

Association for Information Systems

AIS Electronic Library (AISeL)

AMCIS 2020 TREOs

TREO Papers

8-10-2020

The Impact of Speech Recognition Systems on The Productivity and The Workflow in Radiology Departments: A Systematic Review

Ahmad Al-Aiad

Jordan University of Science and Technology, aiaiad@just.edu.jo

Ahmad K. Momani

Jordan University of Science and Technology, ahmad.momani@just.edu.jo

Yazan Alnsour

University of Northern Colorado, yazan.alsour@unco.edu

Mohammad Alsharo

Al Albayt University, mohammad.alsharo@aabu.edu.jo

Follow this and additional works at: https://aisel.aisnet.org/treos_amcis2020

Recommended Citation

Al-Aiad, Ahmad; Momani, Ahmad K.; Alnsour, Yazan; and Alsharo, Mohammad, "The Impact of Speech Recognition Systems on The Productivity and The Workflow in Radiology Departments: A Systematic Review" (2020). *AMCIS 2020 TREOs*. 62.

https://aisel.aisnet.org/treos_amcis2020/62

This material is brought to you by the TREO Papers at AIS Electronic Library (AISeL). It has been accepted for inclusion in AMCIS 2020 TREOs by an authorized administrator of AIS Electronic Library (AISeL). For more information, please contact elibrary@aisnet.org.

The Impact of Speech Recognition Systems on The Productivity and The Workflow in Radiology Departments: A Systematic Review

Abstract

Speech Recognition dictation systems are becoming more popular and provide a viable alternative to conventional transcription services. On the other hand, there is a scarcity in the studies that address the impact of speech recognition on productivity and the workflow in the radiology department. To review the most updated literature in the past 10 years regarding the effects of Speech Recognition systems on the productivity and workflow of radiology departments. A systematic literature review was done using PRISMA, including 14 articles in total, and they were divided into four main themes. The finding confirmed the positive effect of Speech Recognition on departmental productivity, with decreased report turnaround time and an increase in the number of reports available per unit of time.

Keywords: voice recognition, speech recognition, voice dictation, workflow, productivity, and radiology.

Introduction

In a speech recognition (SR), the speech dictated is converted into digital signals and then converted to a sequence of words in written text. The use of SR software in the radiology department is not new. Speech recognition systems have been available for medicine since the 1980s, and by the late 1990s have been proven sufficiently to be more reliable and agile for report dictation [1][2][3].

In the last years, SR systems have developed to the point that they are now considered as a practical method of producing radiology reports. The radiology department is beginning to use this technology increasingly.

Traditionally, the process of report creation starts when the radiologist dictates a case, creating an audio report. This is sent into the transcriptions to type the dictated voice material, creating a preliminary report. The preliminary report is sent back to the radiologist for reviewing, who may or may not edit it, and who then accepts the report, which produces the final report available for clinicians to review. Often, there is a significant delay between the time that the transcriptions type the report and the time of review and acceptance by the radiologist.

With SR, the radiologist can dictate the case, edit it, and then accept it at once, making the report available to the clinicians immediately. Therefore, the physicians can review the report sooner than the traditional reporting method.

It has been demonstrated that SR systems improve patient care with reduced report production time, reduced staffing needs, and also the efficient completion of reports and result in cost savings compared with conventional dictation transcription [4][5][6][7]. Speech recognition systems replace expensive transcription services and enable much quicker report distribution and delivery. Furthermore, speech recognition dictation systems are becoming more popular and provide a viable alternative to traditional transcription services.

The purpose of this study is to review the most updated literature in the past 10 years, regarding the effects of SR systems on the productivity and workflow of radiology departments

The independent variable in this review was speech recognition. Speech recognition defined as the capability of an electronic device to understand spoken words. A microphone records a person's voice and the hardware converts the signal from analog sound waves to digital audio. The audio data is then processed by software, which interprets the sound as individual words [8]. In addition, the dependent variables were productivity and workflow. Productivity defined as a measure of the efficiency of a person, machine, factory, system, etc., in converting inputs into useful outputs [9]. Whereas workflow defined as Progression of steps (tasks, events, interactions) that comprise a work process, involve two or more persons, and create or add value to the organization's activities [10].

The finding of this review hopefully, will improve the knowledge about how using SR systems affecting the productivity and workflow of radiology department in writing reports, while it could reduce the time between report dictation and finalization. Also, there is a scarcity in the studies that address the impact of speech recognition on productivity and the workflow in radiology department.

