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Original Research Article

Piloting and Evaluation by Forensic Pathology Registrars of a Mobile Application Created for Autopsy Reporting

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Mobile Application, Portable Autopsy Data Collection Tool, Forensic Pathology, Record-Keeping, Statistics.

Abstract

Background: Mobile applications have shown promise in various medical settings. However, the KwaZulu-Natal Forensic Medicine department still relies on manual reporting for autopsy data recording, highlighting the need for a portable tool for data collection and statistical reporting.**Objective**: This study aimed to pilot a mobile application for portable autopsy data collection and assess user acceptability among Forensic Medicine registrars. **Methods**: A multi-methods pilot study involved four enrolled Forensic Medicine registrars who tested and evaluated the portable autopsy data collection tool. Surveys and interviews gathered their perceptions of usability, benefits, and challenges. The Technology Acceptance Model (Davis's) was used to evaluate the perceived ease of use and perceived usefulness of the tool. **Results**: Participants reported positive perceptions of the tool's usefulness, ease of use, and benefits for service, training, and research. Some concerns were voiced related to the impact of time constraints and the potential increase in workload due to unfamiliarity with the tool. The registrar's feedback also informed amendments to the tool for greater user acceptability. **Conclusion**: The portable autopsy data collection tool was well-received by department registrars, showing potential for improving service and research. Similar tools could benefit other medical departments, warranting further exploration.

1. Introduction

In Forensic Pathology involves the determination of the cause of death in "unnatural" and sudden unexpected deaths using the scientific methods of the autopsy and related investigations. In South Africa, the laws directing autopsy procedures are primarily outlined in the Inquests Act 58 of 1959.[1]

The doctors conduct an autopsy and comp-

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ile a report in affidavit form for use in court proceedings according to the Criminal Procedures Act 51 of 1977 and in terms of the Regulations and National Code of Guidelines for Forensic Pathology Practice in South Africa.[2]

In South Africa, particularly in the province of KwaZulu-Natal, autopsy reports are typed and printed in hard copy for court procedures. This process of producing an autopsy report can be lengthy, depending on the investigations required for each case, viz. histology, toxicology, and DNA analysis. A hard copy of the report is filed in the mortuary archive filing room and may be re-accessed for reporting purposes and trends. The information recorded during a post-mortem is largely anonymised because each case is given a de-identified post-mortem reference number. Identification of the deceased is recorded in a separate hard copy register by administrative staff members, resulting in multiple registers and auditing processes.

The process of accessing the hard copy reports from different facilities after archiving is a cumbersome and arduous process, which is exacerbated by human error and misfiling, which occurs at several medical institutions, nationally and internationally.[3-5] To support the National Health Insurance scheme, the South African government has prioritised bringing electronic health records to health facilities.[6] Although technology has advanced greatly and can facilitate the move to electronic record-keeping, the process is paradoxically rather complex due to the confidential nature of health records. Well-organised and comprehensive medical records that contain information regarding a patient's care are important for continuing care, assessing the quality of medical care, and determining medico-legal liability.[7] These important records are expected to be stored for many years, but their safety and security remain a challenge due to the conditions or facilities in which they are archived.[4,7]Poor record-keeping is a critical issue to address, impacting the accuracy and, therefore, reliability of the data for statistical evaluation, auditing, research, and data quality.[4,7,8] Health information services in South Africa require urgent attention because the successful implementation of electronic health records and storage will provide valuable evidence-based data to support the development and improvement of healthcare.[6] Electronic data capturing has the potential to greatly reduce the time and costs associated with reporting and data storage.[9] Internationally, primary healthcare databases are used to provide anonymised electronic health data that greatly contributes to research in the healthcare sector.[10] It is possible and realistic in the current technological age to create a low-cost, simplistically designed, accessible repository of electronic records. Underutilised information that can be gained from post-mortems will illuminate statistical and population trends, inform medical knowledge, and support research.[11]An autopsy database containing information of value for pathologists, epidemiologists, and other researchers is technically feasible and can be designed to protect the deceased's privacy.[12] Placing the autopsy database on the smartphone maximizes its access to relevant stakeholders interested in using or contributing to the database thus improving the standards of reporting and research.

