OR 'prussian blue staining'/de OR 'silver staining'/de OR 'specimen handling'/de OR 'staining'/de OR 'telepathology'/de OR 'tissue embedding'/exp OR 'tissue fixation'/de OR 'tissue preservation'/de OR 'tissue microarray'/de OR 'uterine cervix cytology'/de OR 'vagina cytology'/de OR 'acid-schiff*':ti,ab,kw OR 'antigen retrieval*':ti,ab,kw OR clinicopathology:ti,ab,kw OR 'clunico pathology':ti,ab,kw OR clinicopathologist*:ti,ab,kw OR cryomicrotom*:ti,ab,kw OR cytochemist*:ti,ab,kw OR 'cyto chemist*':ti,ab,kw OR cytodiagnos*:ti,ab,kw OR 'cyto diagnos*':ti,ab,kw OR cytology:ti,ab,kw OR cytologist*:ti,ab,kw OR cytopathology:ti,ab,kw OR 'cyto pathology':ti,ab,kw OR cytopathologist*:ti,ab,kw OR decalcification:ti,ab,kw OR 'de calcification':ti,ab,kw OR 'diagnostic facility':ti,ab,kw OR 'diagnostic facilities':ti,ab,kw OR 'fluorescent antibody technique*':ti,ab,kw OR histochemist*:ti,ab,kw OR 'histo chemist*':ti,ab,kw OR histocytochemist*:ti,ab,kw OR 'histo cytochemist*':ti,ab,kw OR histocytolog*:ti,ab,kw OR histologist*:ti,ab,kw OR histopathology:ti,ab,kw OR 'histo pathology':ti,ab,kw OR histopathologist*:ti,ab,kw OR histotechnolog*:ti,ab,kw OR 'histo technolog*':ti,ab,kw OR immunochemist*:ti,ab,kw OR 'immuno chemist*':ti,ab,kw OR immunocytochemist*:ti,ab,kw OR immunohistochemist*:ti,ab,kw OR immunohistolog*:ti,ab,kw OR 'immuno histolog*':ti,ab,kw OR immunoperoxidase:ti,ab,kw OR 'immuno peroxidase':ti,ab,kw OR immunophosphatase:ti,ab,kw OR 'immuno phosphatase':ti,ab,kw OR lnr:ti,ab,kw OR lnr:ti,ab,kw OR 'lymph* node* ratio*':ti,ab,kw OR 'medical technologist*':ti,ab,kw OR
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	microdissect*:ti,ab,kw OR 'micro dissect*:ti,ab,kw OR microsection*:ti,ab,kw OR 'micro section*:ti,ab,kw OR microtome*:ti,ab,kw OR microtomy:ti,ab,kw OR 'molecular diagnos*:ti,ab,kw OR neuropathology:ti,ab,kw OR 'neuro pathology':ti,ab,kw OR neuropathologist*:ti,ab,kw OR oncopathology:ti,ab,kw OR 'onco pathology':ti,ab,kw OR oncopathologist*:ti,ab,kw OR pathologist*:ti,ab,kw OR 'paraffin* embedd*:ti,ab,kw OR 'prussian blue':ti,ab,kw OR 'silver stain*:ti,ab,kw OR telepathol*:ti,ab,kw OR 'tele pathol*:ti,ab,kw
2	((lab OR labs OR laborator*) NEAR/3 (clinic* OR diagnos* OR facility OR facilities OR health* OR medical OR medicine OR network* OR professional* OR report* OR result OR results OR service* OR system OR systems)):ti,ab,kw
3	((biopsy OR biopsies OR section OR sections OR smear* OR specimen* OR tissue*) NEAR/2 (affix* OR embed* OR fixat* OR frozen OR gross OR handl* OR microarray* OR 'micro array*' OR preparation* OR prepare* OR prepared OR preserv* OR react* OR stain* OR technique* OR test OR tests OR tested OR testing)):ti,ab,kw
4	((histology OR pathology) NEAR/2 (anatomic* OR center OR centers OR centre OR centres OR clinical OR department* OR diagnos* OR digital* OR education* OR facility OR facilities OR general* OR lab OR labs OR laborator* OR medical OR molecular OR network* OR personnel* OR profession* OR program* OR report* OR result OR results OR service* OR tech OR technician* OR train* OR unit*)):ti,ab,kw
5	((histology OR lab OR labs OR laborator* OR pathology) NEXT/1 (assistant* OR attending* OR personnel* OR scientist* OR tech OR techs OR technician* OR staff)):ti,ab,kw
6	#1 or #2 or #3 or #4 or #5
7	'africa'/de OR 'african'/de OR 'africa south of the sahara'/exp OR 'mauritania'/de OR 'mauritiu s'/de OR 'reunion'/de OR 'sao tome and principe'/de OR 'seychelles'/de OR 'sub-saharan african'/exp OR angola*:ti,ab,kw,ca,cy OR basotho*:ti,ab,kw OR benin*:ti,ab,kw,ca,cy OR bissau*:ti,ab,kw,ca,cy OR botswana*:ti,ab,kw,ca,cy OR burkina*:ti,ab,kw,ca,cy OR burundi*:ti,ab,kw,ca,cy OR cameroon*:ti,ab,kw,ca,cy OR 'cabo verde*:ti,ab,kw,ca,cy OR 'cape verde*:ti,ab,kw,ca,cy OR 'central africa*:ti,ab,kw,ca,cy OR chad:ti,ab,kw,ca,cy OR chadian*:ti,ab,kw OR comorian*:ti,ab,kw OR comoros:ti,ab,kw,ca,cy OR congan*:ti,ab,kw OR congo:ti,ab,kw,ca,cy OR congolese:ti,ab,kw OR 'cote divoire*:ti,ab,kw,ca,cy OR djibouti*:ti,ab,kw,ca,cy OR 'east* africa*:ti,ab,kw OR equatoguinean*:ti,ab,kw OR eritrea*:ti,ab,kw,ca,cy OR eswatini*:ti,ab,kw,ca,cy OR ethiopia*:ti,ab,kw,ca,cy OR gabon*:ti,ab,kw,ca,cy OR gambia:ti,ab,kw,ca,cy OR gambian*:ti,ab,kw,ca,cy OR ghana*:ti,ab,kw,ca,cy OR guinea*:ti,ab,kw,ca,cy OR ivorian*:ti,ab,kw OR 'ivory coast*:ti,ab,kw,ca,cy OR kenya*:ti,ab,kw,ca,cy OR lesotho*:ti,ab,kw,ca,cy OR liberia*:ti,ab,kw,ca,cy OR madagasca*:ti,ab,kw,ca,cy OR mahore*:ti,ab,kw,ca,cy OR malawi*:ti,ab,kw,ca,cy OR mali:ti,ab,kw,ca,cy OR malian*:ti,ab,kw OR mauritania*:ti,ab,kw,ca,cy OR mauriti*:ti,ab,kw,ca,cy OR mayotte*:ti,ab,kw,ca,cy OR mosotho*:ti,ab,kw OR mozambi*:ti,ab,kw,ca,cy OR namibia*:ti,ab,kw,ca,cy OR niger*:ti,ab,kw,ca,cy OR ((nonmediterranean NEAR/2 africa*):ti,ab,kw) OR (('non

	mediterranean' NEAR/2 africa*):ti,ab,kw) OR ((reunion NEAR/2 (department OR island OR region)):ti,ab,kw,ca,cy) OR reunionese:ti,ab,kw OR rwanda*:ti,ab,kw,ca,cy OR sahara*:ti,ab,kw,ca,cy OR sahel*:ti,ab,kw OR santomean*:ti,ab,kw OR (('sao tome' NEXT/1 principe*):ti,ab,kw,ca,cy) OR senegal*:ti,ab,kw,ca,cy OR seychell*:ti,ab,kw,ca,cy OR 'sierra leone*':ti,ab,kw,ca,cy OR somali*:ti,ab,kw,ca,cy OR 'south* africa*':ti,ab,kw,ca,cy OR subsahara*:ti,ab,kw,ca,cy OR sudan*:ti,ab,kw,ca,cy OR swaziland*:ti,ab,kw,ca,cy OR tanzania*:ti,ab,kw,ca,cy OR togo*:ti,ab,kw,ca,cy OR uganda*:ti,ab,kw,ca,cy OR 'west* africa*':ti,ab,kw OR zambia*:ti,ab,kw,ca,cy OR zimbabwe*:ti,ab,kw,ca,cy
8	'benchmark'/de OR 'benchmarking'/exp OR 'capacity'/exp OR 'capacity building'/exp OR 'clinical competence'/de OR 'cost effectiveness analysis'/de OR 'delayed diagnosis'/exp OR 'distance learning'/exp OR 'financial management'/de OR 'health impact assessment'/de OR 'in service training'/de OR 'international cooperation'/de OR 'international relations'/exp OR 'mentor'/de OR 'mentoring'/exp OR 'needs assessment'/de OR 'outreach program'/de OR 'performance measurement system'/de OR 'personnel shortage'/exp OR 'professional competence'/de OR 'professional development'/exp OR 'program development'/de OR 'program evaluation'/exp OR 'public expenditure'/de OR 'public finance'/de OR 'quality indicator'/de OR 'strategic planning'/de OR 'telepathology'/de OR 'total quality management'/de OR 'turnaround time'/de OR 'vocational education'/exp OR 'wait time'/de OR 'workflow'/de OR 'workforce'/exp OR 'workload'/de OR benchmark*:ti,ab,kw OR 'bench mark*':ti,ab,kw OR ((diagnos* NEAR/2 (delay* OR speed OR timely)):ti,ab,kw) OR infrastructur*:ti,ab,kw OR 'infra structur*':ti,ab,kw OR mentor*:ti,ab,kw OR mentee*:ti,ab,kw OR 'needs assess*':ti,ab,kw OR ((need* NEAR/2 (meet* OR met OR unmet)):ti,ab,kw) OR 'professional development':ti,ab,kw OR 'self sufficien*':ti,ab,kw OR 'self support*':ti,ab,kw OR 'strategic plan*':ti,ab,kw OR syllabi:ti,ab,kw OR syllabus*:ti,ab,kw OR telecytol*:ti,ab,kw OR 'tele cytol*':ti,ab,kw OR telemed*:ti,ab,kw OR 'tele med*':ti,ab,kw OR telepathol*:ti,ab,kw OR 'tele pathol*':ti,ab,kw OR turnaround*:ti,ab,kw OR 'turn around*':ti,ab,kw OR 'wait time*':ti,ab,kw OR workaround*:ti,ab,kw OR 'work around*':ti,ab,kw OR workflow*:ti,ab,kw OR 'work flow*':ti,ab,kw OR workload*:ti,ab,kw OR 'work load*':ti,ab,kw
9	((advisor* OR capacit* OR coalition* OR facility OR facilities OR financ* OR fund OR funded OR funding OR funds OR intercontinent* OR 'inter continent*' OR intergovernment* OR 'inter government*' OR institution* OR international* OR laborator* OR leader* OR monetary OR national* OR pathology OR personnel* OR program* OR regional* OR service* OR technician* OR 'work force*' OR workforce* OR workgroup* OR 'work group*' OR 'working group*') NEAR/3 (access OR accredit* OR adequa* OR availab* OR barrier* OR build* OR built OR capabil* OR capabl* OR credential* OR centralis* OR centraliz* OR coach* OR competen* OR decentrali* OR discrepen* OR disincentiv* OR efficien* OR enhanc* OR equipp* OR equipt* OR expand* OR expansion* OR framework* OR 'frame work*' OR impact* OR implement* OR improve* OR improving OR inadequa* OR incentiv* OR inefficien* OR initiativ* OR innovat* OR insufficient* OR limited* OR network OR networks OR optimisa* OR optimise* OR optimisi* OR optimiz* OR outreach* OR partner* OR performance* OR rebuil* OR reenhanc* OR reimplement* OR reimprov* OR reform* OR reinnovat* OR

	reorganis* OR reorganiz* OR rescale* OR rescaling OR resource* OR restrengthen* OR restructure* OR retain* OR retention OR 'scal* up' OR shortage* OR shortcoming* OR 'short coming*' OR strengthen* OR sufficient* OR success* OR sustain* OR unsuccessful* OR uptake*)):ti,ab,kw
10	((lab OR labs OR laborator* OR facility OR facilities OR histology OR histologist* OR pathology OR pathologist*) NEAR/2 (capacit* OR establish* OR knowledge OR reestablish* OR remote* OR skill* OR virtual* OR quality)):ti,ab,kw
11	((documentation OR report* OR form OR forms) NEAR/3 (appropriate* OR complet* OR correct OR error* OR incorrect OR inappropriat* OR incomplete* OR insufficient OR nonstandard* OR quality OR sufficient OR standard*)):ti,ab,kw
12	((class OR classes OR course* OR curricul* OR didactic OR educat* OR lecture* OR learn* OR module* OR pedagog* OR practicum* OR seminar* OR teach* OR train* OR tutorial* OR workshop* OR 'work shop*') NEAR/3 (asynchronous OR competenc* OR distance OR global OR 'hands on' OR 'in country' OR 'in person' OR inperson OR inservice OR 'in service' OR international OR local OR online OR onsite OR 'on site' OR outreach* OR patholog* OR professional OR program* OR regional OR synchronous OR vocational)):ti,ab,kw
13	#8 OR #9 OR #10 OR #11 OR #12
14	#6 AND #7 AND #13
15	#14 AND ([english]/lim OR [portuguese]/lim)
16	#15 NOT ([animals]/lim NOT [humans]/lim)

Cochrane Central Register of Controlled Trials (Wiley)

1	(Acid-Schiff* OR (Antigen NEXT retrieval*) OR Clinicopathology OR Clinico-pathology OR Clinicopathologist* OR Cryomicrotom* OR Cytochemist* OR Cyto-chemist* OR Cytodiagnos* OR Cyto-diagnos* OR Cytology OR Cytologist* OR Cytopathology OR Cyto-pathology OR Cytopathologist* OR Decalcification OR De-calcification OR "Diagnostic facility" OR "Diagnostic facilities" OR ("Fluorescent Antibody" NEXT Technique*) OR Histochemist* OR Histo-chemist* OR Histocytochemist* OR Histo-cytochemist* OR Histocytolog* OR Histologist* OR Histopathology OR Histo-pathology OR Histopathologist* OR Histotechnolog* OR Histo-technolog* OR Immunochemist* OR Immuno-chemist* OR Immunocytochemist* OR Immunohistochemist* OR Immunohistolog* OR Immuno-histolog* OR Immunoperoxidase OR Immuno-peroxidase OR Immunophosphatase OR Immuno-phosphatase OR LNR OR LNRs OR (Lymph* NEXT node* NEXT ratio*) OR (Medical NEXT technologist*) OR Microdissect* OR Micro-dissect* OR Microsection* OR Micro-section* OR Microtome* OR Microtomy OR (Molecular NEXT diagnos*) OR Neuropathology OR Neuro-pathology OR Neuropathologist* OR Oncopathology OR
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	Onco-pathology OR Oncopathologist* OR Pathologist* OR (Paraffin* NEXT Embedd*) OR "Prussian Blue" OR (Silver NEXT Stain*) OR Telepathol* OR Tele-pathol*):ti,ab,kw
2	((Lab OR Labs OR Laborator*) NEAR/3 (Clinic* OR Diagnos* OR Facility OR Facilities OR Health* OR Medical OR Medicine OR Network* OR Professional* OR Report* OR Result OR Results OR Service* OR System OR Systems)):ti,ab,kw
3	((Biopsy OR Biopsies OR Section OR Sections OR Smear* OR Specimen* OR Tissue*) NEAR/2 (Affix* OR Embed* OR Fixat* OR Frozen OR Gross OR Handl* OR Microarray* OR Micro-array* OR Preparation* OR Prepare* OR Prepared OR Preserv* OR React* OR Stain* OR Technique* OR Test OR Tests OR Tested OR Testing)):ti,ab,kw
4	((Histology OR Pathology) NEAR/2 (Anatomic* OR Center OR Centers OR Centre OR Centres OR Clinical OR Department* OR Diagnos* OR Digital* OR Education* OR Facility OR Facilities OR General* OR Lab OR Labs OR Laborator* OR Medical OR Molecular OR Network* OR Personnel* OR Profession* OR Program* OR Report* OR Result OR Results OR Service* OR Tech OR Technician* OR Train* OR Unit*)):ti,ab,kw
5	((Histology OR Lab OR Labs OR Laborator* OR Pathology) NEXT (Assistant* OR Attending* OR Personnel* OR Scientist* OR Tech OR Techs OR Technician* OR Staff)):ti,ab,kw
6	#1 OR #2 OR #3 OR #4 OR #5
7	(Angola* OR Basotho* OR Benin* OR Bissau* OR Botswana* OR Burkina* OR Burundi* OR Cameroon* OR ((Cabo OR Cape) NEXT Verde*) OR (Central NEXT Africa*) OR Chad OR Chadian* OR Comorian* OR Comoros OR Congan* OR Congo OR Congolese OR (Cote NEXT dIvoire*) OR Djibouti* OR (East* NEXT Africa*) OR Equatoguinean* OR Eritrea* OR Eswatini* OR Ethiopia* OR Gabon* OR Gambia OR Gambian* OR Ghana* OR Guinea* OR Ivorian* OR (Ivory NEXT Coast*) OR Kenya* OR Lesotho* OR Liberia* OR Madagasca* OR Mahore* OR Malawi* OR Mali OR Malian* OR Mauritania* OR Mauriti* OR Mayotte* OR Mosotho* OR Mozambi* OR Namibia* OR Niger* OR ((Nonmediterranean OR Non-Mediterranean) NEAR/2 Africa*) OR ((Reunion) NEAR/2 (Department OR Island OR Region)) OR Reunionese OR Rwanda* OR Sahara OR Saharan OR Sahel* OR Santomean* OR ("Sao Tome" NEXT Principe*) OR Senegal* OR Seychell* OR (Sierra NEXT Leone*) OR Somali* OR (South* NEXT Africa*) OR Subsahara* OR Sudan* OR Swaziland* OR Tanzania* OR Togo* OR Uganda* OR (West* NEXT Africa*) OR Zambia* OR Zimbabwe*):ti,ab,kw
8	(Benchmark* OR (Bench NEXT mark*) OR (Diagnos* NEAR/2 (Delay* OR Speed OR Timely)) OR Infrastructur* OR (Infra NEXT structur*) OR Mentor* OR Mentee* OR (Needs NEXT assess*) OR (Need* NEAR/2 (Meet* OR Met OR Unmet)) OR "Professional Development" OR Self-sufficien* OR Self-support* OR (Strategic NEXT plan*) OR Syllabi OR Syllabus* OR Telecytol* OR Tele-cytol* OR Telemed* OR Tele-med* OR Telepathol* OR Tele-pathol* OR Turnaround* OR Turn-around* OR (Wait