Research question What is the impact of using speech recognition systems on the workflow and the productivity in radiology departments?

To answer the research question we conducted a systematic review on the literature. This review divided into 4 main sections. The first section was the introduction part; the second is about the methodology; the third one is related to the results and discussion conducted from the final corpus included; and finally the conclusion and recommendation part.

Methodology

The research design used in this review was preferred reporting items for systematic reviews and meta-analyses (PRISMA). PRISMA is an evidence-based minimum set of items for reporting in systematic reviews and meta-analyses [11]. This method suite the purpose of this review where it helps in reviewing previous studies conducted to find the impact of SR systems on the productivity and workflow of radiology departments.

The inclusion criteria was articles who were papers published between 2009-2019, whereas the exclusion criteria were studies a) papers published in language other than English; b) not journal papers; c) not peer reviewed papers; d) no full text available; and e) duplicates citation.

Also, a selection rules related to content were used:

1. Articles that did not use the terms “speech recognition” and “radiology” or related terms in the title, abstract or full text
2. Topics not relevant to review questions
3. The articles should address the two main ideas in our search, workflow and productivity.

Different database used to find the most relevant and up-to-date studies between 2009-2019, including CINAHL, PubMed, and Springer. Keywords used to search in each database were speech recognition and radiology, voice recognition and radiology, and voice dictation and radiology. The exact search terms and keywords that searched in the databases included speech recognition AND radiology, voice recognition AND radiology, and voice dictation AND radiology. For our initial review, we searched in the abstract, keywords, and title to yield an initial corpus of 1578, the output of this initial search were collected into an Excel sheet and all duplicate citations were excluded. The next step was applying inclusion and exclusion criteria as follows:

1. The corpus should include the studies only published in English language. The studies published in languages other than English were excluded (11 studies).

2. Also, the corpus should include the journal articles or conference papers only. Based on this criterion 364 sources were excluded and the remaining passed into the next criterion (481).
3. To include high quality research in our systematic review we only include article or conference papers were peer reviewed and were available in full text. Thus, 10 studies excluded which were not peer reviewed or not available in full text.
4. In the remaining studies, the title and abstract using selection rules related to the content were reviewed. This left us with 90 articles and proceedings (381 were excluded).
5. The same selection rule applied on the full text, 71 studies excluded and 14 articles were the final corpus used for further analysis and data extraction.

Figure 1 below showed the number of articles in each stage based on inclusion and exclusion criteria.

Data Analysis and Results

After applying the inclusion and exclusion criteria, fourteen articles were selected to start the next step which is data analysis. After we analyzed the fourteen studies of the final corpus, we grouped the related studies under one category or theme. The related studies that discuss similar issues of speech recognition or focused in the same research topic were grouped together under the same theme. We identified 4 themes: turnaround time, error rate, workflow, and productivity.

Report Turnaround Time: Report turnaround time was defined as the duration between the time when a case was available for interpretation on the PACS to the time when the case was finalized by the radiologist. One of the major disadvantages of SR systems is transcription errors. Which range from deletion, reports containing confusing and inaccurate sentences, or wrong word substitution [12][13]. Who also stated that SR could decrease turnaround time by making the report available immediately on the PACS.

A study conducted by Krishnaraj et al. (2010) to analyze the effect of work habits and caseload among users. The results confirmed after the application of SR a decrease in the