The smartphone as a portable autopsy data collection tool (**PADCOT**).The PADCOT was created with the goal of developing a secure, indexed digital archive of post-mortem reports required for daily service, court, and statistical reporting. Funding was awarded to the primary author by a government organisation to produce the tool. The design was outsourced to a private software company. Key considerations in the PADCOT design were ease of access to data for service reporting and research purposes, improved accuracy of data input, and the ability to archive electronic records. Features of the tool include the ability to search the database, download functionality of autopsy reports, automatically accurate statistics with graph generation, and tiered security access. The PADCOT is a progressive web app with Wi-Fi and storage capabilities, offering real-time transfer of data. It is accessible on any smartphone device, enhancing mobility, which is an essential feature for training doctors who rotate through different facilities.[13-15] The security access via personalised usernames and passwords allows only registered users (i.e. doctors) to access the information on the application, maintains court admissibility, and conforms to the legislature by using de-identified information.[16] Supervisors have higher level tiered access to the reports, enabling auditing and supervision. Statistics are available to higher security access users, and the visual data graphs can be downloaded. Data can be entered daily, which removes the administrative barriers of manual registers. The PADCOT comprises a standardised autopsy summary with the option to

upload pertinent documents to cloud storage, including the completed autopsy report. (**Table 1**). The PADCOT cloud database can reduce laborious efforts and facilitate access to information previously available in hard copy, saving time and improving reporting for police investigations and statistical and research purposes. Portfolios of doctors will be readily available with autopsy case summaries for postgraduate training.

