Manipal Journal of Medical Sciences

Volume 6 | Issue 1 Article 7

6-30-2021

Comparison of turnaround times (TAT) in Pathology laboratories from developed and developing countries, and its impact on treatment

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Review Article

Comparison of turnaround times (TAT) in Pathology laboratories from developed and developing countries, and its impact on treatment

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Abstract

The timeliness of histopathology reports is one of the most crucial aspects of patient care. Turnaround Time (TAT) is one such parameter that is often considered when performing tests in pathology labs. Simply put, it is the time interval between the day a specimen is accessed in the lab, to the day the final report is signed out. **Aims:** This study aimed to compare the turnaround times in histopathology labs of developed and developing countries and to explore the impact of turnaround times on medical treatment. **Materials and Methods**: Our current review on retrieved articles from databases such as PubMed, EBSCO host and MEDLINE. This study includes the articles published between the years 2000 to 2020. The articles were searched by using keywords such as "turnaround time (TAT)" "developing countries", "developed countries", "mean TAT" and "impact of TAT on medical treatment". **Results**: The search fetched 30 articles, among which 11 were relevant to our study. **Conclusion**: TAT was higher in developing countries compared to developed countries. Lower TAT in developed countries was linked to better infrastructure, resources and technological advancement. Shorter TAT enables early diagnosis and treatment, which in turn helped to achieve better health care outcomes in the developed countries compared to developing countries.

Key words: Turnaround Time, Mean Turnaround Time, Developed countries, Developing countries, and Impact on treatment.

Introduction

Pathology is the study of tissues, cells and body fluid samples to diagnose or predict the progression of various diseases.[1] It provides diagnostic information to the clinicians and the patients. Pathology addresses four components of disease: cause, mechanisms of development, structural alterations of cells and the consequences of changes.[2] Pathologists use gross, microscopic, immunologic, genetic and molecular modalities to ascertain the presence of disease and very often work closely with surgeons, radiologists, oncologists etc.[3]

Pathology tissue samples are examined in histopathology laboratories. The pathology laboratory specimens require tissue preparation, which is then treated and analyzed using techniques appropriate to the type of tissue and the investigation required. The testing of body tissues varies from pap smears to biopsies, and for body fluids, it includes testing blood and urine samples.[4] The results of these tests usually help doctors diagnose and treat patients promptly. These tests need to be done accurately in a given period of time so that the patients can be diagnosed and an appropriate treatment plan is designed. Any unjustified complications that could result in morbidity due to delayed reports can be

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Manuscript received: 16 February 2021
Revision accepted: 28 April 2021

How to cite this article: Rishikha J, Shajeedth SN, Shetty JK, Naik VR. Comparison of turnaround times (TAT) in Pathology laboratories from developed and developing countries, and its impact on treatment. *MJMS*. 2021; 6(1): 36-42

avoided. Therefore, the timeliness of reports is one of the most crucial aspects of patient care.

Turnaround Time (TAT) is one such parameter that is often considered when performing tests in pathology labs. Simply put, it is the time interval between the day a specimen is accessed in the lab to the day the final report is signed out.[5] It is a significant quality indicator for surgical pathology laboratories. Many factors like tissue type, number of slides, decalcification, immunohistochemistry and consultation with other pathologists will affect the TAT.[6] According to the College of American Pathologists, the expected TAT for most routine cases (90%) is less than two days. However, based on the study conducted in 2014-15, an average of about a quarter (24%) of routine surgical pathology testing does not meet the College of American Pathologists' standard TAT recommendation.[7] This is because different labs across the world have varied access to resources, and the type of healthcare system also varies from one country to another.

The International Monetary Fund (IMF) classifies countries as developed or developing based on several factors, including per capita income and Gross Domestic Product (GDP).[8] Both of these factors contribute to the availability of funds that can be used to develop a country. Hence, the advancement of the health care sector also depends on these factors. As a result, pathology laboratories will also be affected by the growth of the health care sector. Therefore, TAT in histopathology laboratories relies significantly on the technological advancements in the country's health care sector.