	NEXT time*) OR Workaround* OR (Work NEXT around*) OR Workflow* OR (Work NEXT flow*) OR Workload* OR (Work NEXT load*)):ti,ab,kw
9	((Advisor* OR Capacit* OR Coalition* OR Facility OR Facilities OR Financ* OR Fund OR Funded OR Funding OR Funds OR Intercontinent* OR Inter-continent* OR Intergovernment* OR Inter-government* OR Institution* OR International* OR Laborator* OR Leader* OR Monetary OR National* OR Pathology OR Personnel* OR Program* OR Regional* OR Service* OR Technician* OR (Work NEXT force*) OR Workforce* OR Workgroup* OR (Work NEXT group*) OR (Working NEXT group*)) NEAR/3 (Access OR Accredite* OR Adequa* OR Availab* OR Barrier* OR Build* OR Built OR Capabil* OR Capabl* OR Credential* OR Centralis* OR Centraliz* OR Coach* OR Competen* OR Decentrali* OR Discrepen* OR Disincentiv* OR Efficien* OR Enhanc* OR Equipp* OR Equipt* OR Expand* OR Expansion* OR Framework* OR (Frame NEXT work*) OR Impact* OR Implement* OR Improve* OR Improving OR Inadequa* OR Incentiv* OR Inefficien* OR Initiativ* OR Innovat* OR Insufficient* OR Limited* OR Network OR Networks OR Optimisa* OR Optimise* OR Optimisi* OR Optimiz* OR Outreach* OR Partner* OR Performance* OR Rebuil* OR Reenhanc* OR Reimplement* OR Reimprov* OR Reform* OR Reinnovat* OR Reorganis* OR Reorganiz* OR Rescale* OR Rescaling OR Resource* OR Restrengthen* OR Restructure* OR Retain* OR Retention OR (Scal* NEXT up) OR Shortage* OR Shortcoming* OR Short-coming* OR Strengthen* OR Sufficient* OR Success* OR Sustain* OR Unsuccess* OR Uptake*)):ti,ab,kw)
10	((Lab OR Labs OR Laborator* OR Facility OR Facilities OR Histology OR Histologist* OR Pathology OR Pathologist*) NEAR/2 (Capacit* OR Establish* OR Knowledge OR Reestablish* OR Remote* OR Skill* OR Virtual* OR Quality)):ti,ab,kw)
11	((Documentation OR Report* OR Form OR Forms) NEAR/3 (Appropriate* OR Complet* OR Correct OR Error* OR Incorrect OR Inappropriat* OR Incomplete* OR Insufficient OR Nonstandard* OR Quality OR Sufficient OR Standard*)):ti,ab,kw)
12	((Class OR Classes OR Course* OR Curricul* OR Didactic OR Educat* OR Lecture* OR Learn* OR Module* OR Pedagog* OR Practicum* OR Seminar* OR Teach* OR Train* OR Tutorial* OR Workshop* OR (Work NEXT shop*)) NEAR/3 (Asynchronous OR Competenc* OR Distance OR Global OR Hands-on OR In-country OR In-person OR Inperson OR Inservice OR In-service OR International OR Local OR Online OR Onsite OR On-site OR Outreach* OR Patholog* OR Professional OR Program* OR Regional OR Synchronous OR Vocational)):ti,ab,kw)
13	#8 OR #9 OR #10 OR #11 OR #12
14	#6 AND #7 AND #13

African Index Medicus
(<https://search.bvsalud.org/aimafro/>)

tw:("Acid Schiff" OR "Antigen retrieval" OR clinicopathology OR "Clinico pathology" OR clinicopathologist* OR cryomicrotom* OR cytochemist* OR "Cyto chemist" OR "Cyto chemistry" OR "Cyto chemists" OR cytodiagnos* OR "Cyto diagnoses" OR "Cyto diagnosis" OR "Cyto diagnostic" OR "Cyto diagnostics" OR cytology OR cytologist* OR cytopathology OR "Cyto pathology" OR cytopathologist* OR decalcification OR "De calcification" OR "Diagnostic facility" OR "Diagnostic facilities" OR "Fluorescent Antibody Technique" OR "Fluorescent Antibody Techniques" OR histochemist* OR "Histo chemist" OR "Histo chemistry" OR "Histo chemists" OR histocytochemist* OR "Histo cytochemist" OR "Histo cytochemistry" OR "Histo cytochemists" OR histocytolog* OR histology OR histologist* OR histopathology OR "Histo pathology" OR histopathologist* OR histotechnolog* OR "Histo technologies" OR "Histo technologist" OR "Histo technologists" OR "Histo technology" OR immunochemist* OR "Immuno chemist" OR "Immuno chemistry" OR "Immuno chemists" OR immunocytochemist* OR "Immuno cytochemistry" OR immunohistochemist* OR "Immuno histochemistry" OR immunohistolog* OR "Immuno histology" OR immunoperoxidase OR "Immuno peroxidase" OR immunophosphatase OR "Immuno phosphatase" OR lnr OR lnr OR "Lymph node ratio" OR "Lymph node ratios" OR "Lymphatic node ratio" OR "Lymphatic node ratios" OR "Medical technologist" OR "Medical technologists" OR microdissect* OR "Micro dissection" OR "Micro dissections" OR microsection* OR "Micro section" OR "Micro sections" OR microtome* OR microtomy OR "Molecular diagnosis" OR "Molecular diagnoses" OR "Molecular diagnostic" OR "Molecular diagnostics" OR neuropathology OR "Neuro pathology" OR neuropathologist* OR oncopathology OR oncopathologist* OR "Paraffin Embedding" OR pathology OR pathologist* OR "Prussian Blue" OR "Silver Stain" OR "Silver Staining" OR "Silver Stains" OR telepathol*) AND (la:("en" OR "pt"))

Appendix 2: Data extraction tool

Study characteristics

First Author

Year of publication

Journal

Setting (pathology laboratory, community hospital, referral hospital, etc.)

Country/geographic region

Study design

Study aims

Methods

Study conclusions

Participants

Who was involved in the study

Number of participants/labs/studies

Study period/literature search date

Size of laboratory (number of specimens or personnel)

Concept

Anatomic pathology services available
Quality assurance/quality improvement monitoring system
Intervention
Intervention aim(s)
Implementation strategy
Facilitators of intervention
Barriers of intervention
Target group(s)
Implementation outcome(s) evaluated
Dissemination
Service system outcome(s) evaluated
Clinical outcome(s) evaluated

Measurement details

Measures used
Scale used
Length of time measured
Author identified limitations
Author identified research opportunities
Comments

BMJ Open

Efforts to strengthen anatomic pathology diagnostic services for cancer in sub-Saharan Africa: a scoping review protocol

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2024-089425.R1
Article Type:	Protocol
Date Submitted by the Author:	23-Oct-2024
Complete List of Authors:	Ng, Dianna; Memorial Sloan Kettering Cancer Center, Department of Pathology Edelweiss, Marcia; Memorial Sloan Kettering Cancer Center, Department of Pathology Kimambo, Asteria; Muhimbili University of Health and Allied Sciences, Department of Pathology Vuhahula, Edda; Muhimbili University of Health and Allied Sciences, Department of Pathology Mushi, Beatrice; Muhimbili University of Health and Allied Sciences Adegoke, Omolade; University of Ibadan, Department of Pathology Goldberg, Johanna; Memorial Sloan Kettering Cancer Center, Research Information Services Ibrahim, Pendo; Muhimbili University of Health and Allied Sciences Illonga, Zainab; Muhimbili University of Health and Allied Sciences Jackman, Julia; Memorial Sloan Kettering Cancer Center, Department of Surgery Jami, Luisa; Maputo Central Hospital, Department of Pathology Van Loon, Katherine ; University of California San Francisco, Department of Medicine Mmbaga, Elia John; Muhimbili University of Health and Allied Sciences, Department of Epidemiology and Biostatistics; University of Oslo, Department of Community Medicine and Global Health
Primary Subject Heading:	Pathology
Secondary Subject Heading:	Global health
Keywords:	Quality Improvement, PATHOLOGY, ONCOLOGY

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Manuscripts

Title: Efforts to strengthen anatomic pathology diagnostic services for cancer in sub-Saharan Africa: a scoping review protocol

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ABSTRACT

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Introduction: Sub-Saharan Africa bears a disproportionate burden of cancer-related morbidity and mortality compared to high-resource settings. Although pathology services are essential to providing optimal oncologic care, diagnostic capacity in sub-Saharan Africa is insufficient for the cancer burden. This scoping review will be conducted to summarize the current state of practices and evidence for interventions and implementation strategies to improve anatomic pathology services for cancer in the region. The objective of this scoping review is to describe efforts to strengthen capacity for anatomic pathology services in sub-Saharan Africa. The information gathered will be used to inform the design of future pathology capacity-building interventions. The primary aim of the scoping review is to comprehensively map the existing evidence on initiatives aimed at enhancing the capacity for pathology services.

Methods and analysis: This study will follow Joanna Briggs Institute methodology for scoping reviews. MEDLINE, Embase, Cochrane Central, and African Index Medicus will be searched for articles published in English and Portuguese with no limitations placed on date or publication type. Two independent reviewers will screen all articles, extract data, and complete the descriptive analysis. All discrepancies will be resolved using a third reviewer. The results will be reported using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for scoping reviews (PRISMA-ScR). This review will consider scientific literature from published primary studies as well as scoping and systematic reviews related to capacity building efforts to strengthen anatomic pathology services in any sub-Saharan African country. All study designs will be considered, including quantitative, qualitative, and/or mixed-methods studies.

Ethics and dissemination:

Ethical approval is not required for this study. Dissemination of findings from this work will include the publication of the results in a peer-reviewed journal and presentations at conferences.

Registration details: Open Science Framework, <https://osf.io/6cmhg>

Word count: 1,883

ARTICLE SUMMARY

Strengths and limitations of this study

- A systematic and comprehensive search of electronic databases will ensure that all peer-reviewed evidence is identified.
- Members of the research team include key stakeholders involved in capacity strengthening of pathology services in sub-Saharan Africa, which will help to strengthen the validity of the findings
- A formal assessment of the quality of evidence will not be performed and may lead to the inclusion of studies with a range of quality.
- Only studies written in English and Portuguese will be included.

Keywords: Africa, Oncology, Pathology, Quality Improvement

INTRODUCTION

Sub-Saharan Africa (SSA) faces a growing burden of cancer with pathology services that are inadequately prepared to meet this public health challenge. High quality pathology services are essential to cancer care and are required for accurate and timely diagnosis, prognosis, and selection of optimal treatments.[1] Although the World Health Organization's "Model List of Essential *In Vitro* Diagnostics" includes tests necessary for cancer diagnosis such as immunohistochemistry (IHC) and flow cytometry, many of these recommended assays are not widely available in SSA.[2–4] In fact, a recent survey of large, referral pathology laboratories in SSA found that only half provided onsite immunohistochemistry services.[4] These disparities are in part attributable to an insufficient number of trained personnel, reagent and equipment shortages, and variable specimen processing protocols.[4]

Several groups, including the Lancet Commission on diagnostics and African Strategies for Advancing Pathology, have previously provided roadmaps or suggestions on how to best improve pathology services in SSA.[3,5,6] Recommendations have included conducting situational analyses to determine the current state of pathology practices and to gain a better understanding of the existing capacity, resources, and infrastructure.[5] Additional proposals include interventions that introduce or bolster governance and regulatory frameworks to support quality, provide additional training to increase the number of skilled pathology personnel, and increased investment in pathology infrastructure, including establishing reliable supply chains, specimen transport processes, specimen reporting, and archiving.[3,5–8]

To help better inform future guidelines and interventions, a rigorous review of the literature is needed to give an overview of the extent and range of prior pathology capacity building

efforts across SSA. While the disparities in pathology services have been well-described in the literature, there has not been a synthesis of attempted interventions that have been used to improve pathology services.[9–13] The majority of published interventions to improve pathology services in low-resource settings have primarily involved intensive training, telepathology, and greater access to new equipment and reagents.[10,12–14] Assessment of clinical impact has also mainly been limited to effect on turnaround time and volume of cases diagnosed.[11–13] Moreover, it is unknown what implementation strategies have been used to deploy these interventions. The implementation and service outcomes, as defined by the Outcomes for Implementation Research framework, are also often not well delineated.[15,16] Elucidating contextual factors such as barriers and facilitators, can provide insight into the design, deployment, and success of an intervention. Furthermore, understanding how interventions were introduced, monitored, and sustained will help to inform the design of future capacity strengthening initiatives. Therefore the primary aim of the scoping review is to comprehensively map the existing evidence on initiatives aimed at enhancing the capacity for pathology services.

This review will focus on anatomic pathology services, which is defined as examinations of organs and tissues for the purpose of diagnosing cancer, and includes tests such as histopathology, immunohistochemistry, molecular assays, and flow cytometry, among others. While clinical pathology services, such as clinical chemistry and microbiology, are related and critical to cancer care, the challenges, gaps in practice, and interventions to address those gaps may be markedly different than those seen in anatomic pathology and will therefore not be included in this scoping review. A preliminary search of MEDLINE and PROSPERO was conducted in November 2023, and no other scoping reviews on the topic were identified as in progress or completed. The librarian continued to look for reviews related to the topic during

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the search building process, which ran from November 2023 to early January 2024.

Overall, the data on successful capacity-building interventions in particular have not been well-described. Therefore, this scoping review will provide insight into the current state of pathology services for cancer care in SSA, as well as previously tested capacity-building interventions and their outcomes.

METHODS AND ANALYSIS

The proposed scoping review will be conducted in accordance with Joanna Briggs Institute (JBI) methodology for scoping reviews, including protocol development, screening, data extraction and presentation of results.[17] The Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) will be used to report the study.[18] The protocol was registered on the Open Science Framework (<https://osf.io/6cmhg>). The study is planned to begin in January 2024 and is planned to end by January 2025.

Review questions

What interventions have been implemented to improve anatomic pathology services in SSA?

The following sub-questions will be addressed:

1. What are the primary gaps that the interventions are addressing in anatomic pathology services in SSA?
2. What interventions have been tested in SSA, their implementation strategies, and their outcomes?
3. What were the contexts, barriers, and facilitators of these interventions?

Inclusion criteria

Participants

The review will focus on interventions to improve anatomic pathology services, including interventions targeting individual-, organizational-, or system-level changes. Therefore, the range in participants may be broad and may include healthcare providers--including laboratory staff--hospital administrators, and ministries of health, among others. Interventions that do not specifically focus on sub-Saharan Africa will be excluded.

Concept

Interventions explicitly aimed to improve tissue-based pathology services and laboratories in SSA will be included in the analysis. Efforts that included pathology services but did not specifically aim to improve pathology services for patient care, such as cancer control plans, screening programs, or the development of laboratories exclusively for research, will be excluded. Initiatives which aimed to improve clinical pathology services will also be excluded. Clinical pathology services include the fields of blood banking, microbiology, hematology, and clinical chemistry and typically perform tests on body fluids.

