Evaluating the Completeness and Timeliness of Tuberculosis Case-Reporting by Laboratories in Washington State, 2019-2023

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Abstract

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Background

The Washington Disease Reporting System (WDRS) is an electronic disease surveillance system used by public health professionals across Washington State to enter, track, and analyze disease-related data on nationally and Washington State notifiable conditions. The information comes from a variety of sources, including healthcare providers, facilities, and laboratories within Washington. Moreover, WDRS serves as the integral system between state and local health departments to communicate and coordinate disease investigations and public health responses.

Electronic Laboratory Reporting (ELR) is a method that laboratories use to report notifiable conditions to public health agencies to aid in prompt response. Historically, health care facilities and laboratories notified state and local health departments of notifiable conditions through email, fax or phone calls, followed by manual data entry into the disease surveillance system.

However, ELR now automates this process by translating information in a laboratory system into an electronic message that is automatically sent to the public health department. The Washington State Department of Health (WADOH) maintains an ELR system through the Washington State Electronic Laboratory Reporting System (WELRS) data base, which tracks and provides laboratory reports to public health professionals across Washington State. Information from the ELR reports ultimately gets integrated into WDRS, providing public health professionals with a comprehensive view of laboratory data. ELR is thought to improve laboratory report quality due to the faster electronic transmission, increased accuracy and consistency of information across various sources.

This evaluation was conducted using the WDRS and WELRS datasets from 2019-2023 to compare the completeness and timeliness of laboratory tuberculosis case reporting in Washington State by the traditional method of faxed reports versus automated ELR.

Methods

Completeness of case reporting was assessed by the proportion of key fields present in laboratory case reports, as required by Washington Administrative Code (WAC) 46-101-115 that have been determined to have value in public health response to TB cases.

Timeliness of manual faxed data reporting was determined by calculating the time in days from the date the laboratory received the specimen to the date the result was reported. To assess ELR laboratory results, timeliness was determined by the time in days from when the laboratory result was reported to DOH to the date DOH processed the message. Timeliness was categorized as

either timely or untimely based on the Washington State reporting law, which requires reporting within 2 business days for laboratories. T-tests and Z-tests were conducted to assess significant differences in means and proportions across data sources. Cases were stratified by clinical or laboratory case defining criteria, and by urban and rural based off patient's reported address.

Results

A total of 4,324 ELR reports, and 151 manual fax reports were included in the analysis. Overall, ELR reports demonstrated higher average completeness (76.2%) compared to manual fax reports (35.7%). ELR reports had a significantly shorter mean lag time (1 day) and a larger proportion of timely reports (94%) as compared to manual fax reports (3 days, 66.2%). Both ELR and manual fax reports had higher completeness for laboratory-confirmed cases as opposed to clinical-confirmed cases. Case reports from urban areas were more complete for ELR reported cases (75.8) and had fewer lag days (1.1 days) as compared to rural areas (44.1%, 3.6 days). For manual fax reports, there was no significant difference in completeness or timeliness between urban and rural areas.

Conclusion

This study highlights the enhanced performance of ELR over manual fax reporting in terms of completeness and timeliness for TB laboratory case reporting in Washington State. These findings emphasize the value and utility of electronic laboratory reporting to strengthen public health surveillance and response efforts, ultimately contributing to more robust disease control and prevention as well as healthier communities across Washington State.

Introduction

Disease surveillance is an integral role of public health systems for effective control and prevention of infectious and non-infectious diseases. In the United States, disease surveillance begins at the local and state level, with regulations determining which diseases are reportable[1]. At the national level, the Center of Disease Control (CDC) monitors a list of notifiable diseases and conditions that are reported by local and state health departments. The National Notifiable Disease Surveillance System (NNDSS) is the case surveillance process conducted by the CDC for national surveillance, prevention and control of over 80 notifiable diseases[1]. Case surveillance is conducted via mandatory case reporting by hospitals, healthcare providers and laboratories to health departments according to the states' disease reporting laws[2]. During case notification, the state departments then notify certain diseases and conditions to the CDC where it is tracked and managed via logistical and financial assistance[2].

The Washington Disease Reporting System (WDRS) is an electronic disease surveillance system used by public health professionals across Washington State to enter, track, and analyze disease related data on nationally and Washington State notifiable conditions[3]. The information comes from variety a of sources, including healthcare providers, facilities, and laboratories within Washington. Moreover, WDRS serves as the integral system between state and local health departments to communicate and coordinate disease investigations and public health responses.