In contrast, developing countries tend to have poor infrastructure and inadequate access to various services. Technological advancements can be slow, and hence the use of modern equipment and machines can be undermined.[9] As a consequence, lack of technology will lead to longer TAT. This can have a severe impact on the quality of health care services provided. On the other hand, developed countries, with their bounty of resources, both economically and technologically, have better access to health care facilities and medical management. These differences in the availability of resources and access to equipment will lead to shorter TAT in developed countries. We have designed this study to provide comprehensive information about the gap between the TAT in these countries and its impact on health care. This review intends to compare the TAT in pathology labs of developed and developing countries and assess the effect of the TAT on medical care.

Materials and methods

Literature Search Strategy

A systematic review was performed to explore the TAT in pathology laboratories of developed and developed countries and to explore the impact of TAT on medical care. Our literature search was based on a keyword-based search, database selection and limiting the search results and number of articles extracted according to the inclusion and exclusion criteria. Most of the articles were collected from our university library databases and were selected based on the above criteria. We have used the databases such as PubMed, EBSCO host and MEDLINE. Some free online journals that fulfilled our inclusion criteria were also included in the study. From the original questions, key phrases and Boolean characters used in the search were 'Turnaround time in Pathology labs', 'Turnaround time in developed countries', 'Turnaround time in developing countries' and 'Median turnaround time'.

Inclusion and Exclusion Criteria

The inclusion criteria were articles from developed and developing countries and the TAT in pathology labs for the respective countries. We also included articles dating between the years 2000 to 2020. A poor technological setup in labs before these years will significantly impact our comparisons. Hence, we decided to limit our time frame for articles to no earlier than the year 2000. The databases included PubMed, EBSCO host and MEDLINE. Only articles written in English with full text were included in our study, and articles from other languages were excluded. Studies reported from both educational institutions and standalone laboratories have been included as available.

Process of selecting relevant studies

All the articles retrieved through search criteria were reviewed for the study scope by closely

examining the objectives of the study. This search strategy identified 11 articles based on our inclusion-exclusion criteria. Figure 1 depicts the process of identifying, screening and choosing the eligible articles suitable using the PRISMA guidelines.