Table 1: Screenshots of the PADCOT

Image I: User login/Security Access

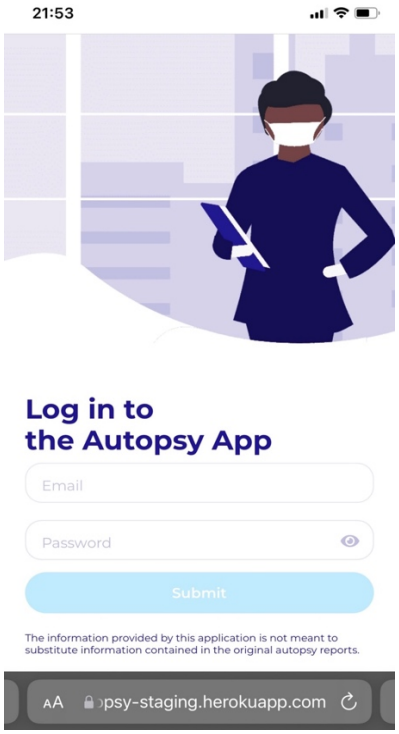


Image II: Landing page

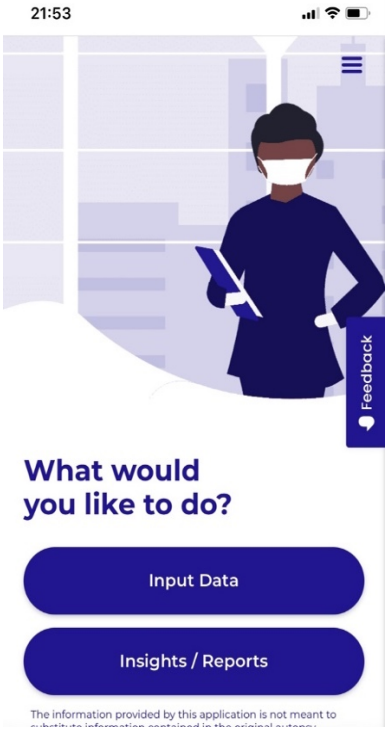


Image III: Summary of case/Data collection form

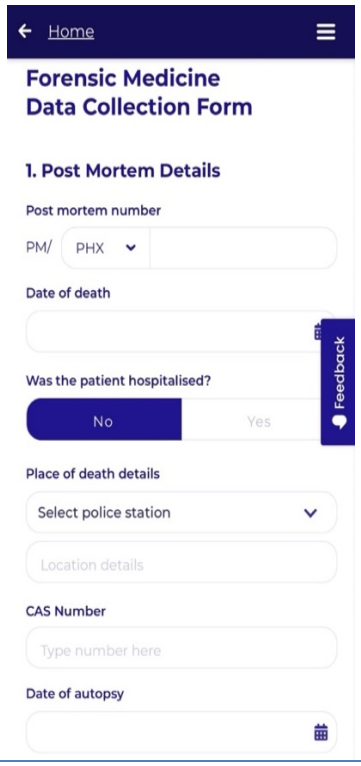


Image IV: Data dashboard

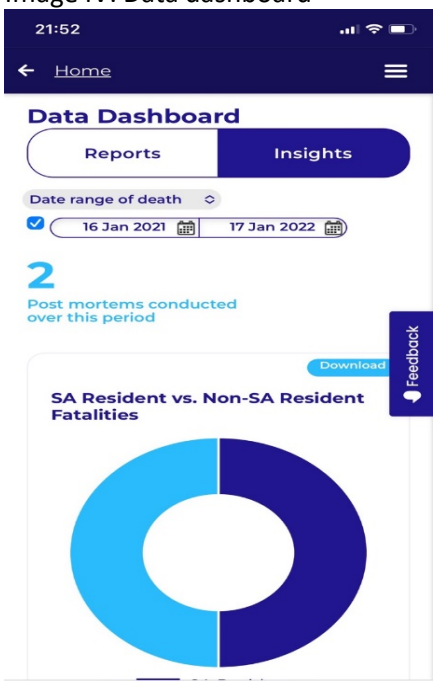
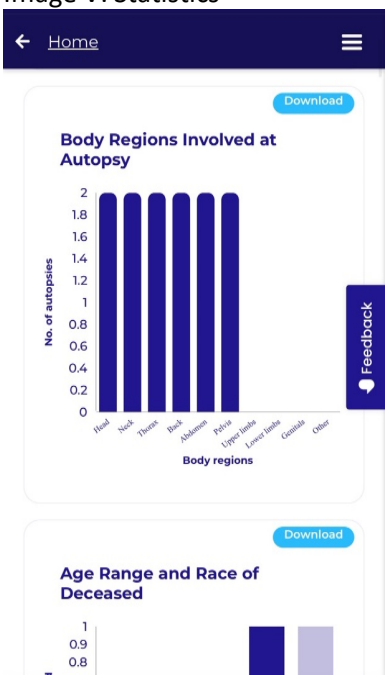
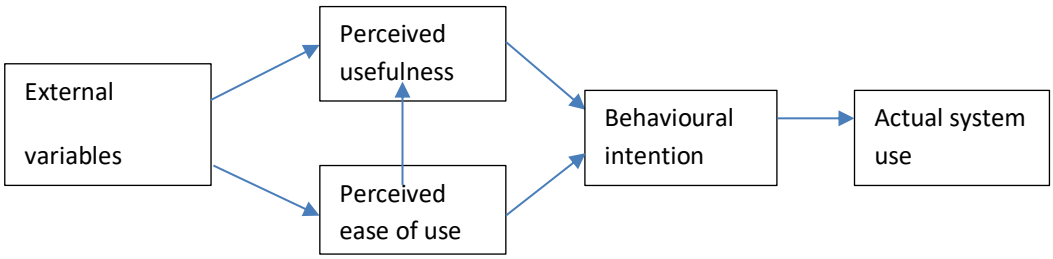


Image V: Statistics



It will create a platform for information sharing amongst trainees and supervisors to assist in training. The PADCOT has the potential to greatly reduce the time and costs associated with data collection and improve its completeness and quality.[17] An additional proposed benefit is the PADCOT database with up-to-date information from current autopsies, which can be used in undergraduate and postgraduate teaching. This phase of the study was conducted to assess the performance, feasibility, and acceptability of the application amongst the registrars in Forensic Medicine using the Technology Acceptance Model (**Figure 1**).[18] The Technology Acceptance Model (Davis, 1989), or TAM, posits that two factors determine whether a computer system will be accepted by its potential users, namely its perceived usefulness and the perceived ease of use translates to behavioural intention to use the system.[18] The key feature of this model is its emphasis on the perceptions of the potential user. The TAM was used to measure the adoption of the new technology (PADCOT) by exploring the attitudes/perceptions of future users, i.e. (registrars). User testing can also prevent recurring issues or duplication of data (seen in COVID-19 pandemic responses), improve the tool, and increase actual system use of electronic health resources.[19]

Figure 1. Davis' Technology Acceptance Model



2. Methods:

Study design

A multi-methods pilot study was conducted with a purposive sample of 4 registrars enrolled in specialisation training in the Forensic Medicine department of KwaZulu-Natal.[20] Homogenous saturation sampling of all the enrolled registrars was used because they were considered to be in the best possible position to give accurate feedback about the value, barriers, and ease of use of the tool which was specifically designed for use in this discipline.[21] The aim was to identify potential problems or deficiencies in the tool before full implementation at the institution. Basic training for the participants was provided by the software company that developed the tool. Each participant was provided with approximately 20 fabricated autopsy reports and, after training by the private software company, was asked to enter the provided data from the autopsy reports into the PADCOT. The participants were then asked to complete a questionnaire and participate in interviews to discuss issues encountered in research and recommendations to improve PADCOT.

Study setting

The study was conducted at Forensic Medicine department offices where Wi-Fi internet access was available. After obtaining consent and basic training, the participants were given approximately one month to test the PADCOT and complete the questionnaire. The interviews were conducted once the participants indicated they were ready to report on PADCOT.

Development of procedures for evaluating the application

A multidisciplinary team composed of a Specialist Forensic Pathologist, Information Technologists, and an Education Specialist/Academic Research Leader created the materials, which included the fabricated reports, the questionnaire, and the interview questions used to evaluate the PADCOT. The fabricated post-mortem reports were used to enter data into the application to test the app for its perceived usefulness and perceived ease of use and for other user feedback.

The fabricated reports were composed of a standardised autopsy reporting template with simulated data to be entered into PADCOT.