Electronic Laboratory Reporting (ELR) is a method that laboratories use to report notifiable conditions to public health agencies to aid in prompt response[4]. Historically, health care facilities and laboratories notified state and local health departments of notifiable conditions manually through email, fax or phone calls, followed by manual data entry into the disease surveillance system. However, ELR now automates this process by translating information in a laboratory system into an electronic message that is automatically sent to the public health department[4]. The Washington State Department of Health (WADOH) maintains an ELR system through the Washington State Electronic Laboratory Reporting System (WELRS) data base, which tracks and provides laboratory reports to public health professionals across Washington State. Information from the ELR reports ultimately gets integrated into WDRS, providing public health professionals with a comprehensive view of laboratory data. ELR is thought to improve laboratory report quality due to the faster electronic transmission, increased accuracy, consistency and comprehensiveness of information across various sources[5].

In Washington (WA) State, notifiable conditions are outlined in Washington Administrative Code (WAC) 246-101. The notifiable conditions that laboratories are required to report are listed under WAC 246-101-201[6]. Tuberculosis (TB) is among the list of notifiable diseases in WA. Laboratories in Washington are required to notify the Department of Health within 2 business days of receiving a positive TB test result, including Nucleic Acid Amplification Detection (NAAT or NAT), *Mycobacterium tuberculosis* complex culture, or drug susceptibility tests (DST)[7].

Background

Tuberculosis was responsible for around 1.3 million deaths globally in 2022 and is the second leading infectious cause of death worldwide[8]. The incidence of TB in the United States was 2.5 per 100,000 people in 2022, with 73% of these occurring in non-US born individuals[9]. In 2021, Washington State (WA) was among the 10 states reporting a TB incidence rate higher than the national average (2.6 per 100,000 people)[10] and had an increase in TB incidence rate in 2022 (3.2 per 100,000 people) relative to the incidence rate in 2020 (2.1 per 100,000 people)[9]. The urgency of timely case reporting is particularly important in diseases like TB, where infected people may not be aware of their status and therefore unknowingly transmit the disease to others. This emphasizes the significance of understanding the most effective reporting methods to facilitate prompt treatment and curb disease transmission.

Previous research conducted by Dixon et. al (2017) investigated reporting patterns for seven reportable diseases using cases reported to the Marion County Public Health Department[11]. They compared the timeliness and completeness of passive reporting by providers and laboratories in the county. They first calculated reporting rates, or the proportion of known and unique cases having a corresponding case report from a provider, or a faxed or electronic laboratory report. They also calculated the completeness of reporting as the proportion of non-blank fields for selected key data fields, and the timeliness of reporting, measured as the difference between date of lab confirmed diagnoses and date the report was received by the health department. They then conducted a binomial generalized linear model (GLM) to compare completeness and timeliness across the data sources. The authors found that electronic laboratory reporting yielded the largest reporting rate out of the three sources for all seven diseases. Laboratory based reports were more complete for three fields: patient sex, provider name, and identification of laboratory test perform ($p<0.001$). They found that electronic lab reports were the most timely data source, followed by faxed lab reports, then provider reports[11].

This study emphasized the importance and current knowledge gap concerning the association between ELR reporting versus the traditional method of manual reporting (fax, email, phone) on the completeness and timeliness of case reporting in Washington State since the implementation of ELR in 2019. The primary objective of this analysis was to assess the completeness and timeliness of TB case reporting to WADOH by laboratories. To assess manual reporting methods, we limited our analysis to only reports that were faxed by laboratories to assess the data that was available at the time of the case report. We compared traditional manual reporting methods via faxed reports to automated ELR in order to determine which method yielded more complete and timely reporting of this notifiable condition.

For this analysis, we utilized TB case report information from the WDRS from 2019-2023 to analyze manually reported cases via fax. The original fax reports of all cases reported in our study time frame were identified using the WDRS. Original fax reports were then reviewed individually and manually. Additionally, we analyzed TB reports from the Washington Electronic Laboratory Reporting System (WELRS) dataset for the same time period to analyze ELR-reported cases. This comparison enabled us to assess the performance of TB case reporting via traditional methods (fax) versus ELR. Furthermore, we evaluated the performance based on case-defining criteria of either laboratory or clinical.

By stratifying the completeness and timeliness of case reporting by patient residence of either urban or rural, we highlighted the geographical impact on public health infrastructure for disease surveillance. Ultimately, this analysis identifies gaps in laboratory reporting by manual fax methods and demonstrates that ELR reporting was more robust in terms of both completeness and timeliness. This informs that improvements should be made to notifiable disease reporting laws in Washington State, thereby enhancing public health surveillance and response efforts overall.

Study Aims

Aim 1: Investigate the association between the completeness and timeliness of TB cases reported by laboratories in Washington State from 2019-2023, comparing cases reported via Electronic Lab Reporting (ELR) to cases that were reported manually via fax.