Context

Studies that focus on anatomic pathology services, such as infrastructure, workflows, diagnostic assays, personnel, supply chains, and quality assurance/quality improvement initiatives, such as laboratory accreditation programs, will be included. We will consider studies conducted in SSA as well as those that target capacity-building for anatomic pathology services in SSA.

Types of sources

Articles will be identified through a comprehensive search of electronic databases and reference scanning of relevant studies. All study designs will be considered, including quantitative, qualitative, and/or mixed methods studies. Reviews of the scientific literature, such as scoping and systematic reviews, will also be included. Opinion pieces (e.g., editorials, commentaries, letters to the editor) and non-systematic reviews will be excluded.

In all databases, results will be limited to items in English and Portuguese, which are the languages that the review teams are fluent in. No limitations will be placed on date or publication type.

Search strategy

The search strategy will aim to identify published studies. Grey literature will be excluded because accessing literature published by organizations and scholars from sub-Saharan Africa is challenging because it is often not consistently digitized or curated into searchable databases, or may not have sufficient detail on the interventions. An initial limited search of Ovid Medline ALL and was undertaken to identify articles on the topic.

A medical librarian (JG) will design the scoping review search in Ovid Medline ALL. Subject headers and keywords reflecting three topics—pathology, SSA, and capacity-building—were combined using Boolean and adjacency operators. A second librarian will perform a PRESS review of the search, which will then translate to Embase (Elsevier) and Cochrane Central Register of Controlled Trials (Wiley) with the help of the Systematic Review Accelerator's Polyglot Tool.[14,15] In Medline and Embase, the Cochrane filter for human studies will be utilized.[16] A simplified version of the search, using only keywords relating to pathology, will be developed in African Index Medicus (<https://search.bvvsalud.org/aimafro/>). View the complete search strategies for all databases in Appendix 1. The reference list of all included sources of evidence will be screened for additional studies. To make up for any potential omissions, we will perform a forward and backward reference check of the items selected for inclusion in the review.

Study/Source of evidence selection

Following the search, all identified citations will be imported into the systematic review management tool Covidence (Veritas Health Innovation, Melbourne, Australia), which will remove duplicates. Titles and abstracts will then be screened by 2 independent reviewers for

assessment against the inclusion criteria for the review. Potentially relevant sources will be retrieved in full, with citation details imported into Covidence. The full text of selected citations will be assessed in detail against the inclusion criteria by 2 independent reviewers. Reasons for exclusion of sources of evidence at full text that do not meet the inclusion criteria will be recorded and reported in the scoping review. Any disagreements that arise between the reviewers at each stage of the selection process will be adjudicated by a third reviewer and/or further discussion among the review team. The results of the search and the study inclusion process will be reported in full in the final scoping review and presented in a PRISMA-ScR flow diagram. [12]

Data extraction

Two independent reviewers will extract data from relevant articles using a data extraction tool developed by the review team. A draft data extraction form is presented in Appendix 2. The initial draft of the data extraction tool is based on the tool developed by Ashoor, et al. and Proctor’s framework on implementation research outcomes. [10,17]

The data extraction tool will be modified and revised as needed during the data extraction process. Modifications will be detailed in the scoping review. Any disagreements that arise between the reviewers will be resolved through discussion or with a third reviewer. Where required, authors of papers will be contacted to request missing or additional data.

Data analysis and presentation

The data extracted from each included article will be presented in a tabular or diagrammatic format. Descriptive frequencies, counts, and thematic analysis will be included along with the tabulated results and will describe how the results relate to the objectives of the review. Thematic analysis will be guided by the Outcomes for Implementation Research framework.[15] Gaps in the literature, effective implementation strategies, and areas of further research in how to effectively improve pathology services in SSA will be identified.

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Patient and public involvement

There will be no patient or public involvement in this study.

DISCUSSION

Our scoping review will aim to provide insight into the existing evidence as well as gaps on interventions intended to improve pathology services in SSA. By exploring previous and interventions, their targeted gaps, and outcomes, we can better understand which implementation strategies are the most effective in improving diagnostic capacity in resource constrained settings. Therefore this review will provide insights into how to best design and implement future interventions to reduce disparities in tissue-based diagnostics in SSA.

ETHICS AND DISSEMINATION

Ethical approval is not required for the planned scoping review. All data will be obtained from publicly available documents, and no primary data will be generated. The findings from this work includes publication of the results in a peer-reviewed journal and presentations at conferences.

FUNDING

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AUTHOR CONTRIBUTIONS

DLN conceptualized and designed the study. DLN wrote the original draft of the protocol. JG provided methodological guidance. All authors were involved in the review and editing of the manuscript. DLN is the guarantor. All authors reviewed the manuscript and gave their approval for the final version of the work to be published, and agreed to be accountable for the integrity of the work published.

COMPETING INTERESTS

The authors have no conflicts of interest to disclose.

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APPENDIX

Appendix 1: Search strategy

Ovid Medline ALL

1	exp "Clinical Laboratory Services"/ or "Clinical Laboratory Techniques"/ or Cytodiagnosis/ or Decalcification technique/ or exp Dissection/ or Fluorescent antibody technique/ or Fluorescent antibody technique, direct/ or Fluorescent antibody technique, indirect/ or Histochemistry/ or Histocytological preparation techniques/ or Histological techniques/ or Immunohistochemistry/ or In situ hybridization, fluorescence/ or exp Laboratories/ or Lymph node ratio/ or exp "Medical Laboratory Personnel"/ or Microdissection/ or exp microtomy/ or exp molecular diagnostic techniques/ or Neuropathology/ or exp Pathologists/ or Pathology/ or exp "Pathology, Clinical"/ or "Pathology, Molecular"/ or "Pathology, Surgical"/ or periodic acid-schiff reaction/ or prussian blue reaction/ or silver staining/ or specimen handling/ or "staining and labeling"/ or Telepathology/ or exp tissue embedding/ or tissue fixation/ or tissue preservation/ or Acid-Schiff*.ti,ab,kf. or Antigen retrieval*.ti,ab,kf. or Clinicopathology.ti,ab,kf. or Clinico-pathology.ti,ab,kf. or Clinicopathologist*.ti,ab,kf. or Cryomicrotom*.ti,ab,kf. or Cytochemist*.ti,ab,kf. or Cyto-chemist*.ti,ab,kf. or Cytodiagnos*.ti,ab,kf. or Cyto-diagnos*.ti,ab,kf. or Cytology.ti,ab,kf. or Cytologist*.ti,ab,kf. or Cytopathology.ti,ab,kf. or Cyto-pathology.ti,ab,kf. or Cytopathologist*.ti,ab,kf. or Decalcification.ti,ab,kf. or De-calcification.ti,ab,kf. or Diagnostic facility.ti,ab,kf. or Diagnostic facilities.ti,ab,kf. or Fluorescent Antibody Technique*.ti,ab,kf. or Histochemist*.ti,ab,kf. or Histo-chemist*.ti,ab,kf. or Histocytochemist*.ti,ab,kf. or Histo-cytochemist*.ti,ab,kf. or Histocytolog*.ti,ab,kf. or Histologist*.ti,ab,kf. or Histopathology.ti,ab,kf. or Histo-pathology.ti,ab,kf. or Histopathologist*.ti,ab,kf. or Histotechnolog*.ti,ab,kf. or Histo-technolog*.ti,ab,kf. or Immunochemist*.ti,ab,kf. or Immuno-chemist*.ti,ab,kf. or Immunocytochemist*.ti,ab,kf. or Immunohistochemist*.ti,ab,kf. or Immunohistolog*.ti,ab,kf. or Immuno-histolog*.ti,ab,kf. or Immunoperoxidase.ti,ab,kf. or Immuno-peroxidase.ti,ab,kf. or Immunophosphatase.ti,ab,kf. or Immuno-phosphatase.ti,ab,kf. or LNR.ti,ab,kf. or LNRs.ti,ab,kf. or Lymph* node* ratio*.ti,ab,kf. or Medical technologist*.ti,ab,kf. or Microdissect*.ti,ab,kf. or Micro-dissect*.ti,ab,kf. or Microsection*.ti,ab,kf. or Micro-section*.ti,ab,kf. or Microtome*.ti,ab,kf. or Microtomy.ti,ab,kf. or Molecular diagnos*.ti,ab,kf. or Neuropathology.ti,ab,kf. or Neuro-pathology.ti,ab,kf. or Neuropathologist*.ti,ab,kf. or Oncopathology.ti,ab,kf. or Onco-pathology.ti,ab,kf. or Oncopathologist*.ti,ab,kf. or Pathologist*.ti,ab,kf. or Paraffin* Embedd*.ti,ab,kf. or Prussian Blue.ti,ab,kf. or Silver Stain*.ti,ab,kf. or Telepathol*.ti,ab,kf. or Tele-pathol*.ti,ab,kf.
2	((Lab or Labs or Laborator*) adj3 (Clinic* or Diagnos* or Facility or Facilities or Health* or Medical or Medicine or Network* or Professional* or Report* or Result or Results or Service* or System or Systems)).ti,ab,kf.

3	((Biopsy or Biopsies or Section or Sections or Smear* or Specimen* or Tissue*) adj2 (Affix* or Embed* or Fixat* or Frozen or Gross or Handl* or Microarray* or Microarray* or Preparation* or Prepare* or Prepared or Preserv* or React* or Stain* or Technique* or Test or Tests or Tested or Testing)).ti,ab,kf.
4	((Histology or Pathology) adj2 (Anatomic* or Center or Centers or Centre or Centres or Clinical or Department* or Diagnos* or Digital* or Education* or Facility or Facilities or General* or Lab or Labs or Laborator* or Medical or Molecular or Network* or Personnel* or Profession* or Program* or Report* or Result or Results or Service* or Tech or Technician* or Train* or Unit*)).ti,ab,kf.
5	((Histology or Lab or Labs or Laborator* or Pathology) adj (Assistant* or Attending* or Personnel* or Scientist* or Tech or Techs or Technician* or Staff)).ti,ab,kf.
6	or/1-5
7	Africa/ or African People/ or exp "Africa South of the Sahara"/ or "Mauritius"/ or "Reunion"/ or exp "Sub-Saharan African People"/ or Angola*.ti,ab,kf,cp,ia. or Basotho*.ti,ab,kf. or Benin*.ti,ab,kf,cp,ia. or Bissau*.ti,ab,kf,cp,ia. or Botswana*.ti,ab,kf,cp,ia. or Burkina*.ti,ab,kf,cp,ia. or Burundi*.ti,ab,kf,cp,ia. or Cameroon*.ti,ab,kf,cp,ia. or Cabo Verde*.ti,ab,kf,cp,ia. or Cape Verde*.ti,ab,kf,cp,ia. or Central Africa*.ti,ab,kf,cp,ia. or Chad.ti,ab,kf,cp,ia. or Chadian*.ti,ab,kf. or Comorian*.ti,ab,kf. or Comoros.ti,ab,kf,cp,ia. or Congan*.ti,ab,kf. or Congo.ti,ab,kf,cp,ia. or Congolese.ti,ab,kf. or Cote d'Ivoire*.ti,ab,kf,cp,ia. or Djibouti*.ti,ab,kf,cp,ia. or East* Africa*.ti,ab,kf. or Equatoguinean*.ti,ab,kf. or Eritrea*.ti,ab,kf,cp,ia. or Eswatini*.ti,ab,kf,cp,ia. or Ethiopia*.ti,ab,kf,cp,ia. or Gabon*.ti,ab,kf,cp,ia. or Gambia.ti,ab,kf,cp,ia. or Gambian*.ti,ab,kf,cp,ia. or Ghana*.ti,ab,kf,cp,ia. or Guinea*.ti,ab,kf,cp,ia. or Ivorian*.ti,ab,kf. or Ivory Coast*.ti,ab,kf,cp,ia. or Kenya*.ti,ab,kf,cp,ia. or Lesotho*.ti,ab,kf,cp,ia. or Liberia*.ti,ab,kf,cp,ia. or Madagasca*.ti,ab,kf,cp,ia. or Mahore*.ti,ab,kf,cp,ia. or Malawi*.ti,ab,kf,cp,ia. or Mali.ti,ab,kf,cp,ia. or Malian*.ti,ab,kf. or Mauritania*.ti,ab,kf,cp,ia. or Mauriti*.ti,ab,kf,cp,ia. or Mayotte*.ti,ab,kf,cp,ia. or Mosotho*.ti,ab,kf. or Mozambi*.ti,ab,kf,cp,ia. or Namibia*.ti,ab,kf,cp,ia. or Niger*.ti,ab,kf,cp,ia. or (Nonmediterranean adj2 Africa*).ti,ab,kf. or (Non-Mediterranean adj2 Africa*).ti,ab,kf. or (Reunion adj2 (Department or Island or Region)).ti,ab,kf,cp,ia. or Reunionese.ti,ab,kf. or Rwanda*.ti,ab,kf,cp,ia. or Sahara.ti,ab,kf,cp,ia. or Saharan.ti,ab,kf,cp,ia. or Sahel*.ti,ab,kf. or Santomean*.ti,ab,kf. or (Sao Tome adj Principe*).ti,ab,kf,cp,ia. or Senegal*.ti,ab,kf,cp,ia. or Seychell*.ti,ab,kf,cp,ia. or Sierra Leone*.ti,ab,kf,cp,ia. or Somali*.ti,ab,kf,cp,ia. or South* Africa*.ti,ab,kf,cp,ia. or Subsahara*.ti,ab,kf,cp,ia. or Sudan*.ti,ab,kf,cp,ia. or Swaziland*.ti,ab,kf,cp,ia. or Tanzania*.ti,ab,kf,cp,ia. or Togo*.ti,ab,kf,cp,ia. or Uganda*.ti,ab,kf,cp,ia. or West* Africa*.ti,ab,kf. or Zambia*.ti,ab,kf,cp,ia. or Zimbabwe*.ti,ab,kf,cp,ia.
8	exp "Capacity Building"/ or "Cost-Effectiveness Analysis"/ or "Delayed Diagnosis"/ or exp "Education, Distance"/ or exp "Education, Professional"/ or "Financing, Organized"/ or "Financing, Government"/ or "Health Impact Assessment"/ or exp "Inservice Training"/ or exp "International Educational Exchange"/ or "Mentoring"/ or "Mentors"/ or "Needs Assessment"/ or exp "Professional Competence"/ or exp "Program Development"/

	or exp "Program Evaluation"/ or "Quality of Health Care"/ or "Quality Improvement"/ or "Quality Indicators, Health Care"/ or "Strategic Planning"/ or "Telepathology"/ or "Workflow"/ or exp "Workforce"/ or "Workload"/ or Benchmark*.ti,ab,kf. or Bench mark*.ti,ab,kf. or (Diagnos* adj2 (Delay* or Speed or Timely)).ti,ab,kf. or Infrastructur*.ti,ab,kf. or Infra-structur*.ti,ab,kf. or Mentor*.ti,ab,kf. or Mentee*.ti,ab,kf. or Needs assess*.ti,ab,kf. or (Need* adj2 (Meet* or Met or Unmet)).ti,ab,kf. or Professional Development.ti,ab,kf. or Self-sufficien*.ti,ab,kf. or Self-support*.ti,ab,kf. or Strategic plan*.ti,ab,kf. or Syllabi.ti,ab,kf. or Syllabus*.ti,ab,kf. or Telecytol*.ti,ab,kf. or Tele-cytol*.ti,ab,kf. or Telemed*.ti,ab,kf. or Tele-med*.ti,ab,kf. or Telepathol*.ti,ab,kf. or Tele-pathol*.ti,ab,kf. or Turnaround*.ti,ab,kf. or Turn-around*.ti,ab,kf. or Wait time*.ti,ab,kf. or Workaround*.ti,ab,kf. or Work around*.ti,ab,kf. or Workflow*.ti,ab,kf. or Work flow*.ti,ab,kf. or Workload*.ti,ab,kf. or Work load*.ti,ab,kf.
9	((Advisor* or Capacit* or Coalition* or Facility or Facilities or Financ* or Fund or Funded or Funding or Funds or Intercontinent* or Inter-continent* or Intergovernment* or Inter-government* or Institution* or International* or Laborator* or Leader* or Monetary or National* or Pathology or Personnel* or Program* or Regional* or Service* or Technician* or Work force* or Workforce* or Workgroup* or Work group* or Working group*) adj3 (Access or Accredite* or Adequa* or Availab* or Barrier* or Build* or Built or Capabil* or Capabl* or Credential* or Centralis* or Centraliz* or Coach* or Competen* or Decentrali* or Discrepen* or Disincentiv* or Efficien* or Enhanc* or Equipp* or Equip* or Expand* or Expansion* or Framework* or Frame work* or Impact* or Implement* or Improve* or Improving or Inadequa* or Incentiv* or Inefficien* or Initiativ* or Innovat* or Insufficient* or Limited* or Network or Networks or Optimisa* or Optimise* or Optimisi* or Optimiz* or Outreach* or Partner* or Performance* or Rebuil* or Reenhanc* or Reimplement* or Reimprov* or Reform* or Reinnovat* or Reorganis* or Reorganiz* or Rescale* or Rescaling or Resource* or Restrengthen* or Restructure* or Retain* or Retention or Scal* up or Shortage* or Shortcoming* or Short-coming* or Strengthen* or Sufficient* or Success* or Sustain* or Unsuccess* or Uptake*).ti,ab,kf.
10	((Lab or Labs or Laborator* or Facility or Facilities or Histology or Histologist* or Pathology or Pathologist*) adj2 (Capacit* or Establish* or Knowledge or Reestablish* or Remote* or Skill* or Virtual* or Quality)).ti,ab,kf.
11	((Documentation or Report* or Form or Forms) adj3 (Appropriate* or Complet* or Correct or Error* or Incorrect or Inappropriat* or Incomplete* or Insufficient or Nonstandard* or Quality or Sufficient or Standard)).ti,ab,kf.
12	((Class or Classes or Course* or Curricul* or Didactic or Educat* or Lecture* or Learn* or Module* or Pedagog* or Practicum* or Seminar* or Teach* or Train* or Tutorial* or Workshop* or Work shop*) adj3 (Asynchronous or Competenc* or Distance or Global or Hands-on or In-country or In-person or Inperson or Inservice or In-service or International or Local or Online or Onsite or On-site or Outreach* or Patholog* or Professional or Program* or Regional or Synchronous or Vocational)).ti,ab,kf.
13	or/8-12