Data collection methods

Survey

The survey consisted of 10 open-ended questions regarding the daily reporting of autopsy records. The initial section captured the biographical details of the participants. The questionnaire

collected information relating to how data collection currently occurred in Forensic Medicine and the impact on the participants' ability to conduct research; how the application could improve service and practice in Forensic Medicine; and whether participants perceived the need for any additional information fields for the PADCOT. The content validity and suitability of the questionnaire were evaluated by an education expert, a university statistician, and a Specialist Forensic Pathologist.

Semi-structured interviews

The interview questions were first piloted to ensure there was no ambiguity in the questions. Permission was obtained to audio-record the interviews, which were conducted in English by the first author. The interviews were between 15-45 minutes in duration. Apart from biographical details taken at the time of the interview, the eight questions were related to current service work record-keeping, the perceived usefulness, and the perceived ease of use of the tool (based on the TAM), including their recommendations. All participants were invited to express their individual opinions and additional comments at the end of the interview.

Data Analysis of the Quantitative Data

The questionnaires were sent via email by the participants. While all four agreed to participate, only three completed and returned the questionnaires. The data from the questionnaires were then entered into a table and analysed by the authors using descriptive statistics.[22,23]

Data analysis of the Qualitative data

The interviews were audio-recorded and manually transcribed by the first author at the same time. After the interviews were completed, the audio was listened to, and transcription was re-evaluated to ensure that all the data was directly transcribed verbatim. The transcriptions were made available to all the authors and the participants to increase the validity and reliability of the data. The coding and themes were done using thematic analysis and the framework analysis of data; data familiarisation; identifying a thematic framework; indexing all study data against the framework; charting and summarisation of the data; and mapping and interpretation of patterns found within the charts as seen in **Figure 2**.

Ethical procedures followed

The study protocol was approved by the University Biomedical Research Committee. All four eligible participants provided informed consent to participate, while only three completed the questionnaire, but all four participated in the interviews.

3. Results

Participant characteristics for the survey

The three participants in the survey were female: 1 African, 1 White, and 1 Indian, with ages between 29 and 31 years. Their experience in Forensic Pathology ranged from 6 months in the registrar training programme (excluding medical officer time) to having completed the 4-year programme in 5th-year extended time.

Participant characteristics for interviews

All participants were female: 2 African, 1 White, and 1 Indian with ages between 29 and 31 years. One participant chose not to complete the questionnaire. Their experience in Forensic Pathology ranged from 6 months in the registrar training programme (excluding medical officer time) to having completed the 4-year programme in 5th-year extended time. All participants self-reported being comfortable with mobile applications and using their smartphones.

Survey results (Participants n=3)

The participants indicated that they would all continue using PADCOT. One response from a participant reported that the application was "excellent" and a "good advancement" for use in autopsies. The majority (n=2; 66,6%) of the participants were involved in research and collected data for research using hard copy reports, with only n=1 (33,3%) collecting data for research via an electronic database (Excel spreadsheet). However, all participants (n=3, 100%) were willing to use a comprehensive electronic database for research if it was available. Two of the participants agreed that the PADCOT was user-friendly, allowed easy data access, was less time-consuming than manual recording, and allowed for secure storage that is accessible (66.6%; n=2). Recommendations from the participants for PADCOT included improvement of text efficiency/text fillable sections (33.3%; n=1), a more in-depth searchable database (33.3%; n=1) and one participant suggested that a dedicated administrator be used for an in-depth database (33.3%; n=1).

Qualitative findings (Figure 2):

The following themes emerged from the data, namely Perceived Ease of Use (Usability), Usefulness (Benefits) of the application for autopsy reporting, training, and statistical analysis, the Disadvantages of using the tool, and Suggestions to

improve the tool. Verbatim quotes were used to represent the participant's voice.

Perceived ease of use (User acceptance)

One of the participants highlighted that South Africa is amongst the top countries with violent crimes resulting in death. She proposed that if employed daily, the PADCOT would become easier to use once the users are familiarised with the process. The drop-down menus in the tool were considered helpful by another participant, promoting efficiency (reported as approximately 10 minutes per report) with a subtheme of user acceptance arising from their responses.

*"*It's a quick process, not too time-consuming, and very helpful. (How long does it take to do a single case?) Less than a minute…it's clicking a drop-down screen therefore not too much typing. But it's quite helpful if I had the app, I could see what's going on. I think it works quite well." 3rd-year Registrar, Female, Age 30

"We are amongst the top countries regarding murder and forensic-related deaths. …it's very (very) easy to use… it will be easier for us to retrieve data to lean more towards using the app as time goes by. I think once people see how we can benefit from this app and use it daily for future purposes… It takes time to upload the information but it's worth it in the long run." 1st-year Registrar, Female, Age 29

Definitely shorter than doing a report, if you're going to do it properly, about 10 minutes." 4th-year Registrar, Female, Age 31

Usefulness (benefits) of the application for autopsy reporting, training, and statistical analysis/research.

This theme highlighted the perceived benefits of using the app. The theme had three subthemes, namely, the benefits of the application for service work, the benefits of training, and the benefits of statistical analysis/research.