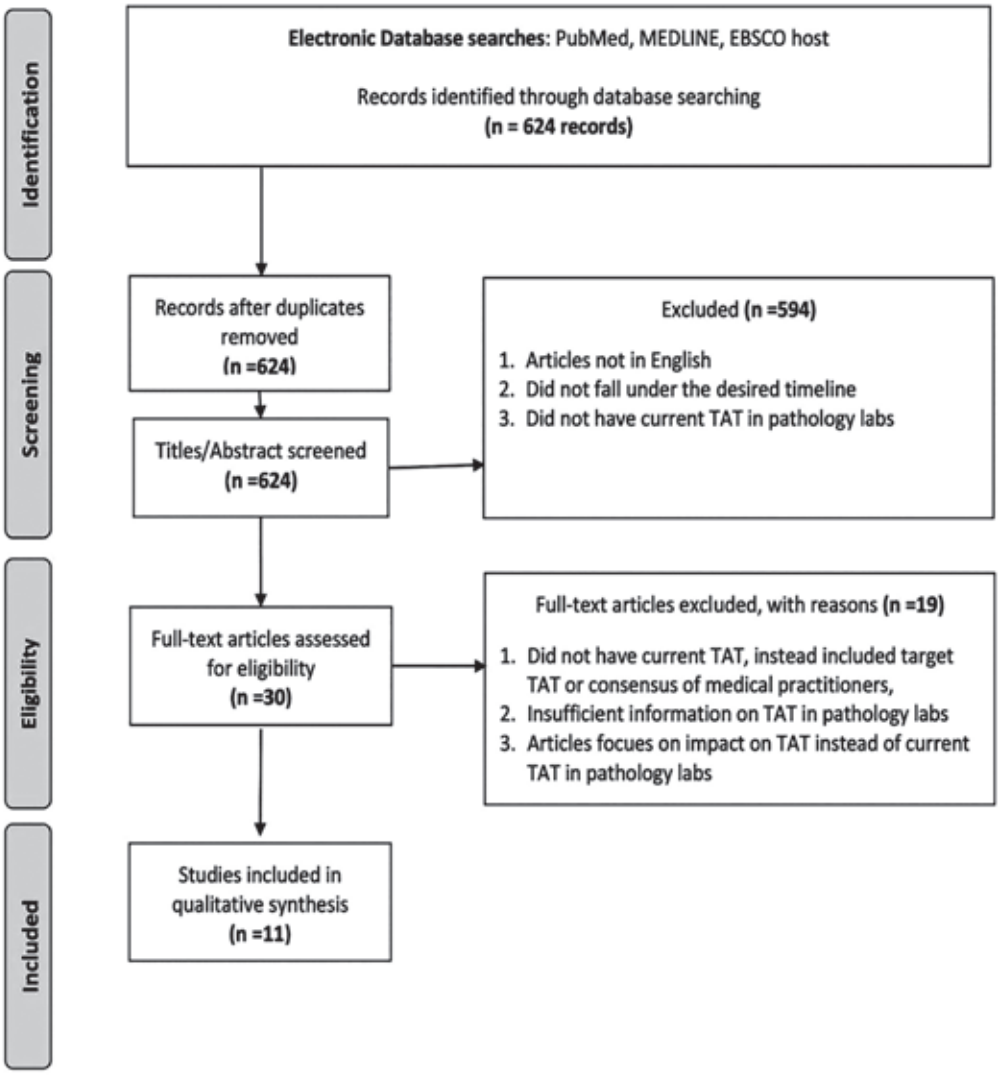

Fig 1:. PRISMA flow diagram, including database searches, the number of abstracts screened, and the full texts retrieved.

Results

Developed Countries

Table 1 shows the median TAT in pathology laboratories in developed countries. The countries we have chosen to be included in this comparison are the United States of America, Canada and Australia. Among the selected countries, Australia shows significant results with a TAT of one day[10], which is the shortest time among the selected countries. The United States of America and Canada show results of TAT from one to three days.[11]

Table 1: Median TAT in pathology labs in developed countries.

Country	Turnaround time (days)
USA (Volmar et al., 2015)	1-3
Canada (Volmar et al., 2015)	1-3
Australia (Akinfenwa et al., 2017)	1

Among developed countries, TAT for Large and Complex Specimens in surgical pathology was studied.[11] This was a Q-probe study that was conducted by the College of American Pathologists

among 56 institutions involving three countries (51 in the USA (Table 1), four in Canada (Table 1) and one in Saudi Arabia (Table 2)). The median TAT reported for these countries was 2.72 days.

Developing Countries

Table 2 shows the median TAT in pathology laboratories in developing countries. The countries that were chosen to be included in this comparison were Rwanda, Botswana, Myanmar, Malawi and Saudi Arabia. Among the selected list of developing countries, the TAT in Malawi is significantly the longest. However, the TAT of Saudi Arabia is also notable as it is between one to three days, being comparable to the TAT of developed countries such as Australia, the USA and Canada.[11]

Table 2: Median TAT in pathology labs in developing countries.

Country	Turnaround time (days)
Rwanda (Muvugabigwi et al.,2018)	30
Botswana (Martei et al., 2018)	57.5
Myanmar (Thiha et al., 2017)	49
Malawi (Masamba et al., 2017)	71
Saudi Arabia (Volmar et al., 2015)	1-3

A study was done aimed to inspect analytic TAT in a histopathology laboratory in Nigeria.[10] They searched records of 1440 batches of specimens over a period of 5 years in a Nigerian teaching hospital. A median analytic TAT of two days was obtained. It was observed that the Nigerian hospital had a 40.7% sign-out rate on day-1, which was slower than the day-1 TAT observed in Australia (Table 1).