14	6 and 7 and 13
15	14 and (English or Portuguese).lg.
16	15 not (exp animals/ not humans.sh.)
17	remove duplicates from 16

Embase (Elsevier)

'antigen retrieval'/de OR 'aspiration cytology'/de OR 'brain histology'/de OR 'cancer cytodiagnosis'/de OR 'cancer detection kit'/exp OR 'cancer prognostic test kit'/exp OR 'clinical laboratory personnel'/de OR 'clinical laboratory service'/de OR 'cytochemistry'/exp OR 'cytodiagnosis'/de OR 'cytology'/de OR 'cytopathology'/de OR 'cytometry'/de OR 'digital pathology'/de OR 'direct fluorescent antibody technique'/de OR 'dna microarray kit'/exp OR 'embedding'/exp OR 'fluorescence histochemistry'/de OR 'fluorescence in situ hybridization'/de OR 'fluorescence in situ hybridization kit'/exp OR 'fluorescent antibody technique'/de OR 'frozen section'/de OR 'general pathology'/de OR 'histological techniques equipment and supplies'/de OR 'immunocytochemistry'/de OR 'immunohistochemistry'/de OR 'immunohistology'/de OR 'immunoperoxidase staining'/de OR 'immunophosphatase technique'/de OR 'indirect fluorescent antibody technique'/de OR 'laboratory'/exp OR 'laboratory technique'/de OR 'lymph node ratio'/de OR 'microdissection'/de OR 'microtomy'/exp OR 'molecular diagnostics'/de OR 'molecular pathology'/de OR 'neuropathology'/de OR 'pathological anatomy'/de OR 'pathologist'/exp OR 'pathology'/de OR 'periodic acid-schiff stain'/de OR 'prussian blue staining'/de OR 'silver staining'/de OR 'specimen handling'/de OR 'staining'/de OR 'telepathology'/de OR 'tissue embedding'/exp OR 'tissue fixation'/de OR 'tissue preservation'/de OR 'tissue microarray'/de OR 'uterine cervix cytology'/de OR 'vagina cytology'/de OR 'acid-schiff*':ti,ab,kw OR 'antigen retrieval*':ti,ab,kw OR clinicopathology:ti,ab,kw OR 'clunico pathology':ti,ab,kw OR clinicopathologist*:ti,ab,kw OR cryomicrotom*:ti,ab,kw OR cytochemist*:ti,ab,kw OR 'cyto chemist*':ti,ab,kw OR cytodiagnos*:ti,ab,kw OR 'cyto diagnos*':ti,ab,kw OR cytology:ti,ab,kw OR cytologist*:ti,ab,kw OR cytopathology:ti,ab,kw OR 'cyto pathology':ti,ab,kw OR cytopathologist*:ti,ab,kw OR decalcification:ti,ab,kw OR 'de calcification':ti,ab,kw OR 'diagnostic facility':ti,ab,kw OR 'diagnostic facilities':ti,ab,kw OR 'fluorescent antibody technique*':ti,ab,kw OR histochemist*:ti,ab,kw OR 'histo chemist*':ti,ab,kw OR histocytochemist*:ti,ab,kw OR 'histo cytochemist*':ti,ab,kw OR histocytolog*:ti,ab,kw OR histologist*:ti,ab,kw OR histopathology:ti,ab,kw OR 'histo pathology':ti,ab,kw OR histopathologist*:ti,ab,kw OR histotechnolog*:ti,ab,kw OR 'histo technolog*':ti,ab,kw OR immunochemist*:ti,ab,kw OR 'immuno chemist*':ti,ab,kw OR immunocytochemist*:ti,ab,kw OR immunohistochemist*:ti,ab,kw OR immunohistolog*:ti,ab,kw OR 'immuno histolog*':ti,ab,kw OR immunoperoxidase:ti,ab,kw OR 'immuno peroxidase':ti,ab,kw OR immunophosphatase:ti,ab,kw OR 'immuno phosphatase':ti,ab,kw OR lnr:ti,ab,kw OR lnr:ti,ab,kw OR 'lymph* node* ratio*':ti,ab,kw OR 'medical technologist*':ti,ab,kw OR
--

	microdissect*:ti,ab,kw OR 'micro dissect*:ti,ab,kw OR microsection*:ti,ab,kw OR 'micro section*:ti,ab,kw OR microtome*:ti,ab,kw OR microtomy:ti,ab,kw OR 'molecular diagnos*:ti,ab,kw OR neuropathology:ti,ab,kw OR 'neuro pathology':ti,ab,kw OR neuropathologist*:ti,ab,kw OR oncopathology:ti,ab,kw OR 'onco pathology':ti,ab,kw OR oncopathologist*:ti,ab,kw OR pathologist*:ti,ab,kw OR 'paraffin* embedd*:ti,ab,kw OR 'prussian blue':ti,ab,kw OR 'silver stain*:ti,ab,kw OR telepathol*:ti,ab,kw OR 'tele pathol*:ti,ab,kw
2	((lab OR labs OR laborator*) NEAR/3 (clinic* OR diagnos* OR facility OR facilities OR health* OR medical OR medicine OR network* OR professional* OR report* OR result OR results OR service* OR system OR systems)):ti,ab,kw
3	((biopsy OR biopsies OR section OR sections OR smear* OR specimen* OR tissue*) NEAR/2 (affix* OR embed* OR fixat* OR frozen OR gross OR handl* OR microarray* OR 'micro array*' OR preparation* OR prepare* OR prepared OR preserv* OR react* OR stain* OR technique* OR test OR tests OR tested OR testing)):ti,ab,kw
4	((histology OR pathology) NEAR/2 (anatomic* OR center OR centers OR centre OR centres OR clinical OR department* OR diagnos* OR digital* OR education* OR facility OR facilities OR general* OR lab OR labs OR laborator* OR medical OR molecular OR network* OR personnel* OR profession* OR program* OR report* OR result OR results OR service* OR tech OR technician* OR train* OR unit*)):ti,ab,kw
5	((histology OR lab OR labs OR laborator* OR pathology) NEXT/1 (assistant* OR attending* OR personnel* OR scientist* OR tech OR techs OR technician* OR staff)):ti,ab,kw
6	#1 or #2 or #3 or #4 or #5
7	'africa'/de OR 'african'/de OR 'africa south of the sahara'/exp OR 'mauritania'/de OR 'mauritius'/de OR 'reunion'/de OR 'sao tome and principe'/de OR 'seychelles'/de OR 'sub-saharan african'/exp OR angola*:ti,ab,kw,ca,cy OR basotho*:ti,ab,kw OR benin*:ti,ab,kw,ca,cy OR bissau*:ti,ab,kw,ca,cy OR botswana*:ti,ab,kw,ca,cy OR burkina*:ti,ab,kw,ca,cy OR burundi*:ti,ab,kw,ca,cy OR cameroon*:ti,ab,kw,ca,cy OR 'cabo verde*:ti,ab,kw,ca,cy OR 'cape verde*:ti,ab,kw,ca,cy OR 'central africa*:ti,ab,kw,ca,cy OR chad:ti,ab,kw,ca,cy OR chadian*:ti,ab,kw OR comorian*:ti,ab,kw OR comoros:ti,ab,kw,ca,cy OR congan*:ti,ab,kw OR congo:ti,ab,kw,ca,cy OR congolese:ti,ab,kw OR 'cote divoire*:ti,ab,kw,ca,cy OR djibouti*:ti,ab,kw,ca,cy OR 'east* africa*:ti,ab,kw OR equatoguinean*:ti,ab,kw OR eritrea*:ti,ab,kw,ca,cy OR eswatini*:ti,ab,kw,ca,cy OR ethiopia*:ti,ab,kw,ca,cy OR gabon*:ti,ab,kw,ca,cy OR gambia:ti,ab,kw,ca,cy OR gambian*:ti,ab,kw,ca,cy OR ghana*:ti,ab,kw,ca,cy OR guinea*:ti,ab,kw,ca,cy OR ivorian*:ti,ab,kw OR 'ivory coast*:ti,ab,kw,ca,cy OR kenya*:ti,ab,kw,ca,cy OR lesotho*:ti,ab,kw,ca,cy OR liberia*:ti,ab,kw,ca,cy OR madagasca*:ti,ab,kw,ca,cy OR mahore*:ti,ab,kw,ca,cy OR malawi*:ti,ab,kw,ca,cy OR mali:ti,ab,kw,ca,cy OR malian*:ti,ab,kw OR mauritania*:ti,ab,kw,ca,cy OR mauriti*:ti,ab,kw,ca,cy OR mayotte*:ti,ab,kw,ca,cy OR mosotho*:ti,ab,kw OR mozambi*:ti,ab,kw,ca,cy OR namibia*:ti,ab,kw,ca,cy OR niger*:ti,ab,kw,ca,cy OR ((nonmediterranean NEAR/2 africa*):ti,ab,kw) OR (('non

	mediterranean' NEAR/2 africa*):ti,ab,kw) OR ((reunion NEAR/2 (department OR island OR region)):ti,ab,kw,ca,cy) OR reunionese:ti,ab,kw OR rwanda*:ti,ab,kw,ca,cy OR sahara*:ti,ab,kw,ca,cy OR sahel*:ti,ab,kw OR santomean*:ti,ab,kw OR (('sao tome' NEXT/1 principe*):ti,ab,kw,ca,cy) OR senegal*:ti,ab,kw,ca,cy OR seychell*:ti,ab,kw,ca,cy OR 'sierra leone*':ti,ab,kw,ca,cy OR somali*:ti,ab,kw,ca,cy OR 'south* africa*':ti,ab,kw,ca,cy OR subsahara*:ti,ab,kw,ca,cy OR sudan*:ti,ab,kw,ca,cy OR swaziland*:ti,ab,kw,ca,cy OR tanzania*:ti,ab,kw,ca,cy OR togo*:ti,ab,kw,ca,cy OR uganda*:ti,ab,kw,ca,cy OR 'west* africa*':ti,ab,kw OR zambia*:ti,ab,kw,ca,cy OR zimbabwe*:ti,ab,kw,ca,cy
8	'benchmark'/de OR 'benchmarking'/exp OR 'capacity'/exp OR 'capacity building'/exp OR 'clinical competence'/de OR 'cost effectiveness analysis'/de OR 'delayed diagnosis'/exp OR 'distance learning'/exp OR 'financial management'/de OR 'health impact assessment'/de OR 'in service training'/de OR 'international cooperation'/de OR 'international relations'/exp OR 'mentor'/de OR 'mentoring'/exp OR 'needs assessment'/de OR 'outreach program'/de OR 'performance measurement system'/de OR 'personnel shortage'/exp OR 'professional competence'/de OR 'professional development'/exp OR 'program development'/de OR 'program evaluation'/exp OR 'public expenditure'/de OR 'public finance'/de OR 'quality indicator'/de OR 'strategic planning'/de OR 'telepathology'/de OR 'total quality management'/de OR 'turnaround time'/de OR 'vocational education'/exp OR 'wait time'/de OR 'workflow'/de OR 'workforce'/exp OR 'workload'/de OR benchmark*:ti,ab,kw OR 'bench mark*':ti,ab,kw OR ((diagnos* NEAR/2 (delay* OR speed OR timely)):ti,ab,kw) OR infrastructur*:ti,ab,kw OR 'infra structur*':ti,ab,kw OR mentor*:ti,ab,kw OR mentee*:ti,ab,kw OR 'needs assess*':ti,ab,kw OR ((need* NEAR/2 (meet* OR met OR unmet)):ti,ab,kw) OR 'professional development':ti,ab,kw OR 'self sufficien*':ti,ab,kw OR 'self support*':ti,ab,kw OR 'strategic plan*':ti,ab,kw OR syllabi:ti,ab,kw OR syllabus*:ti,ab,kw OR telecytol*:ti,ab,kw OR 'tele cytol*':ti,ab,kw OR telemed*:ti,ab,kw OR 'tele med*':ti,ab,kw OR telepathol*:ti,ab,kw OR 'tele pathol*':ti,ab,kw OR turnaround*:ti,ab,kw OR 'turn around*':ti,ab,kw OR 'wait time*':ti,ab,kw OR workaround*:ti,ab,kw OR 'work around*':ti,ab,kw OR workflow*:ti,ab,kw OR 'work flow*':ti,ab,kw OR workload*:ti,ab,kw OR 'work load*':ti,ab,kw
9	((advisor* OR capacit* OR coalition* OR facility OR facilities OR financ* OR fund OR funded OR funding OR funds OR intercontinent* OR 'inter continent*' OR intergovernment* OR 'inter government*' OR institution* OR international* OR laborator* OR leader* OR monetary OR national* OR pathology OR personnel* OR program* OR regional* OR service* OR technician* OR 'work force*' OR workforce* OR workgroup* OR 'work group*' OR 'working group*') NEAR/3 (access OR accredit* OR adequa* OR availab* OR barrier* OR build* OR built OR capabil* OR capabl* OR credential* OR centralis* OR centraliz* OR coach* OR competen* OR decentrali* OR discrepen* OR disincentiv* OR efficien* OR enhanc* OR equipp* OR equipt* OR expand* OR expansion* OR framework* OR 'frame work*' OR impact* OR implement* OR improve* OR improving OR inadequa* OR incentiv* OR inefficien* OR initiativ* OR innovat* OR insufficient* OR limited* OR network OR networks OR optimisa* OR optimise* OR optimisi* OR optimiz* OR outreach* OR partner* OR performance* OR rebuil* OR reenhanc* OR reimplement* OR reimprov* OR reform* OR reinnovat* OR

	reorganis* OR reorganiz* OR rescale* OR rescaling OR resource* OR restrengthen* OR restructure* OR retain* OR retention OR 'scal* up' OR shortage* OR shortcoming* OR 'short coming*' OR strengthen* OR sufficient* OR success* OR sustain* OR unsuccessful* OR uptake*)):ti,ab,kw
10	((lab OR labs OR laborator* OR facility OR facilities OR histology OR histologist* OR pathology OR pathologist*) NEAR/2 (capacit* OR establish* OR knowledge OR reestablish* OR remote* OR skill* OR virtual* OR quality)):ti,ab,kw
11	((documentation OR report* OR form OR forms) NEAR/3 (appropriate* OR complet* OR correct OR error* OR incorrect OR inappropriat* OR incomplete* OR insufficient OR nonstandard* OR quality OR sufficient OR standard*)):ti,ab,kw
12	((class OR classes OR course* OR curricul* OR didactic OR educat* OR lecture* OR learn* OR module* OR pedagog* OR practicum* OR seminar* OR teach* OR train* OR tutorial* OR workshop* OR 'work shop*') NEAR/3 (asynchronous OR competenc* OR distance OR global OR 'hands on' OR 'in country' OR 'in person' OR inperson OR inservice OR 'in service' OR international OR local OR online OR onsite OR 'on site' OR outreach* OR patholog* OR professional OR program* OR regional OR synchronous OR vocational)):ti,ab,kw
13	#8 OR #9 OR #10 OR #11 OR #12
14	#6 AND #7 AND #13
15	#14 AND ([english]/lim OR [portuguese]/lim)
16	#15 NOT ([animals]/lim NOT [humans]/lim)