Benefits of the application for autopsy reporting (service work*)*

The reported benefits included the mobility of PADCOT and remote accessibility to reports. Doctors are approached frequently regarding post-mortem information by investigating officers (usually by the South African Police Services), family members, and staff. Hard copy reports are archived in the facility or department and, therefore, are not easily accessible. Reports are often misfiled or misplaced, and therefore, secure storage would be beneficial for both service and research. The doctors entering their own allocated autopsy case information into the application will ensure that errors in reporting are minimised.

'…… (Won't) get physically lost. Now that I am in my Anatomical Pathology rotation, literally on a weekly basis I'm receiving messages about where a certain PM report is, and I have to explain that I'm not actually in the department this year and I don't have the time to physically (obtain the report). So, if someone needed details on my report, for example, an investigating officer, and I don't have physical access to the reports but if I have an app on my phone, the report will always be with me, and I can provide some sort of information to the officer. " 3rd-year Registrar, Female, Age 30

"Records through mortuary and register (for numbers). Some of the information is missing (case numbers) and also the history does not match with what you find at the autopsy… I think it will be beneficial, mostly, not just for research purposes but for our day-to-day work, knowing where each case is, how far it is …. It will be speeding up the process of signing out reports." 4th-year Registrar, Female, Age 31

Benefits of the application for training

The value of the application for training and quality assurance purposes was highlighted as it was believed that supervisors would be able to access reports timeously for auditing purposes conducted on all registrar autopsy reports.

"I am sure in a consultant capacity, it's also beneficial because they will be able to access any of our reports at any point in time." 3rd-year Registrar, Female, Age 30

Benefits of the application for statistical analysis/research

Data collection for research may be relatively effortless with the PADCOT. The application automatically generates demographic and common characteristics of cases that were reported by a participant to benefit her in terms of her research. One participant expressed frustration with the current manual records, which were often inaccurate, lost, misfiled, or incomplete. Autopsy reports are completed and signed out by the doctor who performs the autopsies. This process, depending on the type of case and the investigations each report requires, may take months to years. Only once the report is completed and signed out after auditing is it then archived in the mortuary or the department. The tool enables the doctor to enter information

immediately after completing the autopsy, allowing for real-time data transfer.

"The benefit for me is that I can see the app can tabulate and visually make data in a graphical form which is extremely helpful to me in terms of my own personal research." 3rd-year Registrar, Female, Age 30

"For research, it will be much easier to find information regarding what could have happened and select the cases you are interested in, selecting cases that you need and saves on time because manually looking is a lot [time-consuming]." 4th-year Registrar, Female, Age 31

"My main barrier is that not all cases have been signed out [autopsy report completed] with all information], so I am lacking a lot of information, my latest date is 2018 but there are still cases that have not been signed out which is frustrating. But it's been quite difficult because it's just going to be me manually… literally…trying to trace my way through the record room… "5th-year extended time Registrar, Female, Age 31