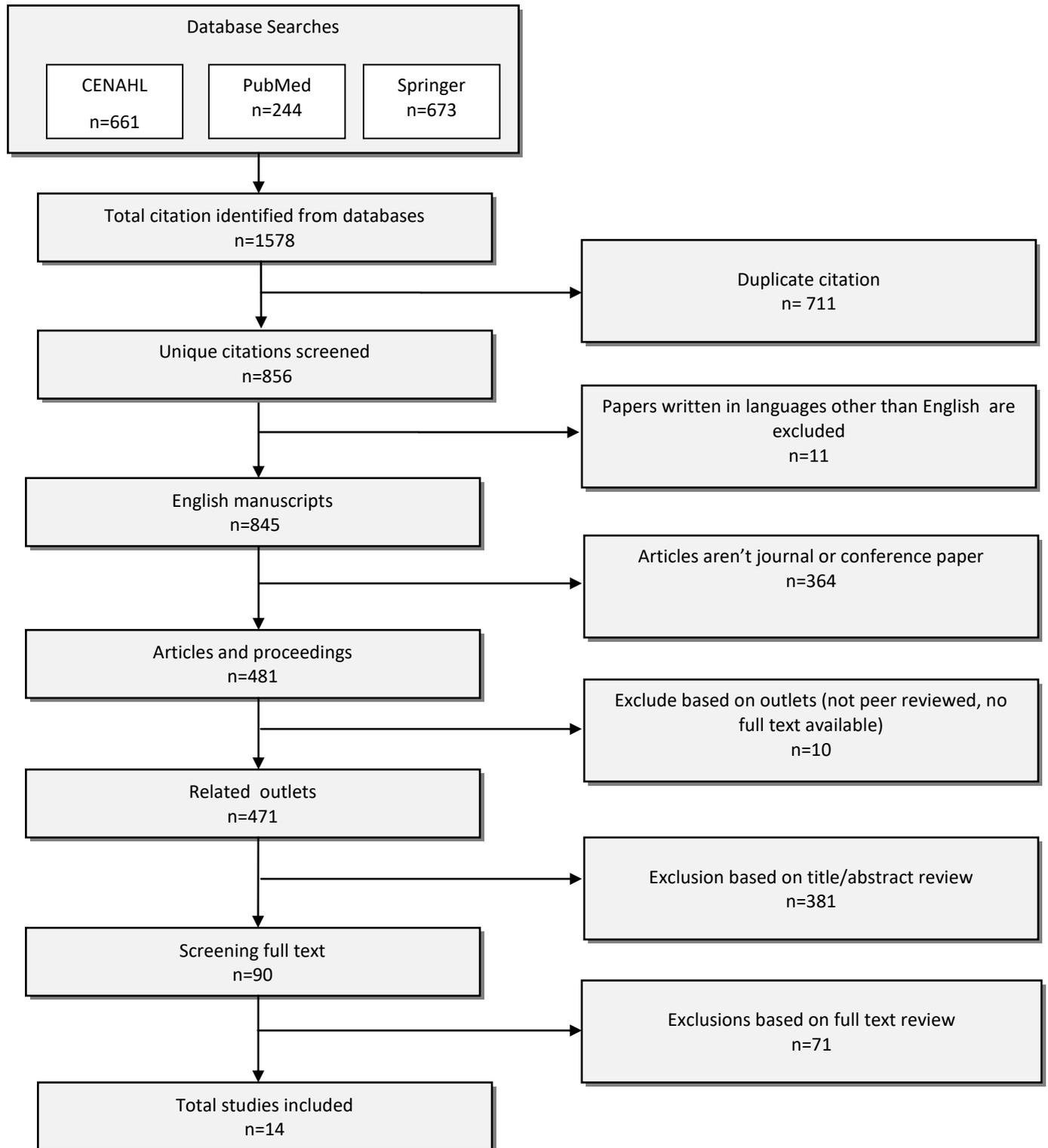


Figure 1: The number of articles in each stage based on inclusion and exclusion criteria.

average report turnaround time for the entire department from 28 hours to 12.7 hours after the implementation of SR system [14]. Which was earlier confirmed by Koivikko et al, (2008) who stated that the utilization of SR decreases turnaround times by more than 80%. Also, the whole patient care process by significantly facilitating online reporting [15].

A systematic review which identified 218 abstracts, which aimed to describe the impact of speech recognition systems on report error rates and productivity in radiology departments. Findings of this review support positive effect of SR system on the productivity of the department by decreasing the turnaround time and increase the number of reports available in a unit time [16][17].

Error Rate: Basma et al., 2011 had defined error rate as the total number of reports with errors divided by the total number of reports [18]. The aim of their study was to determine the frequency of error in finalized breast imaging reports generated by SR system in comparison with finalized reports generated with conventional dictation transcriptions, and found that 52% of reports generated using SR system contained at least one error compared to 22% of reports generated with conventional dictation transcription. This result was confirmed recently by Hammana et al., 2015, who stated that the radiologist reports still contained at least one error ranged from 4% to 52% [16].

A study of Chang et al., in 2010 revealed that the weighted error rate in computed radiography (CR) was 6%, whereas 38% in the non-CR reports [12]. In another study in 2010 showed that 42% and 30% of the finalized SR reports for each of the two radiologists investigated contained errors. Whereas only 6% and 8% of the transcriptionist-generated final reports contained errors [19].

The previous result supported by Luetmer et al., 2013 who also reported minor and major discrepancies Major discrepancies were defined as report errors that have the potential to influence patient management, particularly within the first 24 hours of report generation. Minor discrepancies are defined as report errors that are felt to be incidental to treatment and management [20].