A study was conducted to quantify TAT for breast cancer specimens that were processed by the National Health Laboratory and Diagnofirm Laboratory in Gaborone, Botswana.[12] A total of 219 surgical specimens were analyzed, and a median TAT of 57.5 days was obtained.

In Rwanda, a study was conducted on pathology lab's TAT by comparing different modes of transport.[13] Tissue blocks and slides were prepared in Butaro and then physically transported to Brigham and Women's Hospital in Boston, MA, for evaluation and diagnosis. A median TAT of 30 days was observed among tissue blocks of 2695 patient samples. However, when static images of slides prepared in Butaro by histo-technicians were uploaded to the case-sharing software/platform 'iPath', the median TAT was reduced to 14 days.

A study in Myanmar collaborated with the National AIDS program, where an integrated HIV care program implemented early infant diagnosis through Anti-Retroviral Therapy (ART) centers across ten cities in five states of Myanmar. Here, a median TAT from sample collection to reporting was observed to be around seven weeks (49 days).[14]

A study conducted at Queen Elizabeth's Central hospital in Malawi showed that a median TAT of 31 days was observed for 544 suspected cancer patients.[15] It was observed that a higher median TAT was observed here when compared to other African and high-income countries.

Discussion

Based on the results shown in Table 1 and Table 2, the median TAT, in general, is found to be longer in developing countries when compared to developed countries. This is because TAT is affected by the advancements seen in technology within a particular country. Developed countries have more access to funds that can be used to enhance laboratory equipment which will, in turn, decrease TAT and increase efficiency. However, developing countries do not have available funds present to be used to buy the equipment of current standards in their pathology laboratories and depend heavily on equipped labs that are often overloaded with samples. This also leads to an increase in TAT. The usage of automated instruments in laboratory testing in developed countries also aids in shortening TAT. Furthermore, the affordability to procure automated instruments provides an avenue to reduce manual labour in pathology labs which in turn significantly reduced the TAT. Therefore, as technological advancements are not as rapid in developing countries, TAT is longer in pathology labs.

Tissue processing for histopathological examination is a tedious and time-consuming process. A study done in 2007 reported that various automation done in different testing stages would greatly help reduce the TAT. Procedures like fixation and processing can be automated to save up to 24 hours, and the slides are ready for viewing by the second day.[16] Nowadays, tissue processing using

microwave techniques also speeds up the time taken for processing. Until recently, automation in the histopathology laboratories was only restricted to tissue processing and slide preparations. Recently studies have proposed the use of "Signal Processing Technology" to screen the slides automatically.[17]

In an editorial article in Nature Biomedical Engineering journal exciting new technologies have been described like "soaking whole tissue samples with fluorescent dyes, whose surface-emission under ultraviolet illumination can then be visualized within minutes through a camera with standard optics." "Performing optical 'sections' the sample, hence enabling volumetric imaging by stacking virtual slices (each taking less than 10 minutes to image)" and "Tissue staining circumvented by using spectroscopic techniques that take advantage of endogenous contrast generated from tissue components".[18]

A recent study proposed mathematical modelling to predict a reduction in TAT in a histopathology laboratory. A "mixed-integer linear program" (MILP) was used to predict specific times of three days for particular activities, for example, tissue processing. They found that it helped save up to 25% decrease in TAT and spread the work equally over the day.[19] In this study, TAT for both small biopsies and large specimens was included. However, they were not deemed suitable for separation due to a lack of literary evidence to support such practice. A recent study reported TAT from laboratories with 19 articles. Among those, most of them were looking at Chemical pathology laboratories' TAT by exploring the time taken to get reports if serum, blood samples are given but not looking at the tissue samples.[20]