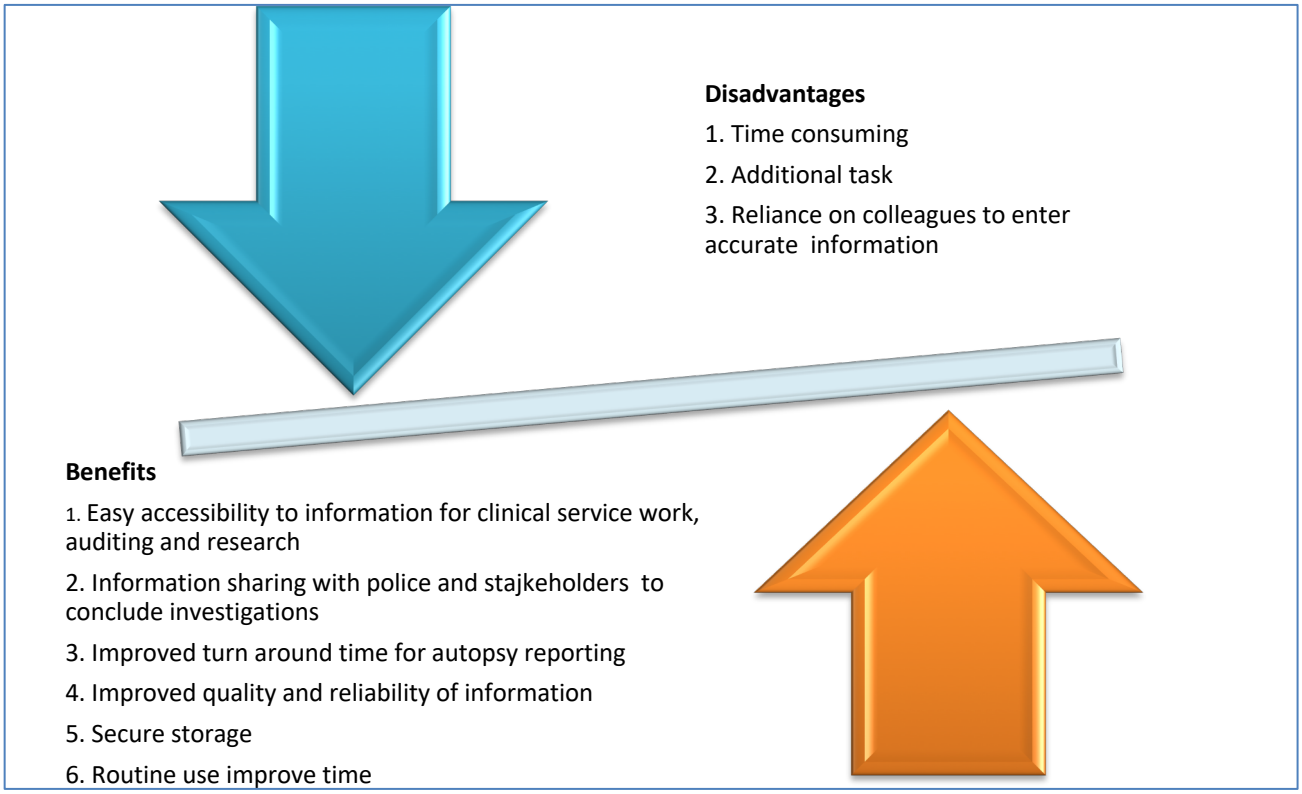
Disadvantages of using the application

The subthemes of impact on service work and the reliability of the data were of concern to two registrars.

Subtheme of impact on service time

The approximate time taken to enter each report was estimated to be between 2-10 minutes for each autopsy, depending on the type of case. While one participant reported making the application simpler or enlisting an administrative assistant to enter data due to time needed to enter each case by the pathologist, another participant suggested the need to enter more data such as blood alcohol levels (related to her research). Another issue raised brought about the subtheme of the reliability of the data. The database would only be beneficial if all the other doctors would complete the information accurately and timeously. Autopsy information is already being collected manually but inconsistently; therefore, it would be a more efficient and accurate substitute for the manual process/register already in place.

Figure 2: Registrar/participants perspectives of the portable autopsy data collection tool



"Besides it is that we will have to add another process to formulating a PM report, which means we also have to use this app. Another limitation is that you won't get intricate details of the autopsy report, you will get snippets." 3rd-year Registrar, Female, Age 30

"And it also provided that it is done properly like then you're putting your trust in the other doctors that you know have to fill in the app that they are doing it right…It will be very helpful (for portfolio purposes). The one limitation is that it is an extra step that

doesn't exist …just got to make a habit but people it must be done properly otherwise." 5th-year extended time Registrar, Female, Age 31

Suggestions to improve the tool

One of the participants suggested that an additional option be included, which is an information log indicating what stage the autopsy report was in at any given moment (completed or outstanding investigations are required) as this would be useful in their daily service work.

"Just a side note, it would be helpful if we had an option to say if the PM report was signed out or at what stage of the process the report was in." 3rd-year Registrar, Female, Age 30

4. Discussion

The many challenges facing low- and middle-income countries include imperfect or incomplete health data, which may cause limitations and compromise data integrity, limiting data sharing capability amongst the research community for wider societal benefit.[4,23,24] Many countries have utilised computerised data collection in general practice to improve the quality of care and reduce unnecessary retesting whilst accumulating exponentially growing data for statistics and research.[25] There also seems to be increasing acceptance from patients for the use of their health data for research. The use of Electronic Health Records has similarly been successfully adopted across many medical departments although some healthcare practitioners are resistant to adopting electronic record-keeping systems.[27]

This study used Davis' Technology Acceptance Model to test usability and registrars' willingness to adopt an electronic record-keeping system which theorises that developers explore the perceived usefulness and ease of use of technology before implementation to improve system design and promote the actual use of the proposed system.[17] Previously identified barriers to implementing computerised methods for medical record-keeping in Forensic Pathology include issues of costs/funding, user acceptability and customizability of the proposed system, ethical issues regarding security and privacy of the confidential data, and data ownership.[10,25,27] In Forensic Medicine, ethical concerns regarding the security and privacy of confidential information can be properly addressed with suitably designed anonymised electronic records, and legislature recognises court admissibility of electronic records when auditing and custodianship of the records are properly instituted.[16] Information from autopsies is often undervalued and overlooked.[11,29] Adopting electronic records and enforcing complete and accurate records will improve data quality, supporting statistics and research.[30] Registrars often encounter difficulties initiating and/or completing research due to unequal distribution of time because of large caseloads and service work.[31] An electronic database can support and improve time management, which has already been seen in well-established systems.[9,10,12,27,32,33]