Productivity: The productivity can be improved by the utilization SR system [15]. Strahan et al. assesses the productivity in MRI reporting using of SR and transcriptionist, in their study the productivity for one of the radiologists was calculated at 8.6 MRI reports per hour using SR and 13.3 MRI reports per hour using the transcriptionist. This represented a 55% increase using the transcriptionist over SR, this may be due to that in case of SR, the reporting time included reading, dictation, and verifying time, whereas in case of transcriptionist report, the reporting time included reading and dictation time [19].

The previous results were confirmed by a study conducted by Chang et al. which found that there was a decrease in the radiologist productivity due to the additional time needed for the radiologist to transcribe and proofread their reports [12].

In contrast, Prevedello et al, conducted an interventional study to evaluate the impact of SR systems on report the turnaround time and the radiologist productivity. The study showed that the radiologist productivity was stable throughout the study period, with no significant trend observed. Although, they demonstrated that the report turnaround time was decreased by 24 folds [21]. In the systematic review by Hammana et al. reported that overall departmental productivity was improved in all the studies retrieved for that study. Although, the radiologist's productivity was diminished when compared to traditional transcription [16].

Workflow: A scarcity of studies found to assess the workflow directly. However, Janhson et al., 2014 stated that there is an evidence of improved workflow processes within health care settings [17]. Whereas, Derman et al.,2010 stated that there was no clear perceived benefit from SR on clinical and administrative workflow among Psychiatric department [22].

Based on the themes of research on SR which identified early, a thematic taxonomy of research developed (Figure 2). Few studies have proposed a thematic taxonomy that classified the major themes related to the speech recognition. This taxonomy may provide a comprehensive view that help the researcher understand the concentration of existing research and found future research directions.

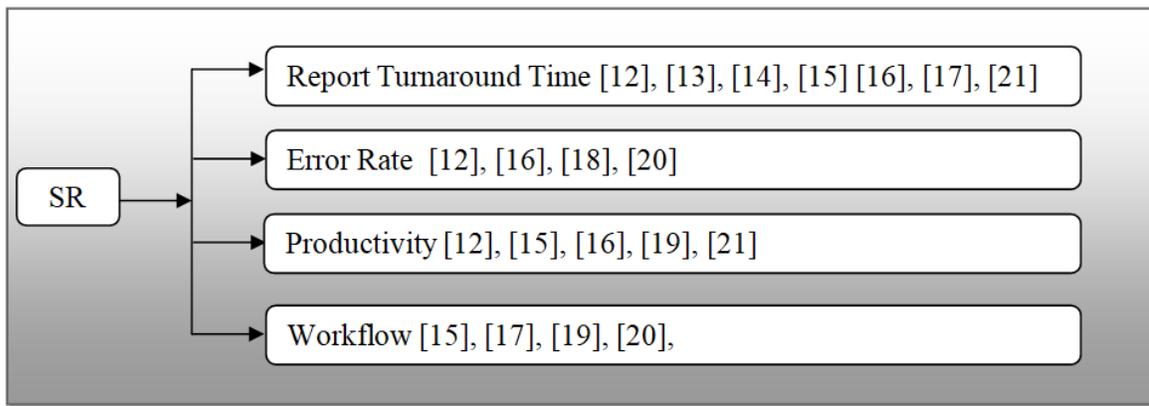


Figure 2: Taxonomy of research on speech recognition.

The limitations of our study were there is a scarcity of studies that address the effect of SR on the productivity and workflow together. Another limitation, that there was a little studies identified the effect of SR on the workflow in radiology departments.

Conclusion

The reviewed studies where searched using different databases between 2009-2019. The research design was PRISMA, and based on the inclusion and exclusion criteria the number of selected articles was fourteen.

The findings of the current literature review, showed the effect of SR on the productivity and workflow in radiology departments. Furthermore it was divided into four themes including: turnaround time, error rate, productivity, and workflow.

To conclude, the previous studies have confirmed the positive effect of SR on departmental productivity, with decreased report turnaround time and an increase in the number of reports available per unit of time. Further researches is needed to study the factors which affect the relationship between the productivity and workflow.