Aim 2: Determine the performance of reporting utilizing the case-defining criteria of either laboratory or clinical case defining criteria.

Aim 3: Conduct a stratified analysis based on the urbanicity of cases, using zip codes to explore variations in both completeness and timeliness of case reporting between urban and rural laboratories in Washington.

Methods

Study Design

This retrospective evaluation was conducted using the Washington Disease Reporting System (WDRS) and Washington Electronic Laboratory Reporting Systems (WELRS) data from 2019-2023 to assess the completeness and timeliness of laboratory tuberculosis case reporting by reporting type in Washington State.

Study Setting

The WDRS is an electronic surveillance system used by public health professionals across Washington State to enter, track, and analyze disease related data[3]. Tuberculosis cases are reported to the state through the WDRS database, which allows for active tracking of cases. Reports are submitted by providers, facilities, and laboratories. For the analysis of manually reported cases, we utilized the WDRS dataset, focusing on laboratory-reported cases communicated only via fax. We used a subset of the dataset that had been cleaned, with duplicate cases excluded. The data included all TB cases reported to the state from 2019 to 2023 that met the CDC/CSTE 2009 TB case definition based on clinical and laboratory criteria[12]. We excluded all reports outside the 2019-2023 period, outside of Washington State, and all ELR cases. The final sample size for analysis was determined as the number of original fax reports that could be linked using the WDRS_ID for NAAT test results (N=156) (Figure 1). Culture samples were not included in the analysis due to the long incubation period for TB cultures to grow.

Information from original fax reports were manually extracted to determine what data was available at the time of original test result notification. If for the same patient, reports were faxed from multiple labs, these were counted as separate reports. The following variables were extracted manually from individual fax reports and used in this analysis:

- NAAT specimen receive date
- Result report date
- Patient physical address
- Patient date of birth
- Patient sex
- Patient ethnicity
- Patient race
- Patient preferred language
- Patient phone number
- Requesting provider name
- Requesting provider phone
- Address patient received care

The WELRS dataset tracks all ELR TB cases for each laboratory test ordered. For this analysis, we included only laboratory tests whose results are notifiable by the Washington Administrative Code (WAC). We examined all culture and Nucleic Acid Amplification Tests (NAAT) reported via ELR from 2019-2023, excluding all other tests, including Drug Sensitivity Tests (DST) due to complexity of ELR HL7 reporting structure. After excluding ELR reports for lab tests collected outside of 2019-2023 and cases that did not meet the CSTE TB 2009 case definition, the final sample size for analysis was 4,324 ELR reports (Figure 2).

Both datasets contain information to determine the completeness and timeliness of case reporting. Completeness of case reporting was assessed by the proportion of the following fields present in laboratory case reports, as required by WAC 246-101-115[13] and have been determined to have value in public health response to TB cases:

- Patient's first and last name
- Patient's physical address, including zip code
- Patient's date of birth
- Patient's sex
- Patient's ethnicity, as required in WAC 246-101-011
- Patient's race, as required in WAC 246-101-011
- Patient's preferred language, as required in WAC 246-101-011
- Telephone number of the principal health care provider
- Address where patient received care

Timeliness of manual faxed data reporting was determined by calculating time (in days) between the date the laboratory received the first NAAT specimen collected to the date the result was reported. We used the date that NAAT specimen was received as a proxy for the test result

observation date, as NAATs are typically performed on the same day the specimen is received by the laboratory.

To assess ELR laboratory results, timeliness was determined by the time in days from when the laboratory result was reported to DOH to the date DOH processed the message. Timeliness was categorized as either timely or untimely based on the Washington State reporting law, which requires reporting within 2 business days for laboratories[7].

Data Analysis

Completeness of reporting was calculated as the proportion of each key data elements completed by ELR and manual fax laboratory reports. A two-proportion Z-test was conducted to determine if proportions are significantly different for each data element (Table 2).

Timeliness of reporting was evaluated by detailing the total number of reported cases that were timely, as well as the mean, median, minimum, and maximum number of lag days. A t-test was conducted to compare the mean lag days between ELR and fax reports (Table 3).

The case definition criteria for each report as determined using the "VERIFICATION_STATUS" variable in the WDRS. The proportions of ELR and faxed manual reports stratified by clinical and laboratory case defining criteria are presented in Table 4. Urbanicity was determined using the zip codes of the patients' residence and was categorized as either urban or rural. This stratification of ELR and faxed manual reports is also presented in Table 4.