As for developing countries such as Rwanda, higher than ideal TAT was caused by the need for physical transport to diagnostic centers.[13] This increased the TAT because of the impact imposed by these logistic challenges. The same study was carried out in a different mode. In this, static images of slides prepared in Butaro by histo-technicians were uploaded to the case-sharing software/platform 'iPath'. This eliminated the logistic challenges caused by physically transporting the slides. Hence, the TAT was significantly reduced (median TAT was 14 days).[13] Investments in shipment demonstrated a more consistent means for transport and reception of samples. Moreover, the need to transport samples to other locations outside the country for diagnostic purposes significantly increased the TAT in this study.[13] The availability of in-country processing also impacts TAT as a developing country like Rwanda will face challenges in moving samples to a developed country[13] such as the United States. Therefore, the availability of funds to the developed countries helped improve their infrastructure in terms of logistics which had a significant impact on TAT.

For easier tracking, TAT can be divided into three phases: 1) Pre-analytical 2) Analytical and 3) Post-analytical.[21, 22] The pre-analytical phase is where most of the delays can be observed, owing to a longer TAT.[21] It also explains the large TAT in developing countries, as most of these steps must be done manually.

Table 3: Phases in analyzing laboratory TAT.

Phases	Tasks
Pre-analytical phase	Transport to a laboratory, sample receiving and labelling, tissue processing, bar code scanning, specimen loading.
Analytical phase	Analysis of the specimen, interpretation and finalizing the reports.
Post- analytical phase	Proofreading, verification, dispatch of the results.

TAT impacts medical care because shorter TAT helps in early diagnosis and treatment for the illness. It is evident that delays in diagnosis can severely impact patient outcome because of unnecessary complications. In an 11-hospital based study conducted in the emergency department [ED] settings, the average length of stay in the ED correlated significantly with the percentage of total laboratory outlier results and, to a lesser extent, the TAT. The authors recommended that a more appropriate method of benchmarking might be to aggressively set clinically driven TAT targets and assess performance as the percentage of results achieving this goal.[23] It is essential to make sure that laboratory data is obtained fast and is also accurate. This will help the medical professionals to institute an appropriate treatment, thereby increasing the efficiency of clinicians. This also leads to an increase

in the quality of care and patient satisfaction.[24] However, it has to be noted that adequate clinical information (CI) is necessary for timely and error-free reporting of a specimen in surgical histopathology. A short-focused and concise CI is associated with a shorter TAT. Long and detailed CI is often seen with a complex surgical specimen that requires a longer time to report. Factors like specimen type, special staining, and the need for the use of multiple special stains and diagnosis of malignancy also affect TAT.[25] It is widely accepted that those teaching hospitals by nature of their work, including the process of teaching in the laboratory activity, would naturally have longer TAT compared to laboratories that are only service-oriented. Studies have stated that longer TAT is seen in teaching hospitals and big institutions.[10] In this study, the author concluded that there is an increasing disparity between developed and developing countries in terms of histopathology practice. They attributed this to challenges such as human resources, finances, lack of facilities, lag in technological advancement, lack of quality assurance programs and increasing cases of litigation among others.[26]

Conclusion

TAT varies according to different conditions like sample size, participants' involvement, staffing practices, access to resources etc. It is also different in various medical departments. Since pathology has many sub-divisions, it is challenging to achieve precise TAT measurements and compare them as they have been calculated from widely different conditions and samples. So, what exactly is a suitable TAT? Though the College of American Pathologists has recommended that report completion be done within two working days, this checklist (ANP.12150) was deleted on July 10, 2011.[11] It was also suggested by the Association of Directors of Anatomic and Surgical Pathology (ADASP) in the 1990s that 80% of routine biopsies be completed within two working days and a written report to be made available within three working days. The ADASP has now denoted that the acceptable TAT should be selected based on present-day literature and that it can also vary depending on the complexity of the case.[11] Hence, an appropriate TAT is something that an individual institution should decide, keeping in mind that timeliness and accuracy are the pillars of quality management in the health care industry.[11]

Limitations

The study's limitations include small sample size, wide variation on what is accepted as "Turnaround Time", looking at only articles published in the English language. Broadly grouping the countries into developed and developing countries and not taking healthcare infrastructure expenditure by different countries.

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