Cochrane Central Register of Controlled Trials (Wiley)

1	(Acid-Schiff* OR (Antigen NEXT retrieval*) OR Clinicopathology OR Clinico-pathology OR Clinicopathologist* OR Cryomicrotom* OR Cytochemist* OR Cyto-chemist* OR Cytodiagnos* OR Cyto-diagnos* OR Cytology OR Cytologist* OR Cytopathology OR Cyto-pathology OR Cytopathologist* OR Decalcification OR Decalcification OR "Diagnostic facility" OR "Diagnostic facilities" OR ("Fluorescent Antibody" NEXT Technique*) OR Histochemist* OR Histo-chemist* OR Histocytochemist* OR Histo-cytochemist* OR Histocytolog* OR Histologist* OR Histopathology OR Histo-pathology OR Histopathologist* OR Histotechnolog* OR Histo-technolog* OR Immunochemist* OR Immuno-chemist* OR Immunocytochemist* OR Immunohistochemist* OR Immunohistolog* OR Immuno-histolog* OR Immunoperoxidase OR Immuno-peroxidase OR Immunophosphatase OR Immunophosphatase OR LNR OR LNRs OR (Lymph* NEXT node* NEXT ratio*) OR (Medical NEXT technologist*) OR Microdissect* OR Micro-dissect* OR Microsection* OR Micro-section* OR Microtome* OR Microtomy OR (Molecular NEXT diagnos*) OR Neuropathology OR Neuro-pathology OR Neuropathologist* OR Oncopathology OR
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	Onco-pathology OR Oncopathologist* OR Pathologist* OR (Paraffin* NEXT Embedd*) OR "Prussian Blue" OR (Silver NEXT Stain*) OR Telepathol* OR Tele-pathol*):ti,ab,kw
2	((Lab OR Labs OR Laborator*) NEAR/3 (Clinic* OR Diagnos* OR Facility OR Facilities OR Health* OR Medical OR Medicine OR Network* OR Professional* OR Report* OR Result OR Results OR Service* OR System OR Systems)):ti,ab,kw
3	((Biopsy OR Biopsies OR Section OR Sections OR Smear* OR Specimen* OR Tissue*) NEAR/2 (Affix* OR Embed* OR Fixat* OR Frozen OR Gross OR Handl* OR Microarray* OR Micro-array* OR Preparation* OR Prepare* OR Prepared OR Preserv* OR React* OR Stain* OR Technique* OR Test OR Tests OR Tested OR Testing)):ti,ab,kw
4	((Histology OR Pathology) NEAR/2 (Anatomic* OR Center OR Centers OR Centre OR Centres OR Clinical OR Department* OR Diagnos* OR Digital* OR Education* OR Facility OR Facilities OR General* OR Lab OR Labs OR Laborator* OR Medical OR Molecular OR Network* OR Personnel* OR Profession* OR Program* OR Report* OR Result OR Results OR Service* OR Tech OR Technician* OR Train* OR Unit*)):ti,ab,kw
5	((Histology OR Lab OR Labs OR Laborator* OR Pathology) NEXT (Assistant* OR Attending* OR Personnel* OR Scientist* OR Tech OR Techs OR Technician* OR Staff)):ti,ab,kw
6	#1 OR #2 OR #3 OR #4 OR #5
7	(Angola* OR Basotho* OR Benin* OR Bissau* OR Botswana* OR Burkina* OR Burundi* OR Cameroon* OR ((Cabo OR Cape) NEXT Verde*) OR (Central NEXT Africa*) OR Chad OR Chadian* OR Comorian* OR Comoros OR Congan* OR Congo OR Congolese OR (Cote NEXT dIvoire*) OR Djibouti* OR (East* NEXT Africa*) OR Equatoguinean* OR Eritrea* OR Eswatini* OR Ethiopia* OR Gabon* OR Gambia OR Gambian* OR Ghana* OR Guinea* OR Ivorian* OR (Ivory NEXT Coast*) OR Kenya* OR Lesotho* OR Liberia* OR Madagasca* OR Mahore* OR Malawi* OR Mali OR Malian* OR Mauritania* OR Mauriti* OR Mayotte* OR Mosotho* OR Mozambi* OR Namibia* OR Niger* OR ((Nonmediterranean OR Non-Mediterranean) NEAR/2 Africa*) OR ((Reunion) NEAR/2 (Department OR Island OR Region)) OR Reunionese OR Rwanda* OR Sahara OR Saharan OR Sahel* OR Santomean* OR ("Sao Tome" NEXT Principe*) OR Senegal* OR Seychell* OR (Sierra NEXT Leone*) OR Somali* OR (South* NEXT Africa*) OR Subsahara* OR Sudan* OR Swaziland* OR Tanzania* OR Togo* OR Uganda* OR (West* NEXT Africa*) OR Zambia* OR Zimbabwe*):ti,ab,kw
8	(Benchmark* OR (Bench NEXT mark*) OR (Diagnos* NEAR/2 (Delay* OR Speed OR Timely)) OR Infrastructur* OR (Infra NEXT structur*) OR Mentor* OR Mentee* OR (Needs NEXT assess*) OR (Need* NEAR/2 (Meet* OR Met OR Unmet)) OR "Professional Development" OR Self-sufficien* OR Self-support* OR (Strategic NEXT plan*) OR Syllabi OR Syllabus* OR Telecytol* OR Tele-cytol* OR Telemed* OR Tele-med* OR Telepathol* OR Tele-pathol* OR Turnaround* OR Turn-around* OR (Wait

	NEXT time*) OR Workaround* OR (Work NEXT around*) OR Workflow* OR (Work NEXT flow*) OR Workload* OR (Work NEXT load*)):ti,ab,kw
9	(((Advisor* OR Capacit* OR Coalition* OR Facility OR Facilities OR Financ* OR Fund OR Funded OR Funding OR Funds OR Intercontinent* OR Inter-continent* OR Intergovernment* OR Inter-government* OR Institution* OR International* OR Laborator* OR Leader* OR Monetary OR National* OR Pathology OR Personnel* OR Program* OR Regional* OR Service* OR Technician* OR (Work NEXT force*) OR Workforce* OR Workgroup* OR (Work NEXT group*) OR (Working NEXT group*)) NEAR/3 (Access OR Accredite* OR Adequa* OR Availab* OR Barrier* OR Build* OR Built OR Capabil* OR Capabl* OR Credential* OR Centralis* OR Centraliz* OR Coach* OR Competen* OR Decentrali* OR Discrepen* OR Disincentiv* OR Efficien* OR Enhanc* OR Equipp* OR Equipt* OR Expand* OR Expansion* OR Framework* OR (Frame NEXT work*) OR Impact* OR Implement* OR Improve* OR Improving OR Inadequa* OR Incentiv* OR Inefficien* OR Initiativ* OR Innovat* OR Insufficient* OR Limited* OR Network OR Networks OR Optimisa* OR Optimise* OR Optimisi* OR Optimiz* OR Outreach* OR Partner* OR Performance* OR Rebuil* OR Reenhanc* OR Reimplement* OR Reimprov* OR Reform* OR Reinnoval* OR Reorganis* OR Reorganiz* OR Rescale* OR Rescaling OR Resource* OR Restrengthen* OR Restructure* OR Retain* OR Retention OR (Scal* NEXT up) OR Shortage* OR Shortcoming* OR Short-coming* OR Strengthen* OR Sufficient* OR Success* OR Sustain* OR Unsuccess* OR Uptake*)):ti,ab,kw)
10	(((Lab OR Labs OR Laborator* OR Facility OR Facilities OR Histology OR Histologist* OR Pathology OR Pathologist*) NEAR/2 (Capacit* OR Establish* OR Knowledge OR Reestablish* OR Remote* OR Skill* OR Virtual* OR Quality)):ti,ab,kw)
11	(((Documentation OR Report* OR Form OR Forms) NEAR/3 (Appropriate* OR Complet* OR Correct OR Error* OR Incorrect OR Inappropriat* OR Incomplete* OR Insufficient OR Nonstandard* OR Quality OR Sufficient OR Standard*)):ti,ab,kw)
12	(((Class OR Classes OR Course* OR Curricul* OR Didactic OR Educat* OR Lecture* OR Learn* OR Module* OR Pedagog* OR Practicum* OR Seminar* OR Teach* OR Train* OR Tutorial* OR Workshop* OR (Work NEXT shop*)) NEAR/3 (Asynchronous OR Competenc* OR Distance OR Global OR Hands-on OR In-country OR In-person OR Inperson OR Inservice OR In-service OR International OR Local OR Online OR Onsite OR On-site OR Outreach* OR Patholog* OR Professional OR Program* OR Regional OR Synchronous OR Vocational)):ti,ab,kw)
13	#8 OR #9 OR #10 OR #11 OR #12
14	#6 AND #7 AND #13

African Index Medicus
[\(https://search.bvsalud.org/aimafro/\)](https://search.bvsalud.org/aimafro/)

tw:("Acid Schiff" OR "Antigen retrieval" OR clinicopathology OR "Clinico pathology" OR clinicopathologist* OR cryomicrotom* OR cytochemist* OR "Cyto chemist" OR "Cyto chemistry" OR "Cyto chemists" OR cytodiagnos* OR "Cyto diagnoses" OR "Cyto diagnosis" OR "Cyto diagnostic" OR "Cyto diagnostics" OR cytology OR cytologist* OR cytopathology OR "Cyto pathology" OR cytopathologist* OR decalcification OR "De calcification" OR "Diagnostic facility" OR "Diagnostic facilities" OR "Fluorescent Antibody Technique" OR "Fluorescent Antibody Techniques" OR histochemist* OR "Histo chemist" OR "Histo chemistry" OR "Histo chemists" OR histocytochemist* OR "Histo cytochemist" OR "Histo cytochemistry" OR "Histo cytochemists" OR histocytolog* OR histology OR histologist* OR histopathology OR "Histo pathology" OR histopathologist* OR histotechnolog* OR "Histo technologies" OR "Histo technologist" OR "Histo technologists" OR "Histo technology" OR immunochemist* OR "Immuno chemist" OR "Immuno chemistry" OR "Immuno chemists" OR immunocytochemist* OR "Immuno cytochemistry" OR immunohistochemist* OR "Immuno histochemistry" OR immunohistolog* OR "Immuno histology" OR immunoperoxidase OR "Immuno peroxidase" OR immunophosphatase OR "Immuno phosphatase" OR lnr OR lnr OR "Lymph node ratio" OR "Lymph node ratios" OR "Lymphatic node ratio" OR "Lymphatic node ratios" OR "Medical technologist" OR "Medical technologists" OR microdissect* OR "Micro dissection" OR "Micro dissections" OR microsection* OR "Micro section" OR "Micro sections" OR microtome* OR microtomy OR "Molecular diagnosis" OR "Molecular diagnoses" OR "Molecular diagnostic" OR "Molecular diagnostics" OR neuropathology OR "Neuro pathology" OR neuropathologist* OR oncopathology OR oncopathologist* OR "Paraffin Embedding" OR pathology OR pathologist* OR "Prussian Blue" OR "Silver Stain" OR "Silver Staining" OR "Silver Stains" OR telepathol*) AND (la:("en" OR "pt"))

Appendix 2: Data extraction tool

Study characteristics

- First Author
- Year of publication
- Journal
- Setting (pathology laboratory, community hospital, referral hospital, etc.)
- Country/geographic region
- Study design
- Study aims
- Methods
- Study conclusions

Participants

- Who was involved in the study
- Number of participants/labs/studies
- Study period/literature search date
- Size of laboratory (number of specimens or personnel)

Concept

Anatomic pathology services available

Quality assurance/quality improvement monitoring system

Intervention

Intervention aim(s)

Implementation strategy

Facilitators of intervention

Barriers of intervention

Target group(s)

Implementation outcome(s) evaluated

Dissemination

Service system outcome(s) evaluated

Clinical outcome(s) evaluated

Measurement details

Measures used

Scale used

Length of time measured

Author identified limitations

Author identified research opportunities

Comments

BMJ Open

Efforts to strengthen anatomic pathology diagnostic services for cancer in sub-Saharan Africa: a scoping review protocol

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2024-089425.R2
Article Type:	Protocol
Date Submitted by the Author:	13-Jan-2025
Complete List of Authors:	Ng, Dianna; Memorial Sloan Kettering Cancer Center, Department of Pathology Edelweiss, Marcia; Memorial Sloan Kettering Cancer Center, Department of Pathology Kimambo, Asteria; Muhimbili University of Health and Allied Sciences, Department of Pathology Vuhahula, Edda; Muhimbili University of Health and Allied Sciences, Department of Pathology Mushi, Beatrice; Muhimbili University of Health and Allied Sciences Adegoke, Omolade; University of Ibadan, Department of Pathology Goldberg, Johanna; Memorial Sloan Kettering Cancer Center, Research Information Services Ibrahim, Pendo; Muhimbili University of Health and Allied Sciences Illonga, Zainab; Muhimbili University of Health and Allied Sciences Jackman, Julia; Memorial Sloan Kettering Cancer Center, Department of Surgery Jami, Luisa; Maputo Central Hospital, Department of Pathology Van Loon, Katherine ; University of California San Francisco, Department of Medicine Mmbaga, Elia John; Muhimbili University of Health and Allied Sciences, Department of Epidemiology and Biostatistics; University of Oslo, Department of Community Medicine and Global Health
Primary Subject Heading:	Pathology
Secondary Subject Heading:	Global health
Keywords:	Quality Improvement, PATHOLOGY, ONCOLOGY

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Manuscripts

Title: Efforts to strengthen anatomic pathology diagnostic services for cancer in sub-Saharan Africa: a scoping review protocol

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ABSTRACT

Introduction: Sub-Saharan Africa bears a disproportionate burden of cancer-related morbidity and mortality compared to high-resource settings. Although pathology services are essential to providing optimal oncologic care, diagnostic capacity in sub-Saharan Africa is insufficient for the cancer burden. This scoping review will be conducted to summarize the current state of practices and evidence for interventions and implementation strategies to improve anatomic pathology services for cancer in the region. The objective of this scoping review is to describe efforts to strengthen capacity for anatomic pathology services in sub-Saharan Africa. The information gathered will be used to inform the design of future pathology capacity-building interventions. The primary aim of the scoping review is to comprehensively map the existing evidence on initiatives aimed at enhancing the capacity for pathology services.

Methods and analysis: This study will follow Joanna Briggs Institute methodology for scoping reviews. MEDLINE, Embase, Cochrane Central, and African Index Medicus will be searched for articles published in English and Portuguese with no limitations placed on date or publication type. A limited search for grey literature will be conducted using the WHO Institutional Repository for Information Sharing. Two independent reviewers will screen all articles, extract data, and complete the descriptive analysis. All discrepancies will be resolved using a third reviewer. The results will be reported using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for scoping reviews (PRISMA-ScR). This review will consider scientific literature from published primary studies as well as scoping and systematic reviews related to capacity building efforts to strengthen anatomic pathology services in any sub-Saharan African country. All study designs will be considered, including quantitative, qualitative, and/or mixed-methods studies.

Ethics and dissemination:

Ethical approval is not required for this study. Dissemination of findings from this work will include the publication of the results in a peer-reviewed journal and presentations at conferences.

Registration details: Open Science Framework, <https://osf.io/6cmhg>

Word count: 1,844

ARTICLE SUMMARY

Strengths and limitations of this study

- A systematic and comprehensive search of electronic databases will ensure that all peer-reviewed evidence is identified.
- Members of the research team include key stakeholders involved in capacity strengthening of pathology services in sub-Saharan Africa, which will help to strengthen the validity of the findings.
- A formal assessment of the quality of evidence will not be performed and may lead to the inclusion of studies with a range of quality.
- Decisions made to reduce the volume of results may omit relevant papers in the final review, including missing synonyms in the search, filtering for human studies, and including only articles written in English or Portuguese.
- The search for grey literature will be limited to the World Health Organization (WHO) publications available in their Institutional Repository for Information Sharing (IRIS) database, which may also omit relevant papers in the final review.