The completeness and timeliness of ELR versus faxed manual cases are stratified by case definition criteria (Table 5) and urbanicity (Table 6). To assess completeness, we calculated the percent of average complete fields and used t-tests to determine significant differences in means, comparing laboratory to clinical case definition criteria, and urban to rural areas. To assess timeliness, we calculated the mean number of lag days and used t-tests to assess significant differences in means, also comparing laboratory to clinical case definition criteria, and urban to rural patient residence.

All data cleaning and statistical analyses were performed on R and Excel.

Results

A total of 4,324 ELR reports, and 151 manual fax reports were included and analyzed.

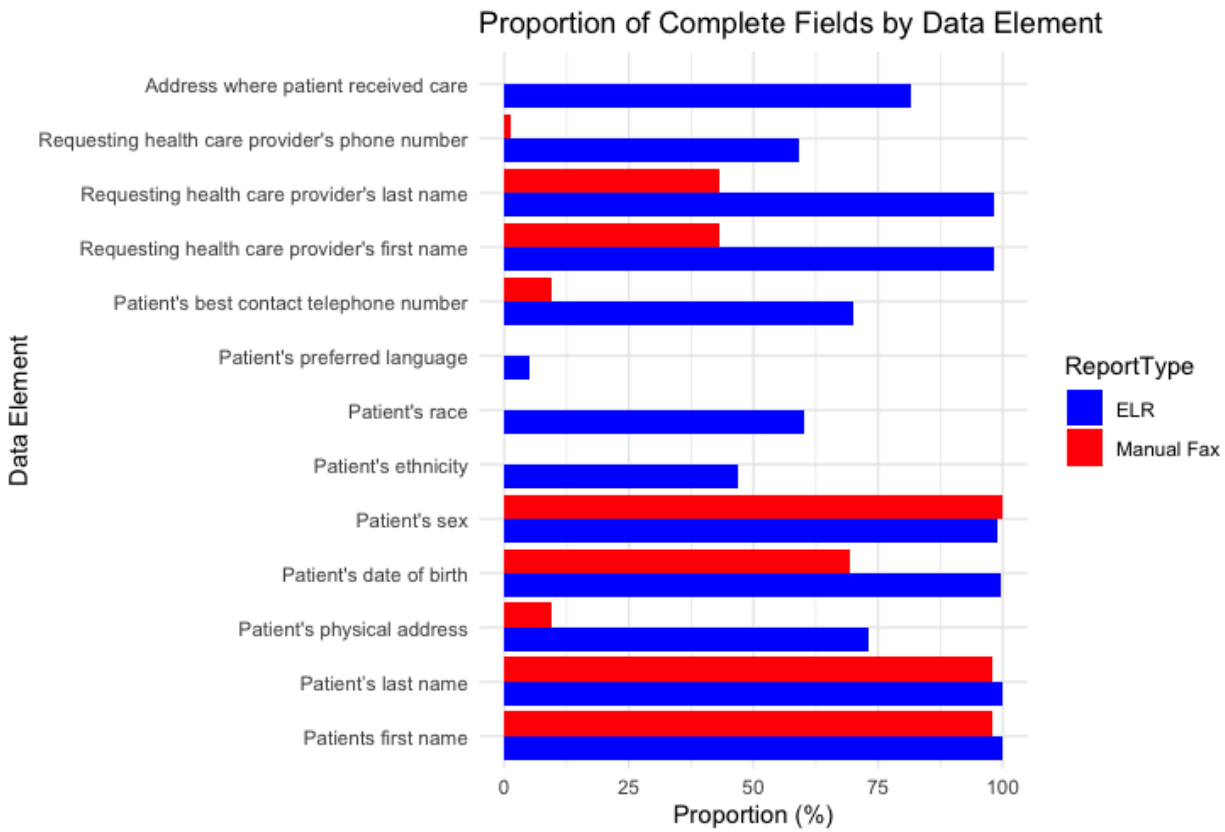

Figure 5. Proportion of complete fields by data element for ELR and Manual Fax reports in Washington from 2019-2023

Completeness

The completeness of reporting varied by data element (Table 2). Basic patient information, such as patient name and sex was consistently reported at high proportions across both data sources. For ELR reports, completeness ranged from 100% for patient first and last name to 5.2% complete for patient preferred language. For manual fax reports, completeness ranged from 100% for patient sex to 1.3% for requesting health care provider's phone number. There was 0% completeness for patient ethnicity, race, and preferred language, and the address where patient received care. Additionally, very low reporting proportions were observed for patient physical address (9.3%) and telephone number (9.3%) (Figure 5).

Overall, ELR reports demonstrated higher average completeness (76.2%) compared to manual fax reports (35.7%) ($p<0.05$). The differences in proportion of complete fields were statistically significant when comparing ELR to manual fax reports for each data element except for patient sex ($p=0.419$). ELR reports consistently had a higher proportion of complete fields for each data element.