References

1. White KS: Speech recognition implementation in radiology. *Pediatr Radiol* 35:841–846, 2005

2. Vorbeck F, Ba-Ssalamah A, Kettenbach J, Huebsch P: Report generation using speech recognition in radiology. *Eur Radiol* 10:1976–1982, 2000
3. Trumm C, Francke M, Küttner B, Nissen-Meyer S, Reiser M, Glaser C: Speech recognition: impact on report availability and clinical workflow. *Hosp Imaging Radiol Eur* 1:14–16, 2006
4. Voll K, Atkins S, Forster B: Improving the utility of speech recognition through error detection. *J Digit Imaging*, DOI 10.1007/s10278-007-9034-7, 2008
5. Gale B, Safriel Y, Lukban A, Kalowitz J, Fleischer J, Gordon D. Radiology report production times: voice recognition vs. transcription. *Radiol Manage* 2001; 23:18–22
6. Sferrella SM. Success with voice recognition. *Radiol Manage* 2003; 25:42–49
7. Marquez LO. Improving medical imaging report turnaround times. *Radiol Manage* 2005; 27:34–37
8. Christensson, P. (2014, January 10). Speech Recognition Definition. Retrieved 2019, Dec 17, from <https://techterms.com>
9. productivity. BusinessDictionary.com. Retrieved December 16, 2019, from BusinessDictionary.com website: <http://www.businessdictionary.com/definition/productivity.htmlbb>
10. workflow. BusinessDictionary.com. Retrieved December 17, 2019, from BusinessDictionary.com website: <http://www.businessdictionary.com/definition/workflow.html>
11. Moher D, Liberati A, Tetzlaff J, Altman DG, PRISMA Group. *J Clin Epidemiol*. 2009 Oct; 62(10):1006-12.
12. C. A. Chang, R. Strahan, and D. Jolley, “Non-Clinical Errors Using Voice Recognition Dictation Software for Radiology Reports: A Retrospective Audit,” *Journal of Digital Imaging*, vol. 24, no. 4, pp. 724–728, 2010.

13. J. L. Hart, A. McBride, D. Blunt, P. Gishen, and N. Strickland, "Immediate and sustained benefits of a 'total' implementation of speech recognition reporting," *The British Journal of Radiology*, vol. 83, no. 989, pp. 424–427, 2010.
14. A. Krishnaraj, J. K. T. Lee, S. A. Laws, and T. J. Crawford, "Voice Recognition Software: Effect on Radiology Report Turnaround Time at an Academic Medical Center," *American Journal of Roentgenology*, vol. 195, no. 1, pp. 194–197, 2010.
15. M. Koivikko, T. Kauppinen and J. Ahovuo, "Improvement of Report Workflow and Productivity Using Speech Recognition—A Follow-up Study", *Journal of Digital Imaging*, vol. 21, no. 4, pp. 378-382, 2008. Available: 10.1007/s10278-008-9121-4 [Accessed 21 December 2019].
16. I. Hammana, L. Lepanto, T. Poder, C. Bellemare, and M.-S. Ly, "Speech Recognition in the Radiology Department: A Systematic Review," *Health Information Management Journal*, vol. 44, no. 2, pp. 4–10, 2015.
17. M. Johnson, S. Lapkin, V. Long, P. Sanchez, H. Suominen, J. Basilakis, and L. Dawson, "A systematic review of speech recognition technology in health care," *BMC Medical Informatics and Decision Making*, vol. 14, no. 1, 2014.
18. S. Basma, B. Lord, L. M. Jacks, M. Rizk, and A. M. Scaranelo, "Error Rates in Breast Imaging Reports: Comparison of Automatic Speech Recognition and Dictation Transcription," *American Journal of Roentgenology*, vol. 197, no. 4, pp. 923–927, 2011.
19. R. H. Strahan and M. E. Schneider-Kolsky, "Voice recognition versus transcriptionist: Error rates and productivity in MRI reporting," *Journal of Medical Imaging and Radiation Oncology*, vol. 54, no. 5, pp. 411–414, 2010.
20. M. T. Luetmer, C. H. Hunt, R. J. McDonald, B. J. Bartholmai, and D. F. Kallmes, "Laterality Errors in Radiology Reports Generated With and Without Voice Recognition Software: Frequency and Clinical Significance," *Journal of the American College of Radiology*, vol. 10, no. 7, pp. 538–543, 2013.

21. L. M. Prevedello, S. Ledbetter, C. Farkas, and R. Khorasani, "Implementation of Speech Recognition in a Community-based Radiology Practice: Effect on Report Turnaround Times," *Journal of the American College of Radiology*, vol. 11, no. 4, pp. 402–406, 2014.
22. Derman, Y. D., Arenovich, T., & Strauss, J. (2010). Speech recognition software and electronic psychiatric progress notes: physicians' ratings and preferences. *BMC Medical Informatics and Decision Making*, 10(1). doi:10.1186/1472-6947-10-44