Keywords: Africa, Oncology, Pathology, Quality Improvement

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INTRODUCTION

Sub-Saharan Africa (SSA) faces a growing burden of cancer with pathology services that are inadequately prepared to meet this public health challenge. High quality pathology services are essential to cancer care and are required for accurate and timely diagnosis, prognosis, and selection of optimal treatments.[1] Although the World Health Organization's (WHO) "Model List of Essential *In Vitro* Diagnostics" includes tests necessary for cancer diagnosis such as immunohistochemistry (IHC) and flow cytometry, many of these recommended assays are not widely available in SSA.[2–4] In fact, a recent survey of large, referral pathology laboratories in SSA found that only half provided onsite immunohistochemistry services.[4] These disparities are in part attributable to an insufficient number of trained personnel, reagent and equipment shortages, and variable specimen processing protocols.[4]

Several groups, including the Lancet Commission on diagnostics and African Strategies for Advancing Pathology, have previously provided roadmaps or suggestions on how to best improve pathology services in SSA.[3,5,6] Recommendations have included conducting situational analyses to determine the current state of pathology practices and to gain a better understanding of the existing capacity, resources, and infrastructure.[5] Additional proposals include interventions that introduce or bolster governance and regulatory frameworks to support quality, provide additional training to increase the number of skilled pathology personnel, and increased investment in pathology infrastructure, including establishing reliable supply chains, specimen transport processes, specimen reporting, and archiving.[3,5–8] To help better inform future guidelines and interventions, a rigorous review of the literature is needed to give an overview of the extent and range of prior pathology capacity building efforts across SSA. While the disparities in pathology services have been well-described in the literature, there has not been a synthesis of attempted interventions that have

been used to improve pathology services.[5,9–12] Many of the published interventions to improve pathology services in low-resource settings have primarily involved intensive training, telepathology, and greater access to new equipment and reagents.[9,11–13] Assessment of clinical impact has also mainly been limited to effect on turnaround time and volume of cases diagnosed.[10–12] Moreover, it is unknown what implementation strategies have been used to deploy these interventions. The implementation and service outcomes, as defined by the Outcomes for Implementation Research framework, are also often not well delineated.[14,15] Elucidating contextual factors such as barriers and facilitators, can provide insight into the design, deployment, and success of an intervention. Furthermore, understanding how interventions were introduced, monitored, and sustained will help to inform the design of future capacity strengthening initiatives. Therefore the primary aim of the scoping review is to systematically map the existing evidence on initiatives aimed at enhancing the capacity for pathology services.

This review will focus on anatomic pathology services, which is defined as examinations of organs and tissues for the purpose of diagnosing cancer, and includes tests such as histopathology, immunohistochemistry, molecular assays, and flow cytometry, among others. While clinical pathology services are related and critical to cancer care, the challenges, gaps in practice, and interventions to address those gaps may be markedly different than those seen in anatomic pathology and will therefore not be included in this scoping review. For example, clinical pathology services, which include the fields of blood banking, microbiology, hematology, and clinical chemistry, primarily perform tests on bodily fluids, such as blood or urine. Overall, the data on successful capacity strengthening interventions have not been well-described. This review will identify the primary gaps in anatomic pathology services in

SSA that the interventions intend to address as well as what interventions have been tested, along with details on their implementation, and their impact.

METHODS AND ANALYSIS

The proposed scoping review will be conducted in accordance with Joanna Briggs Institute (JBI) methodology for scoping reviews, including protocol development, screening, data extraction and presentation of results.[16] The Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) will be used to report the study.[17] The protocol was registered on the Open Science Framework (<https://osf.io/6cmhg>). The study is planned to begin in January 2024 and is planned to end by June 2025.

Review questions

What interventions have been implemented to improve anatomic pathology services in SSA?

The following sub-questions will be addressed:

1. What are the primary gaps that the interventions are addressing in anatomic pathology services in SSA?
2. What interventions have been tested in SSA, their implementation strategies, and their outcomes?
3. What were the contexts, barriers, and facilitators of these interventions?

Inclusion and Exclusion criteria

Participants

Inclusion criteria: The review will focus on interventions to improve anatomic pathology services, including interventions targeting individual-, organizational-, or system-level changes in SSA. Therefore, the range in participants may be broad and will include

healthcare providers--including laboratory staff--hospital administrators, and ministries of health, among others.

Exclusion criteria: Studies that focus on non-human populations will be excluded.

Concept

Inclusion criteria: Interventions explicitly targeting the improvement of tissue-based pathology services and laboratories in SSA will be included in the analysis.

Exclusion criteria: Efforts that include pathology services but do not specifically aim to improve diagnostic services for patient care, such as cancer control plans, screening programs, or the development of laboratories exclusively for research, will be excluded.

Initiatives which focus on clinical pathology services will also be excluded.

Context

Inclusion criteria: Studies that focus on anatomic pathology services, such as infrastructure, workflows, diagnostic assays, personnel, supply chains, and quality assurance/quality improvement initiatives, such as laboratory accreditation programs, will be included. We will consider studies conducted in SSA as well as those that target capacity-building for anatomic pathology services in SSA.

Types of sources

Inclusion criteria: This scoping review will consider peer-reviewed articles with quantitative, qualitative, and mixed methods study designs for inclusion. In addition, scoping reviews, systematic reviews, and meta-analyses will be considered for inclusion. Because grey literature published by organizations and scholars from sub-Saharan Africa is often not consistently digitized or curated into searchable databases, and therefore difficult to access, only grey literature available on the WHO Institutional Repository for Information Sharing (IRIS) database will be considered. Results will be limited to items in English and

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Portuguese, which are the languages that members of the review team are fluent in. No limitations will be placed on date.

Exclusion criteria: Opinion pieces (e.g., editorials, commentaries, and letters to the editor), and critical reviews as defined by Grant and Booth will be excluded[18].

Search strategy

A preliminary search of MEDLINE and PROSPERO was conducted in November 2023, and no other scoping reviews on the topic were identified as in progress or completed. The librarian continued to look for reviews related to the topic during the search building process, which ran from November 2023 to early January 2024.

For the study, a medical librarian (JG) will design the scoping review search in Ovid Medline ALL. Subject headers and keywords reflecting three topics—pathology, SSA, and capacity-building—will be combined using Boolean and adjacency operators. A second librarian will perform a PRESS review of the search, which will then translate to Embase (Elsevier) and Cochrane Central Register of Controlled Trials (Wiley) with the help of the Systematic Review Accelerator's Polyglot Tool.[14,15] In Medline and Embase, the Cochrane filter for human studies will be utilized.[16] A simplified version of the search, using only keywords relating to pathology, will be developed in African Index Medicus (<https://search.bvsalud.org/aimafro/>). A limited search for grey literature will be developed in WHO IRIS (<https://iris.who.int/>). View the complete search strategies for all databases in Appendix 1. The reference list of all included sources of evidence will be screened for additional studies. To make up for any potential omissions, we will perform a forward and backward reference check of the items selected for inclusion in the review.

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Study/Source of evidence selection

Following the search, all identified citations will be imported into the systematic review management tool Covidence (Veritas Health Innovation, Melbourne, Australia), which will remove duplicates. Titles and abstracts will then be screened by 2 independent reviewers for assessment against the inclusion criteria for the review. Potentially relevant sources will be retrieved in full, with citation details imported into Covidence. The full text of selected citations will be assessed in detail against the inclusion criteria by 2 independent reviewers. Reasons for exclusion of sources of evidence at full text that do not meet the inclusion criteria will be recorded and reported in the scoping review. Any disagreements that arise between the reviewers at each stage of the selection process will be adjudicated by a third reviewer and/or further discussion among the review team. The results of the search and the study inclusion process will be reported in full in the final scoping review and presented in a PRISMA-ScR flow diagram. [12]

Data extraction

Two independent reviewers will extract data from relevant articles using a data extraction tool developed by the review team. A draft data extraction form is presented in Appendix 2. The initial draft of the data extraction tool is based on the tool developed by Ashoor, et al. and Proctor’s framework on implementation research outcomes. [10,17] The data extraction tool will be modified and revised as needed during the data extraction process. Modifications will be detailed in the scoping review. Any disagreements that arise between the reviewers will be resolved through discussion or with a third reviewer.

Data analysis and presentation

The data extracted from each included article will be presented in a tabular or diagrammatic format. Descriptive frequencies, counts, and thematic analysis will be included along with the tabulated results and will describe how the results relate to the objectives of the review. Thematic analysis will be guided by the Outcomes for Implementation Research framework.[14] Gaps in the literature, effective implementation strategies, and areas of further research in how to effectively improve pathology services in SSA will be identified.

Patient and public involvement

There will be no patient or public involvement in this study.

Limitations

Limitations in this protocol include decisions made to reduce the number of results may omit relevant papers in the final review. For example, there may be missing synonyms for some of the search terms, the decision to filter for human-specific studies and selection of studies only in English and Portuguese based on the language proficiencies of the research team. It is also challenging to systematically search for grey literature on this subject. Therefore, we will focus only on grey literature available in the WHO IRIS database.

DISCUSSION

Our scoping review will aim to provide insight into the existing evidence as well as gaps on interventions intended to improve pathology services in SSA. By exploring previous and interventions, their targeted gaps, and outcomes, we can better understand which implementation strategies are the most effective in improving diagnostic capacity in resource constrained settings. Therefore this review will provide insights into how to best design and implement future interventions to reduce disparities in tissue-based diagnostics in SSA.

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ETHICS AND DISSEMINATION

Ethical approval is not required for the planned scoping review. All data will be obtained from publicly available documents, and no primary data will be generated. The findings from this work includes publication of the results in a peer-reviewed journal and presentations at conferences.

FUNDING

Members of the research team receive support from the Fogarty International Center and National Cancer Institute Award Number D43TW011598 (AHK, EJM, KVL), the NCI Award Number K08CA263299 (DLN); Cancer Center Support Grant (P30 CA008748) and from the University of California, San Francisco (UCSF) Helen Diller Family Comprehensive Cancer Center (BPM, ZI, PMI, KVL). The content is solely the responsibility of the authors and does not necessarily represent the official views of the U.S. National Institutes of Health.

AUTHOR CONTRIBUTIONS

DLN conceptualized and designed the study. DLN and JG and wrote the original draft of the protocol. JG provided methodological expertise. All authors were involved in the review and editing of the manuscript. DLN is the guarantor. All authors reviewed the manuscript and gave their approval for the final version of the work to be published and agreed to be accountable for the integrity of the work published.

COMPETING INTERESTS

The authors have no conflicts of interest to disclose.

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APPENDIX

Appendix 1: Search strategy

Ovid Medline ALL

1	exp "Clinical Laboratory Services"/ or "Clinical Laboratory Techniques"/ or Cytodiagnosis/ or Decalcification technique/ or exp Dissection/ or Fluorescent antibody technique/ or Fluorescent antibody technique, direct/ or Fluorescent antibody technique, indirect/ or Histochemistry/ or Histocytological preparation techniques/ or Histological techniques/ or Immunohistochemistry/ or In situ hybridization, fluorescence/ or exp Laboratories/ or Lymph node ratio/ or exp "Medical Laboratory Personnel"/ or Microdissection/ or exp microtomy/ or exp molecular diagnostic techniques/ or Neuropathology/ or exp Pathologists/ or Pathology/ or exp "Pathology, Clinical"/ or "Pathology, Molecular"/ or "Pathology, Surgical"/ or periodic acid-schiff reaction/ or prussian blue reaction/ or silver staining/ or specimen handling/ or "staining and labeling"/ or Telepathology/ or exp tissue embedding/ or tissue fixation/ or tissue preservation/ or Acid-Schiff*.ti,ab,kf. or Antigen retrieval*.ti,ab,kf. or Clinicopathology.ti,ab,kf. or Clinico-pathology.ti,ab,kf. or Clinicopathologist*.ti,ab,kf. or Cryomicrotom*.ti,ab,kf. or Cytochemist*.ti,ab,kf. or Cyto-chemist*.ti,ab,kf. or Cytodiagnos*.ti,ab,kf. or Cyto-diagnos*.ti,ab,kf. or Cytology.ti,ab,kf. or Cytologist*.ti,ab,kf. or Cytopathology.ti,ab,kf. or Cyto-pathology.ti,ab,kf. or Cytopathologist*.ti,ab,kf. or Decalcification.ti,ab,kf. or De-calcification.ti,ab,kf. or Diagnostic facility.ti,ab,kf. or Diagnostic facilities.ti,ab,kf. or Fluorescent Antibody Technique*.ti,ab,kf. or Histochemist*.ti,ab,kf. or Histo-chemist*.ti,ab,kf. or Histocytochemist*.ti,ab,kf. or Histo-cytochemist*.ti,ab,kf. or Histocytolog*.ti,ab,kf. or Histologist*.ti,ab,kf. or Histopathology.ti,ab,kf. or Histo-pathology.ti,ab,kf. or Histopathologist*.ti,ab,kf. or Histotechnolog*.ti,ab,kf. or Histo-technolog*.ti,ab,kf. or Immunochemist*.ti,ab,kf. or Immuno-chemist*.ti,ab,kf. or Immunocytochemist*.ti,ab,kf. or Immunohistochemist*.ti,ab,kf. or Immunohistolog*.ti,ab,kf. or Immuno-histolog*.ti,ab,kf. or Immunoperoxidase.ti,ab,kf. or Immuno-peroxidase.ti,ab,kf. or Immunophosphatase.ti,ab,kf. or Immuno-phosphatase.ti,ab,kf. or LNR.ti,ab,kf. or LNRs.ti,ab,kf. or Lymph* node* ratio*.ti,ab,kf. or Medical technologist*.ti,ab,kf. or Microdissect*.ti,ab,kf. or Micro-dissect*.ti,ab,kf. or Microsection*.ti,ab,kf. or Micro-section*.ti,ab,kf. or Microtome*.ti,ab,kf. or Microtomy.ti,ab,kf. or Molecular diagnos*.ti,ab,kf. or Neuropathology.ti,ab,kf. or Neuro-pathology.ti,ab,kf. or Neuropathologist*.ti,ab,kf. or Oncopathology.ti,ab,kf. or Onco-pathology.ti,ab,kf. or Oncopathologist*.ti,ab,kf. or Pathologist*.ti,ab,kf. or Paraffin* Embedd*.ti,ab,kf. or Prussian Blue.ti,ab,kf. or Silver Stain*.ti,ab,kf. or Telepathol*.ti,ab,kf. or Tele-pathol*.ti,ab,kf.
2	((Lab or Labs or Laborator*) adj3 (Clinic* or Diagnos* or Facility or Facilities or Health* or Medical or Medicine or Network* or Professional* or Report* or Result or Results or Service* or System or Systems)).ti,ab,kf.

3	((Biopsy or Biopsies or Section or Sections or Smear* or Specimen* or Tissue*) adj2 (Affix* or Embed* or Fixat* or Frozen or Gross or Handl* or Microarray* or Microarray* or Preparation* or Prepare* or Prepared or Preserv* or React* or Stain* or Technique* or Test or Tests or Tested or Testing)).ti,ab,kf.
4	((Histology or Pathology) adj2 (Anatomic* or Center or Centers or Centre or Centres or Clinical or Department* or Diagnos* or Digital* or Education* or Facility or Facilities or General* or Lab or Labs or Laborator* or Medical or Molecular or Network* or Personnel* or Profession* or Program* or Report* or Result or Results or Service* or Tech or Technician* or Train* or Unit*)).ti,ab,kf.
5	((Histology or Lab or Labs or Laborator* or Pathology) adj (Assistant* or Attending* or Personnel* or Scientist* or Tech or Techs or Technician* or Staff)).ti,ab,kf.
6	or/1-5
7	Africa/ or African People/ or exp "Africa South of the Sahara"/ or "Mauritius"/ or "Reunion"/ or exp "Sub-Saharan African People"/ or Angola*.ti,ab,kf,cp,ia. or Basotho*.ti,ab,kf. or Benin*.ti,ab,kf,cp,ia. or Bissau*.ti,ab,kf,cp,ia. or Botswana*.ti,ab,kf,cp,ia. or Burkina*.ti,ab,kf,cp,ia. or Burundi*.ti,ab,kf,cp,ia. or Cameroon*.ti,ab,kf,cp,ia. or Cabo Verde*.ti,ab,kf,cp,ia. or Cape Verde*.ti,ab,kf,cp,ia. or Central Africa*.ti,ab,kf,cp,ia. or Chad.ti,ab,kf,cp,ia. or Chadian*.ti,ab,kf. or Comorian*.ti,ab,kf. or Comoros.ti,ab,kf,cp,ia. or Congan*.ti,ab,kf. or Congo.ti,ab,kf,cp,ia. or Congolese.ti,ab,kf. or Cote d'Ivoire*.ti,ab,kf,cp,ia. or Djibouti*.ti,ab,kf,cp,ia. or East* Africa*.ti,ab,kf. or Equatoguinean*.ti,ab,kf. or Eritrea*.ti,ab,kf,cp,ia. or Eswatini*.ti,ab,kf,cp,ia. or Ethiopia*.ti,ab,kf,cp,ia. or Gabon*.ti,ab,kf,cp,ia. or Gambia.ti,ab,kf,cp,ia. or Gambian*.ti,ab,kf,cp,ia. or Ghana*.ti,ab,kf,cp,ia. or Guinea*.ti,ab,kf,cp,ia. or Ivorian*.ti,ab,kf. or Ivory Coast*.ti,ab,kf,cp,ia. or Kenya*.ti,ab,kf,cp,ia. or Lesotho*.ti,ab,kf,cp,ia. or Liberia*.ti,ab,kf,cp,ia. or Madagascar*.ti,ab,kf,cp,ia. or Mahore*.ti,ab,kf,cp,ia. or Malawi*.ti,ab,kf,cp,ia. or Mali.ti,ab,kf,cp,ia. or Malian*.ti,ab,kf. or Mauritania*.ti,ab,kf,cp,ia. or Mauriti*.ti,ab,kf,cp,ia. or Mayotte*.ti,ab,kf,cp,ia. or Mosotho*.ti,ab,kf. or Mozambi*.ti,ab,kf,cp,ia. or Namibia*.ti,ab,kf,cp,ia. or Niger*.ti,ab,kf,cp,ia. or (Nonmediterranean adj2 Africa*).ti,ab,kf. or (Non-Mediterranean adj2 Africa*).ti,ab,kf. or (Reunion adj2 (Department or Island or Region)).ti,ab,kf,cp,ia. or Reunionese.ti,ab,kf. or Rwanda*.ti,ab,kf,cp,ia. or Sahara.ti,ab,kf,cp,ia. or Saharan.ti,ab,kf,cp,ia. or Sahel*.ti,ab,kf. or Santomean*.ti,ab,kf. or (Sao Tome adj Principe*).ti,ab,kf,cp,ia. or Senegal*.ti,ab,kf,cp,ia. or Seychell*.ti,ab,kf,cp,ia. or Sierra Leone*.ti,ab,kf,cp,ia. or Somali*.ti,ab,kf,cp,ia. or South* Africa*.ti,ab,kf,cp,ia. or Subsahara*.ti,ab,kf,cp,ia. or Sudan*.ti,ab,kf,cp,ia. or Swaziland*.ti,ab,kf,cp,ia. or Tanzania*.ti,ab,kf,cp,ia. or Togo*.ti,ab,kf,cp,ia. or Uganda*.ti,ab,kf,cp,ia. or West* Africa*.ti,ab,kf. or Zambia*.ti,ab,kf,cp,ia. or Zimbabwe*.ti,ab,kf,cp,ia.
8	exp "Capacity Building"/ or "Cost-Effectiveness Analysis"/ or "Delayed Diagnosis"/ or exp "Education, Distance"/ or exp "Education, Professional"/ or "Financing, Organized"/ or "Financing, Government"/ or "Health Impact Assessment"/ or exp "Inservice Training"/ or exp "International Educational Exchange"/ or "Mentoring"/ or "Mentors"/ or "Needs Assessment"/ or exp "Professional Competence"/ or exp "Program Development"/