Timeliness

ELR reports had a significantly shorter mean lag time (1 day) compared to manual fax reports (3 days) ($p<0.05$). The mean number of lag days for ELR reports is within the WAC notification

requirement for laboratories of two days, while manual fax reports exceed this threshold. However, the maximum number of lag days was considerably higher for ELR reports (98 days) compared to manual fax reports (34 days). Additionally, ELR reports had a larger proportion of timely reports (defined as 2 lag days or less) than manual fax reports (Table 3).

Stratification by Case Definition Criteria and Urbanicity

A larger proportion of both ELR and manual fax reports were verified using laboratory case definition criteria (Table 4). Additionally, a higher proportion of both ELR and manual fax reports were reported from urban laboratories compared to rural ones (Figure 6).

When assessing the completeness of reporting by case definition criteria, we found that the mean proportion of complete data elements was higher for laboratory-confirmed cases for both ELR and manual fax reports ($p<0.05$). However, mean lag days were timelier for cases confirmed by clinical case definitions across both data sources (Table 5).

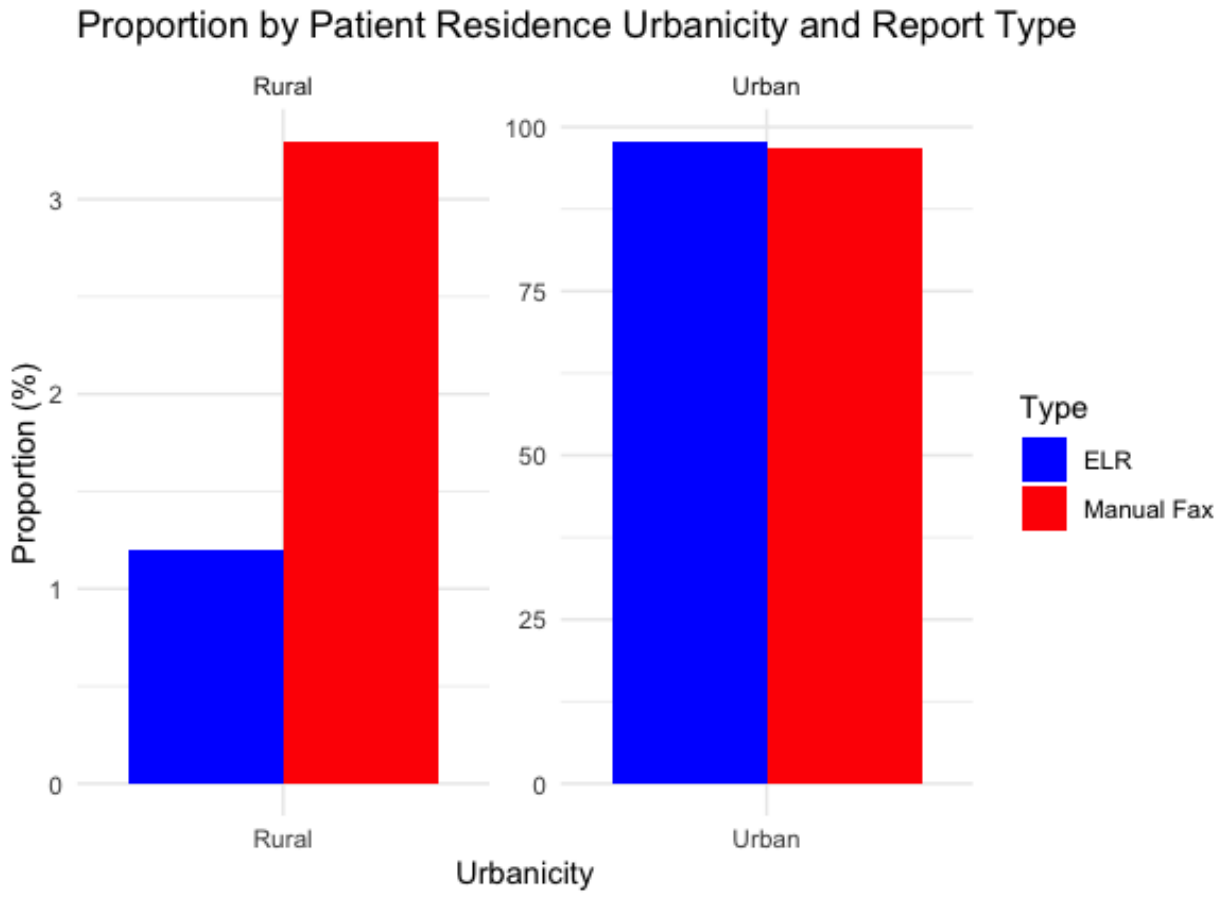

Figure 6. Proportion of TB cases reported by ELR versus manual fax reports by patient residence in rural and urban areas in Washington State, 2019-2023.