Advanced innovative techniques also helpful in medical education regarding medicolegal autopsies.[34-38] Electronic records improve the doctor's ability to retrieve and recall patient information from structured notes in information systems. The issues of patient confidentiality and protection of personal information can be addressed using appropriate security measures with current technological advances.[12] Autopsy information is entered using de-identified post-mortem reference numbers, which address potential security issues, and auditing features can ensure the admissibility of the autopsy reports.[13,16] It is important for new tools to be evaluated for ease of use and usefulness during user testing.[17] The testing process captures and processes live data and demonstrated the registrars' willingness to adopt an electronic record-keeping system for data collection, storage, and research purposes. Adoption of similar models of the tool may benefit other medical departments and may be useful to explore as part of further research studies.

Strengths of the study

Basic training of the participants by the outsourced private software company was conducted prior to the use of the tool. The participants were invited to recommend personalised features that they would want included to improve the usefulness of PADCOT. The study is a pilot study, and further research will be conducted once PADCOT is fully adopted in the institution.

Limitations

The first author who conducted the interviews with the four participants was a consultant in the department which may increase potential research bias. The tool has yet to undergo testing in a mortuary environment with real-time autopsy data which would facilitate more comprehensive analysis with more participants.

5. Conclusion

The adoption of electronic record systems and medical applications in the healthcare industry

has been met with both affirmation and apprehension. The multitude of benefits and positive contributions concerning time management, accuracy, and data storage of health records are considered substantial. The cost and customisation of these systems are often a barrier to their successful implementation.

Abbreviations:

PADCOT: Portable Autopsy Data Collection Tool
KZN: KwaZulu-Natal
UKZN: University of KwaZulu-Natal
Registrar: Forensic Medicine Registrar

Ethical Clearance: IEC approval was taken from the Institutional Ethical committee.

Contributor ship of Author: All authors equally contributed.

Conflict of interest: None to declare.

Source of funding: None to declare.

References:

1. Government SA. Document Act South African Government Website. [Cited on 06 Aug 2023] Available from: https://www.gov.za/documents/acts
2. du Toit-Prinsloo L, Saayman G. Performance of autopsies in South Africa: Selected legal and ethical perspectives 2012. [Cited on 06 Aug 2023] Available from: http://www.cmej.org.za/index.php/cmej/article/view/2326/2188
3. Burnett SJ, Deelchand V, Franklin BD, Moorthy K, Vincent C. Missing Clinical Information in NHS hospital outpatient clinics: prevalence, causes and effects on patient care. BMC Health Serv Res. 2011; 11(1):114;
4. Ennion L. Missing medical records: An obstacle to archival-survey research in a rural community in South Africa. S Afr J Physiother. 2013; 69:15-9.
5. Thomas J. Medical records and issues in negligence. Indian J Urol. 2009; 25(3):384-8.
6. Katurura MC, Cilliers L. Electronic health record system in the public health care sector of South Africa: A systematic literature review. Afr J Prim Health Care Fam Med. 2018; 10(1):e1-e8.
7. Danladi Garba K, Yahaya I. Significance and challenges of medical records: A systematic literature review. Advances in Librarianship. 2018; 9:26-31.
8. Hoeijmakers F, Beck N, Wouters MW, Prins HA, Steup WH. National quality registries: how to improve the quality of data?. J Thorac Dis. 2018; 10(Suppl 29):S3490.
9. Khatri N. Effective implementation of electronic medical records and health information technologies. Mo Med. 2015; 112(1):41-5.
10. Herrett E, Gallagher AM, Bhaskaran K, Forbes H, Mathur R, van Staa T, et al. Data Resource Profile: Clinical Practice Research Datalink (CPRD). Int J Epidemiol. 2015; 44(3):827-36
11. Reichert CM, Kelly VL. Prognosis for the autopsy. Health Aff.1985; 4(2):82-92.
12. Kruse CS, Smith B, Vanderlinden H, Nealand A. Security Techniques for the Electronic Health Records. J Med Syst. 2017; 41(8):127.
13. Prahladh S, Van Wyk J. Advantages of an electronic recording system for medico-legal autopsies in resource-constrained contexts. J Forensic Leg Med. 2022; 88:102336;
14. Ventola CL. Mobile devices and apps for health care professionals: uses and benefits. Pharm Ther. 2014; 39(5):356.
15. Fischer F, Kleen S. Possibilities, Problems, and Perspectives of Data Collection by Mobile Apps in Longitudinal Epidemiological Studies: Scoping Review. J Med Internet Res. 2021; 23(1):e17691
16. Prahladh S, Van Wyk J. South African and international legislature with relevance to the application of electronic documentation in medico-legal autopsies for practice and research purposes. Egypt J Forensic Sci. 2022; 12(1):1.
17. Pereira IM, Bonfim D, Peres HHC, Góes RF, Gaidzinski RR. Mobile application for data collection in health research. Acta Paulista de Enfermagem. 2017; 30(5):479-88.
18. Mohamed AHHM, Tawfik H, Al-Jumeily D, Norton L. MoHTAM: A Technology Acceptance Model for Mobile Health Applications. 2011 Developments in E-systems Engineering 2011. p. 13-8;
19. Madhavan S, Bastarache L, Brown JS, Butte AJ, Dorr DA, Embi PJ, et al. Use of electronic health records to support a public health response to the COVID-19 pandemic in the United States: a perspective from 15 academic medical centres. JAMIA . 2020; 28(2):393-401.
20. UKZN website, Research Methodology Module. [Cited on 06 Aug 2023]. Available from https://medicine.ukzn.ac.za/registrar/researchmethodologymodule/
21. Patil SS, Deokar RB, Mankar DD. Study of Feedback of Survivors of Sexual Offences Subjected For Medicolegal Examination in Tertiary Care Municipal Hospital. J Forensic Med Sci Law. 2022; 31(1):16-23.
22. Althunayan A, Almuhaideb M, Alzahrani MA, Almannie R. Identifying Areas for Development of the Law of Practicing Healthcare Professionals in Saudi Arabia: A Medicolegal Committee-Based Survey Study. J Forensic Med Sci Law. 2023; 32(2):43-50.
23. Palinkas LA, Horwitz SM, Green CA, Wisdom JP, Duan N, Hoagwood K. Purposeful Sampling for Qualitative Data Collection and Analysis in Mixed Method Implementation Research. Adm Policy Ment Health. 2015; 42(5):533-44.