	or exp "Program Evaluation"/ or "Quality of Health Care"/ or "Quality Improvement"/ or "Quality Indicators, Health Care"/ or "Strategic Planning"/ or "Telepathology"/ or "Workflow"/ or exp "Workforce"/ or "Workload"/ or Benchmark*.ti,ab,kf. or Bench mark*.ti,ab,kf. or (Diagnos* adj2 (Delay* or Speed or Timely)).ti,ab,kf. or Infrastructur*.ti,ab,kf. or Infra-structur*.ti,ab,kf. or Mentor*.ti,ab,kf. or Mentee*.ti,ab,kf. or Needs assess*.ti,ab,kf. or (Need* adj2 (Meet* or Met or Unmet)).ti,ab,kf. or Professional Development.ti,ab,kf. or Self-sufficien*.ti,ab,kf. or Self-support*.ti,ab,kf. or Strategic plan*.ti,ab,kf. or Syllabi.ti,ab,kf. or Syllabus*.ti,ab,kf. or Telecytol*.ti,ab,kf. or Tele-cytol*.ti,ab,kf. or Telemed*.ti,ab,kf. or Tele-med*.ti,ab,kf. or Telepathol*.ti,ab,kf. or Tele-pathol*.ti,ab,kf. or Turnaround*.ti,ab,kf. or Turn-around*.ti,ab,kf. or Wait time*.ti,ab,kf. or Workaround*.ti,ab,kf. or Work around*.ti,ab,kf. or Workflow*.ti,ab,kf. or Work flow*.ti,ab,kf. or Workload*.ti,ab,kf. or Work load*.ti,ab,kf.
9	((Advisor* or Capacit* or Coalition* or Facility or Facilities or Financ* or Fund or Funded or Funding or Funds or Intercontinent* or Inter-continent* or Intergovernment* or Inter-government* or Institution* or International* or Laborator* or Leader* or Monetary or National* or Pathology or Personnel* or Program* or Regional* or Service* or Technician* or Work force* or Workforce* or Workgroup* or Work group* or Working group*) adj3 (Access or Accredite* or Adequa* or Availab* or Barrier* or Build* or Built or Capabil* or Capabl* or Credential* or Centralis* or Centraliz* or Coach* or Competen* or Decentrali* or Discrepen* or Disincentiv* or Efficien* or Enhanc* or Equipp* or Equip* or Expand* or Expansion* or Framework* or Frame work* or Impact* or Implement* or Improve* or Improving or Inadequa* or Incentiv* or Inefficien* or Initiativ* or Innovat* or Insufficient* or Limited* or Network or Networks or Optimisa* or Optimise* or Optimisi* or Optimiz* or Outreach* or Partner* or Performance* or Rebuil* or Reenhanc* or Reimplement* or Reimprov* or Reform* or Reinnovat* or Reorganis* or Reorganiz* or Rescale* or Rescaling or Resource* or Restrengthen* or Restructure* or Retain* or Retention or Scal* up or Shortage* or Shortcoming* or Short-coming* or Strengthen* or Sufficient* or Success* or Sustain* or Unsuccess* or Uptake*).ti,ab,kf.
10	((Lab or Labs or Laborator* or Facility or Facilities or Histology or Histologist* or Pathology or Pathologist*) adj2 (Capacit* or Establish* or Knowledge or Reestablish* or Remote* or Skill* or Virtual* or Quality)).ti,ab,kf.
11	((Documentation or Report* or Form or Forms) adj3 (Appropriate* or Complet* or Correct or Error* or Incorrect or Inappropriat* or Incomplete* or Insufficient or Nonstandard* or Quality or Sufficient or Standard)).ti,ab,kf.
12	((Class or Classes or Course* or Curricul* or Didactic or Educat* or Lecture* or Learn* or Module* or Pedagog* or Practicum* or Seminar* or Teach* or Train* or Tutorial* or Workshop* or Work shop*) adj3 (Asynchronous or Competenc* or Distance or Global or Hands-on or In-country or In-person or Inperson or Inservice or In-service or International or Local or Online or Onsite or On-site or Outreach* or Patholog* or Professional or Program* or Regional or Synchronous or Vocational)).ti,ab,kf.
13	or/8-12

14	6 and 7 and 13
15	14 and (English or Portuguese).lg.
16	15 not (exp animals/ not humans.sh.)
17	remove duplicates from 16

Embase (Elsevier)

'antigen retrieval'/de OR 'aspiration cytology'/de OR 'brain histology'/de OR 'cancer cytodiagnosis'/de OR 'cancer detection kit'/exp OR 'cancer prognostic test kit'/exp OR 'clinical laboratory personnel'/de OR 'clinical laboratory service'/de OR 'cytochemistry'/exp OR 'cytodiagnosis'/de OR 'cytology'/de OR 'cytopathology'/de OR 'cytometry'/de OR 'digital pathology'/de OR 'direct fluorescent antibody technique'/de OR 'dna microarray kit'/exp OR 'embedding'/exp OR 'fluorescence histochemistry'/de OR 'fluorescence in situ hybridization'/de OR 'fluorescence in situ hybridization kit'/exp OR 'fluorescent antibody technique'/de OR 'frozen section'/de OR 'general pathology'/de OR 'histological techniques equipment and supplies'/de OR 'immunocytochemistry'/de OR 'immunohistochemistry'/de OR 'immunohistology'/de OR 'immunoperoxidase staining'/de OR 'immunophosphatase technique'/de OR 'indirect fluorescent antibody technique'/de OR 'laboratory'/exp OR 'laboratory technique'/de OR 'lymph node ratio'/de OR 'microdissection'/de OR 'microtomy'/exp OR 'molecular diagnostics'/de OR 'molecular pathology'/de OR 'neuropathology'/de OR 'pathological anatomy'/de OR 'pathologist'/exp OR 'pathology'/de OR 'periodic acid-schiff stain'/de OR 'prussian blue staining'/de OR 'silver staining'/de OR 'specimen handling'/de OR 'staining'/de OR 'telepathology'/de OR 'tissue embedding'/exp OR 'tissue fixation'/de OR 'tissue preservation'/de OR 'tissue microarray'/de OR 'uterine cervix cytology'/de OR 'vagina cytology'/de OR 'acid-schiff*':ti,ab,kw OR 'antigen retrieval*':ti,ab,kw OR clinicopathology:ti,ab,kw OR 'clunico pathology':ti,ab,kw OR clinicopathologist*:ti,ab,kw OR cryomicrotom*:ti,ab,kw OR cytochemist*:ti,ab,kw OR 'cyto chemist*':ti,ab,kw OR cytodiagnos*:ti,ab,kw OR 'cyto diagnos*':ti,ab,kw OR cytology:ti,ab,kw OR cytologist*:ti,ab,kw OR cytopathology:ti,ab,kw OR 'cyto pathology':ti,ab,kw OR cytopathologist*:ti,ab,kw OR decalcification:ti,ab,kw OR 'de calcification':ti,ab,kw OR 'diagnostic facility':ti,ab,kw OR 'diagnostic facilities':ti,ab,kw OR 'fluorescent antibody technique*':ti,ab,kw OR histochemist*:ti,ab,kw OR 'histo chemist*':ti,ab,kw OR histocytochemist*:ti,ab,kw OR 'histo cytochemist*':ti,ab,kw OR histocytolog*:ti,ab,kw OR histologist*:ti,ab,kw OR histopathology:ti,ab,kw OR 'histo pathology':ti,ab,kw OR histopathologist*:ti,ab,kw OR histotechnolog*:ti,ab,kw OR 'histo technolog*':ti,ab,kw OR immunochemist*:ti,ab,kw OR 'immuno chemist*':ti,ab,kw OR immunocytochemist*:ti,ab,kw OR immunohistochemist*:ti,ab,kw OR immunohistolog*:ti,ab,kw OR 'immuno histolog*':ti,ab,kw OR immunoperoxidase:ti,ab,kw OR 'immuno peroxidase':ti,ab,kw OR immunophosphatase:ti,ab,kw OR 'immuno phosphatase':ti,ab,kw OR lnr:ti,ab,kw OR lnr:ti,ab,kw OR 'lymph* node* ratio*':ti,ab,kw OR 'medical technologist*':ti,ab,kw OR
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	microdissect*:ti,ab,kw OR 'micro dissect*:ti,ab,kw OR microsection*:ti,ab,kw OR 'micro section*:ti,ab,kw OR microtome*:ti,ab,kw OR microtomy:ti,ab,kw OR 'molecular diagnos*:ti,ab,kw OR neuropathology:ti,ab,kw OR 'neuro pathology':ti,ab,kw OR neuropathologist*:ti,ab,kw OR oncopathology:ti,ab,kw OR 'onco pathology':ti,ab,kw OR oncopathologist*:ti,ab,kw OR pathologist*:ti,ab,kw OR 'paraffin* embedd*:ti,ab,kw OR 'prussian blue':ti,ab,kw OR 'silver stain*:ti,ab,kw OR telepathol*:ti,ab,kw OR 'tele pathol*:ti,ab,kw
2	((lab OR labs OR laborator*) NEAR/3 (clinic* OR diagnos* OR facility OR facilities OR health* OR medical OR medicine OR network* OR professional* OR report* OR result OR results OR service* OR system OR systems)):ti,ab,kw
3	((biopsy OR biopsies OR section OR sections OR smear* OR specimen* OR tissue*) NEAR/2 (affix* OR embed* OR fixat* OR frozen OR gross OR handl* OR microarray* OR 'micro array*' OR preparation* OR prepare* OR prepared OR preserv* OR react* OR stain* OR technique* OR test OR tests OR tested OR testing)):ti,ab,kw
4	((histology OR pathology) NEAR/2 (anatomic* OR center OR centers OR centre OR centres OR clinical OR department* OR diagnos* OR digital* OR education* OR facility OR facilities OR general* OR lab OR labs OR laborator* OR medical OR molecular OR network* OR personnel* OR profession* OR program* OR report* OR result OR results OR service* OR tech OR technician* OR train* OR unit*)):ti,ab,kw
5	((histology OR lab OR labs OR laborator* OR pathology) NEXT/1 (assistant* OR attending* OR personnel* OR scientist* OR tech OR techs OR technician* OR staff)):ti,ab,kw
6	#1 or #2 or #3 or #4 or #5
7	'africa'/de OR 'african'/de OR 'africa south of the sahara'/exp OR 'mauritania'/de OR 'mauritiu's'/de OR 'reunion'/de OR 'sao tome and principe'/de OR 'seychelles'/de OR 'sub-saharan african'/exp OR angola*:ti,ab,kw,ca,cy OR basotho*:ti,ab,kw OR benin*:ti,ab,kw,ca,cy OR bissau*:ti,ab,kw,ca,cy OR botswana*:ti,ab,kw,ca,cy OR burkina*:ti,ab,kw,ca,cy OR burundi*:ti,ab,kw,ca,cy OR cameroon*:ti,ab,kw,ca,cy OR 'cabo verde*:ti,ab,kw,ca,cy OR 'cape verde*:ti,ab,kw,ca,cy OR 'central africa*:ti,ab,kw,ca,cy OR chad:ti,ab,kw,ca,cy OR chadian*:ti,ab,kw OR comorian*:ti,ab,kw OR comoros:ti,ab,kw,ca,cy OR congan*:ti,ab,kw OR congo:ti,ab,kw,ca,cy OR congolese:ti,ab,kw OR 'cote d'ivoire*:ti,ab,kw,ca,cy OR djibouti*:ti,ab,kw,ca,cy OR 'east* africa*:ti,ab,kw OR equatoguinean*:ti,ab,kw OR eritrea*:ti,ab,kw,ca,cy OR eswatini*:ti,ab,kw,ca,cy OR ethiopia*:ti,ab,kw,ca,cy OR gabon*:ti,ab,kw,ca,cy OR gambia:ti,ab,kw,ca,cy OR gambian*:ti,ab,kw,ca,cy OR ghana*:ti,ab,kw,ca,cy OR guinea*:ti,ab,kw,ca,cy OR ivorian*:ti,ab,kw OR 'ivory coast*:ti,ab,kw,ca,cy OR kenya*:ti,ab,kw,ca,cy OR lesotho*:ti,ab,kw,ca,cy OR liberia*:ti,ab,kw,ca,cy OR madagasca*:ti,ab,kw,ca,cy OR mahore*:ti,ab,kw,ca,cy OR malawi*:ti,ab,kw,ca,cy OR mali:ti,ab,kw,ca,cy OR malian*:ti,ab,kw OR mauritania*:ti,ab,kw,ca,cy OR mauriti*:ti,ab,kw,ca,cy OR mayotte*:ti,ab,kw,ca,cy OR mosotho*:ti,ab,kw OR mozambi*:ti,ab,kw,ca,cy OR namibia*:ti,ab,kw,ca,cy OR niger*:ti,ab,kw,ca,cy OR ((nonmediterranean NEAR/2 africa*):ti,ab,kw) OR (('non