Stratification by urbanicity revealed that ELR cases reported by urban laboratories had a higher mean proportion of complete data elements ($p<0.05$). Urban laboratories also had fewer mean lag days, although this difference was not statistically significant. For manual fax reports, there

was no statistically significant difference in either completeness or timeliness between urban and rural laboratories (Table 6).

Discussion

Key Findings

This study highlights the enhanced performance of ELR over traditional manual fax reporting in the context of TB case reporting in Washington State from 2019-2023.

ELR reports had a higher average completeness (76.2%) compared to manual fax reports (35.7%). Specifically, ELR reports showed a significantly higher proportion of complete fields across most data elements, except for patient sex. In terms of timeliness, ELR reports had a significantly shorter mean lag time of 1 day compared to 3 days for manual fax reports. ELR reports on average adhered to the Washington Administrative Code (WAC) requirement of reporting within 2 days, unlike manual fax reports.

Both ELR and manual fax reports had higher completeness for laboratory-confirmed cases. Conversely, clinical case definitions were associated with more timely reporting for both data sources. However, this finding may be skewed due to very low counts overall for cases verified by clinical case definition. Reports from urban patient residence were more complete for ELR cases and had fewer lag days. For manual fax reports, there was no significant difference in completeness or timeliness between urban and rural laboratories.

These findings align with those of Dixon et al., (2017) whose primary comparison was provider reports to laboratory faxed and HIE-ELR reports[11]. Dixon et al. found slight differences in completeness, with faxed laboratory reports showing slightly higher completeness for certain fields, which may be attributed to differences in study designs, state-specific reporting laws, and the diseases investigated. Findings for timeliness were similar, as they found that fax lab reports were less timely than HIE-ELR[11].

The findings of this analysis suggest that ELR systems improve the completeness and timeliness of TB case reporting compared to manual fax methods in Washington. This enhancement is particularly critical for public health surveillance and response, as timely and complete data are essential for effective disease control and prevention measures. The higher performance of ELR in urban settings may be due to better infrastructure and resources, highlighting the need for targeted improvements in rural areas.

Strengths

A key strength of this study is the robust data used to extract information for manual fax reports. Initially, we considered using information from the WDRS; however, this approach presented several limitations. The WDRS dataset available at the time of this analysis included data obtained during subsequent case investigations, potentially incorporating additional information gathered by state health officers after the initial report. This follow-up process often fills in missing information, making it difficult to distinguish what was reported at the time of the case

report. By manually extracting data from the original fax documents, we ensured that our analysis accurately reflected the information available at the time of the initial case report, providing a clear and reliable assessment of the completeness and timeliness of manual reporting.

Additionally, because ELR reports are sent as HL7 messages, the WELRS dataset accurately reflects the data available at the time of the initial ELR report. This consistency ensures that both manual and electronic reporting methods are assessed based on the same temporal criteria, enhancing the reliability of our comparisons.

Limitations

This study has several limitations inherent to the use of surveillance datasets. The accuracy of the datasets used depends on the quality of the data entry processes. Errors or inconsistencies in data entry could affect the findings. Changes in reporting practices, policies, or technologies over the study period (2019-2023) could influence the results. For instance, each healthcare facility and laboratory in Washington implemented ELR systems at different times within our study timeframe.

This analysis also includes data collected during the COVID-19 pandemic, which may have affected the ability of laboratories to report TB cases as they typically would. Other factors influencing the completeness and timeliness of reporting, such as the staffing levels at laboratories or the availability of resources, are not controlled for in this study. There is potential for bias with the size or complexity of the laboratory that may limit them from establishing an ELR system at their facility, resulting in only traditional reporting from these labs. Laboratories within Washington also established ELR at different time periods within our study time frame, which may also introduce confounding.

There are limitations to comparing ELR reports with manual fax reports due to inconsistencies in measuring the timeliness of reporting. Due to the available data variables in WDRS, we used the date the laboratory received the sample as a proxy for when the test result was observed. This assumption was based on the typical same-day processing of NAATs. However, if the laboratory performed the test the next business day, the reported timeliness might be inflated. The use of statistical tests to compare results between the two groups strengthens the validity of findings.

Additionally, most cases that were manually reported were also reported via ELR. The purpose of this analysis is to evaluate the performance of reporting by source type, regardless of multiple reports for the same disease event. Finally, this analysis is observational and descriptive, limiting our ability to draw strong conclusions about causation. The primary aim is to provide a baseline performance assessment of reporting methods to inform future studies and policy recommendations.