24. Totten V, Simon EL, Jalili M, Sawe HR. Acquiring data in medical research: A research primer for low- and middle-income countries. Afr J Emerg Med. 2020; 10:S135-S9.
25. Kaewkungwal J, Adams P, Sattabongkot J, Lie RK, Wendler D. Issues and Challenges Associated with Data-Sharing in LMICs: Perspectives of Researchers in Thailand. Am J Trop Med Hyg. 2020; 103(1):528-36.
26. de Lusignan S, van Weel C. The use of routinely collected computer data for research in primary care: opportunities and challenges. Fam Pract. 2006; 23(2):253-63.
27. de Lusignan S. Using routinely collected patient data with and without consent: trust and professionalism. Inform Prim Care. 2008; 16(4):251-4.
28. Lemma S, Janson A, Persson L-Å, Wickremasinghe D, Källestål C. Improving quality and use of routine health information system data in low- and middle-income countries: A scoping review. PLoS ONE. 2020; 15(10):e0239683.
29. Ajami S, Bagheri-Tadi T. Barriers for Adopting Electronic Health Records (EHRs) by Physicians. Acta Inform Med. 2013; 21(2): 129-34.
30. Bagher A, Wingren CJ, Ottosson A, Andersson L, Wangefjord S, Acosta S. Necessity of including medico-legal autopsy data in epidemiological surveys of individuals with major trauma. Injury. 2015; 46(8):1515-9.
31. Zhu K, Feng H, Xu Y, Mao Z, Zhang W, Chen J, et al. An analysis of 60 years of autopsy data from Zhejiang University in Hangzhou, China. PLoS ONE. 2014; 9(11):e112500-e. [Cited on 06 Aug 2023] Available from: https://pubmed.ncbi.nlm.nih.gov/25426989
32. Häyrinen K, Saranto K, Nykänen P. Definition, structure, content, use and impacts of electronic health records: a review of the research literature. Int J Med Inform. 2008;77(5):291-304.
33. Hanzlick R, Stauffenberg M. Forensic Pathology Fellowship Training Issues and Suggestions. Acad Forensic Path. 2011; 1(3):332-6.
34. Guze PA. Using Technology to Meet the Challenges of Medical Education. Transactions of the American Clinical and Climatological Association. 2015; 126:260-70. [Cited on 06 Aug 2023] Available from https://pubmed.ncbi.nlm.nih.gov/26330687
35. Deokar RB, Patil SS. Avenues in Forensic Medicine. J Forensic Med Sci Law 2023;32(2):1-3.
36. Dere RC, Kukde HG, Deokar RB, Patil SS, Kumar NB. Executive summary of the XXIV State Annual conference of Medicolegal Association of Maharashtra (MLAM): Forensicon 2021. J Forensic Med Sci Law 2022;31(1):84-88.
37. Varma NM, Pawar MN, Deokar RB. Executive Summary of the Forensicon 2022 - 25th Annual State Conference of Medicolegal Association of Maharashtra (MLAM). J Forensic Med Sci Law 2023;32(2):80-84.
38. Higgins TC, Crosson J, Peikes D, McNellis R, Genevro J, Meyers D. Using health information technology to support quality improvement in primary care. Mathematica Policy Research; 2015.