	mediterranean' NEAR/2 africa*):ti,ab,kw) OR ((reunion NEAR/2 (department OR island OR region)):ti,ab,kw,ca,cy) OR reunionese:ti,ab,kw OR rwanda*:ti,ab,kw,ca,cy OR sahara*:ti,ab,kw,ca,cy OR sahel*:ti,ab,kw OR santomean*:ti,ab,kw OR (('sao tome' NEXT/1 principe*):ti,ab,kw,ca,cy) OR senegal*:ti,ab,kw,ca,cy OR seychell*:ti,ab,kw,ca,cy OR 'sierra leone*':ti,ab,kw,ca,cy OR somali*:ti,ab,kw,ca,cy OR 'south* africa*':ti,ab,kw,ca,cy OR subsahara*:ti,ab,kw,ca,cy OR sudan*:ti,ab,kw,ca,cy OR swaziland*:ti,ab,kw,ca,cy OR tanzania*:ti,ab,kw,ca,cy OR togo*:ti,ab,kw,ca,cy OR uganda*:ti,ab,kw,ca,cy OR 'west* africa*':ti,ab,kw OR zambia*:ti,ab,kw,ca,cy OR zimbabwe*:ti,ab,kw,ca,cy
8	'benchmark'/de OR 'benchmarking'/exp OR 'capacity'/exp OR 'capacity building'/exp OR 'clinical competence'/de OR 'cost effectiveness analysis'/de OR 'delayed diagnosis'/exp OR 'distance learning'/exp OR 'financial management'/de OR 'health impact assessment'/de OR 'in service training'/de OR 'international cooperation'/de OR 'international relations'/exp OR 'mentor'/de OR 'mentoring'/exp OR 'needs assessment'/de OR 'outreach program'/de OR 'performance measurement system'/de OR 'personnel shortage'/exp OR 'professional competence'/de OR 'professional development'/exp OR 'program development'/de OR 'program evaluation'/exp OR 'public expenditure'/de OR 'public finance'/de OR 'quality indicator'/de OR 'strategic planning'/de OR 'telepathology'/de OR 'total quality management'/de OR 'turnaround time'/de OR 'vocational education'/exp OR 'wait time'/de OR 'workflow'/de OR 'workforce'/exp OR 'workload'/de OR benchmark*:ti,ab,kw OR 'bench mark*':ti,ab,kw OR ((diagnos* NEAR/2 (delay* OR speed OR timely)):ti,ab,kw) OR infrastructur*:ti,ab,kw OR 'infra structur*':ti,ab,kw OR mentor*:ti,ab,kw OR mentee*:ti,ab,kw OR 'needs assess*':ti,ab,kw OR ((need* NEAR/2 (meet* OR met OR unmet)):ti,ab,kw) OR 'professional development':ti,ab,kw OR 'self sufficien*':ti,ab,kw OR 'self support*':ti,ab,kw OR 'strategic plan*':ti,ab,kw OR syllabi:ti,ab,kw OR syllabus*:ti,ab,kw OR telecytol*:ti,ab,kw OR 'tele cytol*':ti,ab,kw OR telemed*:ti,ab,kw OR 'tele med*':ti,ab,kw OR telepathol*:ti,ab,kw OR 'tele pathol*':ti,ab,kw OR turnaround*:ti,ab,kw OR 'turn around*':ti,ab,kw OR 'wait time*':ti,ab,kw OR workaround*:ti,ab,kw OR 'work around*':ti,ab,kw OR workflow*:ti,ab,kw OR 'work flow*':ti,ab,kw OR workload*:ti,ab,kw OR 'work load*':ti,ab,kw
9	((advisor* OR capacit* OR coalition* OR facility OR facilities OR financ* OR fund OR funded OR funding OR funds OR intercontinent* OR 'inter continent*' OR intergovernment* OR 'inter government*' OR institution* OR international* OR laborator* OR leader* OR monetary OR national* OR pathology OR personnel* OR program* OR regional* OR service* OR technician* OR 'work force*' OR workforce* OR workgroup* OR 'work group*' OR 'working group*') NEAR/3 (access OR accredit* OR adequa* OR availab* OR barrier* OR build* OR built OR capabil* OR capabl* OR credential* OR centralis* OR centraliz* OR coach* OR competen* OR decentrali* OR discrepen* OR disincentiv* OR efficien* OR enhanc* OR equipp* OR equipt* OR expand* OR expansion* OR framework* OR 'frame work*' OR impact* OR implement* OR improve* OR improving OR inadequa* OR incentiv* OR inefficien* OR initiativ* OR innovat* OR insufficient* OR limited* OR network OR networks OR optimisa* OR optimise* OR optimisi* OR optimiz* OR outreach* OR partner* OR performance* OR rebuil* OR reenhanc* OR reimplement* OR reimprov* OR reform* OR reinnovat* OR

	reorganis* OR reorganiz* OR rescale* OR rescaling OR resource* OR restrengthen* OR restructure* OR retain* OR retention OR 'scal* up' OR shortage* OR shortcoming* OR 'short coming*' OR strengthen* OR sufficient* OR success* OR sustain* OR unsuccessful* OR uptake*)):ti,ab,kw
10	((lab OR labs OR laborator* OR facility OR facilities OR histology OR histologist* OR pathology OR pathologist*) NEAR/2 (capacit* OR establish* OR knowledge OR reestablish* OR remote* OR skill* OR virtual* OR quality)):ti,ab,kw
11	((documentation OR report* OR form OR forms) NEAR/3 (appropriate* OR complet* OR correct OR error* OR incorrect OR inappropriat* OR incomplete* OR insufficient OR nonstandard* OR quality OR sufficient OR standard*)):ti,ab,kw
12	((class OR classes OR course* OR curricul* OR didactic OR educat* OR lecture* OR learn* OR module* OR pedagog* OR practicum* OR seminar* OR teach* OR train* OR tutorial* OR workshop* OR 'work shop*') NEAR/3 (asynchronous OR competenc* OR distance OR global OR 'hands on' OR 'in country' OR 'in person' OR inperson OR inservice OR 'in service' OR international OR local OR online OR onsite OR 'on site' OR outreach* OR patholog* OR professional OR program* OR regional OR synchronous OR vocational)):ti,ab,kw
13	#8 OR #9 OR #10 OR #11 OR #12
14	#6 AND #7 AND #13
15	#14 AND ([english]/lim OR [portuguese]/lim)
16	#15 NOT ([animals]/lim NOT [humans]/lim)

Cochrane Central Register of Controlled Trials (Wiley)

1	(Acid-Schiff* OR (Antigen NEXT retrieval*) OR Clinicopathology OR Clinico-pathology OR Clinicopathologist* OR Cryomicrotom* OR Cytochemist* OR Cyto-chemist* OR Cytodiagnos* OR Cyto-diagnos* OR Cytology OR Cytologist* OR Cytopathology OR Cyto-pathology OR Cytopathologist* OR Decalcification OR Decalcification OR "Diagnostic facility" OR "Diagnostic facilities" OR ("Fluorescent Antibody" NEXT Technique*) OR Histochemist* OR Histo-chemist* OR Histocytochemist* OR Histo-cytochemist* OR Histocytolog* OR Histologist* OR Histopathology OR Histo-pathology OR Histopathologist* OR Histotechnolog* OR Histo-technolog* OR Immunochemist* OR Immuno-chemist* OR Immunocytochemist* OR Immunohistochemist* OR Immunohistolog* OR Immuno-histolog* OR Immunoperoxidase OR Immuno-peroxidase OR Immunophosphatase OR Immunophosphatase OR LNR OR LNRs OR (Lymph* NEXT node* NEXT ratio*) OR (Medical NEXT technologist*) OR Microdissect* OR Micro-dissect* OR Microsection* OR Micro-section* OR Microtome* OR Microtomy OR (Molecular NEXT diagnos*) OR Neuropathology OR Neuro-pathology OR Neuropathologist* OR Oncopathology OR
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	Onco-pathology OR Oncopathologist* OR Pathologist* OR (Paraffin* NEXT Embedd*) OR "Prussian Blue" OR (Silver NEXT Stain*) OR Telepathol* OR Tele-pathol*):ti,ab,kw
2	((Lab OR Labs OR Laborator*) NEAR/3 (Clinic* OR Diagnos* OR Facility OR Facilities OR Health* OR Medical OR Medicine OR Network* OR Professional* OR Report* OR Result OR Results OR Service* OR System OR Systems)):ti,ab,kw
3	((Biopsy OR Biopsies OR Section OR Sections OR Smear* OR Specimen* OR Tissue*) NEAR/2 (Affix* OR Embed* OR Fixat* OR Frozen OR Gross OR Handl* OR Microarray* OR Micro-array* OR Preparation* OR Prepare* OR Prepared OR Preserv* OR React* OR Stain* OR Technique* OR Test OR Tests OR Tested OR Testing)):ti,ab,kw
4	((Histology OR Pathology) NEAR/2 (Anatomic* OR Center OR Centers OR Centre OR Centres OR Clinical OR Department* OR Diagnos* OR Digital* OR Education* OR Facility OR Facilities OR General* OR Lab OR Labs OR Laborator* OR Medical OR Molecular OR Network* OR Personnel* OR Profession* OR Program* OR Report* OR Result OR Results OR Service* OR Tech OR Technician* OR Train* OR Unit*)):ti,ab,kw
5	((Histology OR Lab OR Labs OR Laborator* OR Pathology) NEXT (Assistant* OR Attending* OR Personnel* OR Scientist* OR Tech OR Techs OR Technician* OR Staff)):ti,ab,kw
6	#1 OR #2 OR #3 OR #4 OR #5
7	(Angola* OR Basotho* OR Benin* OR Bissau* OR Botswana* OR Burkina* OR Burundi* OR Cameroon* OR ((Cabo OR Cape) NEXT Verde*) OR (Central NEXT Africa*) OR Chad OR Chadian* OR Comorian* OR Comoros OR Congan* OR Congo OR Congolese OR (Cote NEXT dIvoire*) OR Djibouti* OR (East* NEXT Africa*) OR Equatoguinean* OR Eritrea* OR Eswatini* OR Ethiopia* OR Gabon* OR Gambia OR Gambian* OR Ghana* OR Guinea* OR Ivorian* OR (Ivory NEXT Coast*) OR Kenya* OR Lesotho* OR Liberia* OR Madagasca* OR Mahore* OR Malawi* OR Mali OR Malian* OR Mauritania* OR Mauriti* OR Mayotte* OR Mosotho* OR Mozambi* OR Namibia* OR Niger* OR ((Nonmediterranean OR Non-Mediterranean) NEAR/2 Africa*) OR ((Reunion) NEAR/2 (Department OR Island OR Region)) OR Reunionese OR Rwanda* OR Sahara OR Saharan OR Sahel* OR Santomean* OR ("Sao Tome" NEXT Principe*) OR Senegal* OR Seychell* OR (Sierra NEXT Leone*) OR Somali* OR (South* NEXT Africa*) OR Subsahara* OR Sudan* OR Swaziland* OR Tanzania* OR Togo* OR Uganda* OR (West* NEXT Africa*) OR Zambia* OR Zimbabwe*):ti,ab,kw
8	(Benchmark* OR (Bench NEXT mark*) OR (Diagnos* NEAR/2 (Delay* OR Speed OR Timely)) OR Infrastructur* OR (Infra NEXT structur*) OR Mentor* OR Mentee* OR (Needs NEXT assess*) OR (Need* NEAR/2 (Meet* OR Met OR Unmet)) OR "Professional Development" OR Self-sufficien* OR Self-support* OR (Strategic NEXT plan*) OR Syllabi OR Syllabus* OR Telecytol* OR Tele-cytol* OR Telemed* OR Tele-med* OR Telepathol* OR Tele-pathol* OR Turnaround* OR Turn-around* OR (Wait

	NEXT time*) OR Workaround* OR (Work NEXT around*) OR Workflow* OR (Work NEXT flow*) OR Workload* OR (Work NEXT load*)):ti,ab,kw
9	(((Advisor* OR Capacit* OR Coalition* OR Facility OR Facilities OR Financ* OR Fund OR Funded OR Funding OR Funds OR Intercontinent* OR Inter-continent* OR Intergovernment* OR Inter-government* OR Institution* OR International* OR Laborator* OR Leader* OR Monetary OR National* OR Pathology OR Personnel* OR Program* OR Regional* OR Service* OR Technician* OR (Work NEXT force*) OR Workforce* OR Workgroup* OR (Work NEXT group*) OR (Working NEXT group*)) NEAR/3 (Access OR Accredite* OR Adequa* OR Availab* OR Barrier* OR Build* OR Built OR Capabil* OR Capabl* OR Credential* OR Centralis* OR Centraliz* OR Coach* OR Competen* OR Decentrali* OR Discrepen* OR Disincentiv* OR Efficien* OR Enhanc* OR Equipp* OR Equipt* OR Expand* OR Expansion* OR Framework* OR (Frame NEXT work*) OR Impact* OR Implement* OR Improve* OR Improving OR Inadequa* OR Incentiv* OR Inefficien* OR Initiativ* OR Innovat* OR Insufficient* OR Limited* OR Network OR Networks OR Optimisa* OR Optimise* OR Optimisi* OR Optimiz* OR Outreach* OR Partner* OR Performance* OR Rebuil* OR Reenhanc* OR Reimplement* OR Reimprov* OR Reform* OR Reinnoval* OR Reorganis* OR Reorganiz* OR Rescale* OR Rescaling OR Resource* OR Restrengthen* OR Restructure* OR Retain* OR Retention OR (Scal* NEXT up) OR Shortage* OR Shortcoming* OR Short-coming* OR Strengthen* OR Sufficient* OR Success* OR Sustain* OR Unsuccess* OR Uptake*)):ti,ab,kw)
10	(((Lab OR Labs OR Laborator* OR Facility OR Facilities OR Histology OR Histologist* OR Pathology OR Pathologist*) NEAR/2 (Capacit* OR Establish* OR Knowledge OR Reestablish* OR Remote* OR Skill* OR Virtual* OR Quality)):ti,ab,kw)
11	(((Documentation OR Report* OR Form OR Forms) NEAR/3 (Appropriate* OR Complet* OR Correct OR Error* OR Incorrect OR Inappropriat* OR Incomplete* OR Insufficient OR Nonstandard* OR Quality OR Sufficient OR Standard*)):ti,ab,kw)
12	(((Class OR Classes OR Course* OR Curricul* OR Didactic OR Educat* OR Lecture* OR Learn* OR Module* OR Pedagog* OR Practicum* OR Seminar* OR Teach* OR Train* OR Tutorial* OR Workshop* OR (Work NEXT shop*)) NEAR/3 (Asynchronous OR Competenc* OR Distance OR Global OR Hands-on OR In-country OR In-person OR Inperson OR Inservice OR In-service OR International OR Local OR Online OR Onsite OR On-site OR Outreach* OR Patholog* OR Professional OR Program* OR Regional OR Synchronous OR Vocational)):ti,ab,kw)
13	#8 OR #9 OR #10 OR #11 OR #12
14	#6 AND #7 AND #13

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tw:("Acid Schiff" OR "Antigen retrieval" OR clinicopathology OR "Clinico pathology" OR clinicopathologist* OR cryomicrotom* OR cytochemist* OR "Cyto chemist" OR "Cyto chemistry" OR "Cyto chemists" OR cytodiagnos* OR "Cyto diagnoses" OR "Cyto diagnosis" OR "Cyto diagnostic" OR "Cyto diagnostics" OR cytology OR cytologist* OR cytopathology OR "Cyto pathology" OR cytopathologist* OR decalcification OR "De calcification" OR "Diagnostic facility" OR "Diagnostic facilities" OR "Fluorescent Antibody Technique" OR "Fluorescent Antibody Techniques" OR histochemist* OR "Histo chemist" OR "Histo chemistry" OR "Histo chemists" OR histocytochemist* OR "Histo cytochemist" OR "Histo cytochemistry" OR "Histo cytochemists" OR histocytolog* OR histology OR histologist* OR histopathology OR "Histo pathology" OR histopathologist* OR histotechnolog* OR "Histo technologies" OR "Histo technologist" OR "Histo technologists" OR "Histo technology" OR immunochemist* OR "Immuno chemist" OR "Immuno chemistry" OR "Immuno chemists" OR immunocytochemist* OR "Immuno cytochemistry" OR immunohistochemist* OR "Immuno histochemistry" OR immunohistolog* OR "Immuno histology" OR immunoperoxidase OR "Immuno peroxidase" OR immunophosphatase OR "Immuno phosphatase" OR lnr OR lnr OR "Lymph node ratio" OR "Lymph node ratios" OR "Lymphatic node ratio" OR "Lymphatic node ratios" OR "Medical technologist" OR "Medical technologists" OR microdissect* OR "Micro dissection" OR "Micro dissections" OR microsection* OR "Micro section" OR "Micro sections" OR microtome* OR microtomy OR "Molecular diagnosis" OR "Molecular diagnoses" OR "Molecular diagnostic" OR "Molecular diagnostics" OR neuropathology OR "Neuro pathology" OR neuropathologist* OR oncopathology OR oncopathologist* OR "Paraffin Embedding" OR pathology OR pathologist* OR "Prussian Blue" OR "Silver Stain" OR "Silver Staining" OR "Silver Stains" OR telepathol*) AND (la:("en" OR "pt"))

World Health Organization Institutional Repository for Information Sharing
(<https://iris.who.int/>)

“pathology” AND “capacity”

Appendix 2: Data extraction tool

Study characteristics

- First Author
- Year of publication
- Journal
- Setting (pathology laboratory, community hospital, referral hospital, etc.)
- Country/geographic region
- Study design
- Study aims
- Methods
- Study conclusions

Participants

Who was involved in the study
Number of participants/labs/studies
Study period/literature search date
Size of laboratory (number of specimens or personnel)

Concept

Anatomic pathology services available
Quality assurance/quality improvement monitoring system
Intervention
Intervention aim(s)
Implementation strategy
Facilitators of intervention
Barriers of intervention
Target group(s)
Implementation outcome(s) evaluated
Dissemination
Service system outcome(s) evaluated
Clinical outcome(s) evaluated

Measurement details

Measures used
Scale used
Length of time measured
Author identified limitations
Author identified research opportunities
Comments