Implications

Future research should explore the long-term impact of ELR adoption on public health outcomes. A more complex analysis that takes into account disease outcomes will further strengthen the

results. Studies could examine other notifiable diseases using the same datasets to determine if the benefits observed for TB reporting are consistent across various conditions in Washington State. Further research might also investigate the specific barriers to ELR adoption in different healthcare settings and propose targeted interventions to address these challenges. Additionally, efforts should be made to improve the infrastructure and resources in rural areas to bridge the gap in reporting performance between urban and rural settings.

In conclusion, this study highlights the enhanced performance of ELR over manual fax reporting in terms of completeness and timeliness for TB case reporting in Washington State. These findings emphasize the value and utility of electronic laboratory reporting to strengthen public health surveillance and response efforts, ultimately contributing to more robust disease control and prevention as well as healthier communities across Washington State.

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Appendix

Table 1. Counts of Reports by Source

Source	Count of Reports (N)
ELR reports	4324
Manual fax reports	151

Table 2. Completeness of Reporting by Data Fields and Reporting Type

Data Element	Proportion of ELR Reports Complete n (%) N=4324	Proportion of Manual Fax Reports Complete n (%) N=151	P-value
Patients first name	4324 (100)	148 (98.0)	p<0.0001
Patient's last name	4324 (100)	148 (98.0)	p<0.0001
Patient's physical address	3159 (73.1)	14 (9.3)	p<0.0001
Patient's date of birth	4308 (99.6)	105 (69.5)	p<0.0001
Patient's sex	4281 (99.0)	151 (100)	p=0.4197
Patient's ethnicity	2022 (46.8)	0 (0)	p<0.0001
Patient's race	2607 (60.1)	0 (0)	p<0.0001
Patient's preferred language	226 (5.2)	0 (0)	p=0.0070
Patient's best contact telephone number	3028 (70.0)	14 (9.3)	p<0.0001
Requesting health care provider's first name	4245 (98.2)	65 (43.0)	p<0.0001
Requesting health care provider's last name	4254 (98.4)	65 (43.0)	p<0.0001
Requesting health care provider's phone number	2553 (59.0)	2 (1.3)	p<0.0001
Address where patient received care	3523 (81.5)	0 (0)	p<0.0001
Average	3296.5 (76.2)	53.9 (35.7)	p=0.0093

Table 3. Timeliness of Reporting by Data Source

Data Source	Mean # Lag Days	Median # Lag Days	Max # Lag Days	NA	Total N timely (%)	Total N	p-value*
ELR Reports	1	0	98	1249	3429 (94.0)	3650	0.0002
Manual Fax Reports[a]	3	1	34	0	100 (66.2)	151	

*T-test p-value of the mean lag days, 95% CI [-2.09, -0.67]

[a] The date that the NAAT was received to the laboratory was used as a proxy for when the test result was received to the laboratory due to NAATs typically being performed on the same day

Table 4. ELR and Manual Fax Reports Stratified by Case Definition Criteria and Urbanicity

Characteristic	ELR N= 4324 n (%)	Manual Fax N= 151 n (%)
Case Definition Criteria		
Clinical	12 (0.28)	1 (0.7)
Laboratory	3921 (90.7)	149 (98.7)
NA	391 (9.0)	1 (0.7)
Urbanicity		
Urban	4234 (97.9)	146 (96.7)
Rural	54 (1.2)	5 (3.3)
NA	36 (0.8)	0

Table 5. Completeness and Timeliness by Case Definition Criteria for ELR and Manual Fax Reports

	ELR Reports N = 4324		Manual Fax Reports N = 151	
Characteristic	Mean % Complete	Mean lag days	Mean % Complete	Mean lag days
Clinical	2.14	0.0	16.7	0.0
Laboratory	69	1.2	35.4	2.4
p-value	p=0.0006	p<0.0001	p= 0.0164	N/A

p<0.05 for two-proportion T-test

Table 6. Completeness and Timeliness by Urbanicity for ELR and Manual Fax Reports

	ELR Reports N= 4324		Manual Fax Reports N = 151	
Characteristic	Mean % Complete	Mean lag days	Mean % Complete	Mean lag days
Urban	75.8	1.1	35.7	2.4
Rural	44.1	3.6	36.7	2.4
p-value	p=0.0006	p=0.1058	p= 0.9054	p=0.9538

$p<0.05$ for two-proportion T-test

Table 7. Data Variables

Data Element	ELR HL7 Field	WELRS	WDRS QID	WDRS Data Notes
Completeness				
Patient's first name	PID.5	PtFirstName	FIRST_NAME_REPORTING	Last name of patient at time of initial case report
Patient's last name	PID.5	PtLastName	LAST_NAME	First name of patient at time of initial case report
Patient's physical address	PID.11	PtAddrStreet	CASE_COUNTING_ADDRESS	Manually collected information
Patient's date of birth	PID.7	PtDOB	BIRTH_DATE	Manually collected information
Patient's sex	PID.8	PtSex	SEX_AT_BIRTH_REPORTING	Manually collected information
Patient's ethnicity	PID.22	PtEthnicity	ETHNICITY	Manually collected information
Patient's race	PID.10	PtRace	RACE	Manually collected information
Patient's preferred language	PID.11	PtPreferredLanguage	PREFERRED_LANGUAGE	Manually collected information
Patient's best contact telephone number	PID.13	PtPhonePers	N/A	Manually collected information

Requesting health care provider's first name	OBR.16	OrdProvFirstName	N/A	Manually collected information
Requesting health care provider's last name	OBR.16	OrdProvLastName	N/A	Manually collected information
Requesting health care provider's phone number	OBR.17	OrdProvPhone	N/A	Manually collected information
Address where patient received care	OBX.23	ResultProdName	N/A	Manually collected information
Timeliness				
NAAT date received	N/A	N/A	NUCLEIC_ACID_AMPLIFICATION_RECEIVE_DATE	Optional field in WDRS, QID start date was 1/5/23, Manually collected information
NAAT date reported	N/A	N/A	NUCLEIC_ACID_AMPLIFICATION_LHJ_NOTIFICATION_DATE	Manually collected information
Result report date	OBR.22	ResultRptDt	N/A	
Message date	MSH.7	MsgDtTm	N/A	
Other				
Indication that case meets case definition of TB	N/A	N/A	TB_CASE_COUNTABLE	State DOH team populates
Date event was first created in WDRS	N/A	N/A	C_CREATE_DATE	System generated in WDRS
Current level of diagnostic evidence or clinical judgement supporting diagnosis as a verified case of TB disease	N/A	N/A	VERIFICATION_STATUS	System generated in WDRS

If this case is countable in WA, the date the case was counted for surveillance purposes	N/A	N/A	TB_CASE_COUNTED_DATE	State DOH team populates. This variable was used to subset WDRS data to only cases reported in 2019-2023
Unique WDRS system ID assigned to event record	N/A	N/A	WDRS_ID/C_CASE_ID	

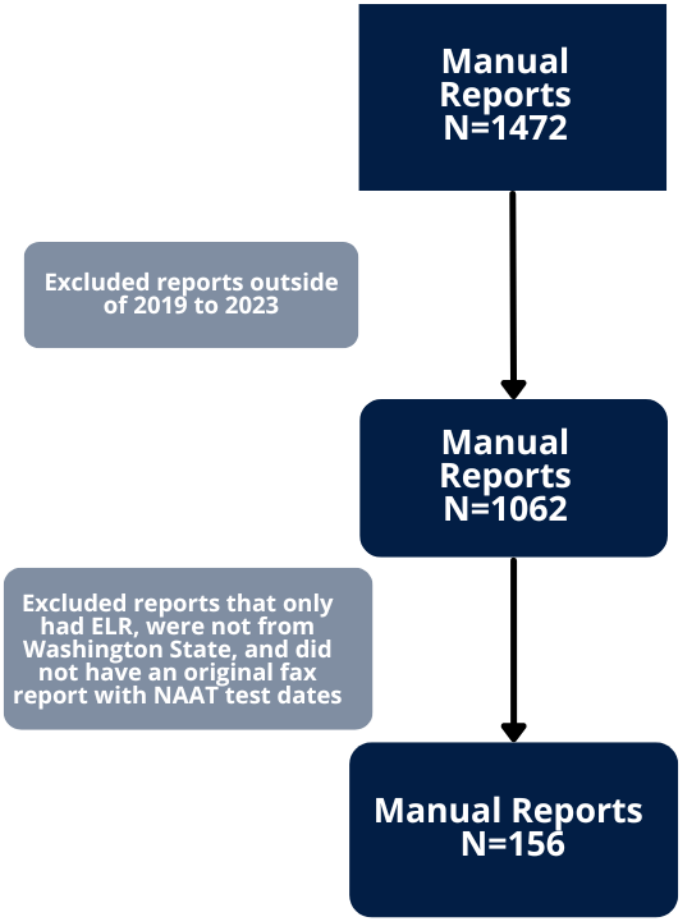

Figure 1. Total N in study population for manual fax reports

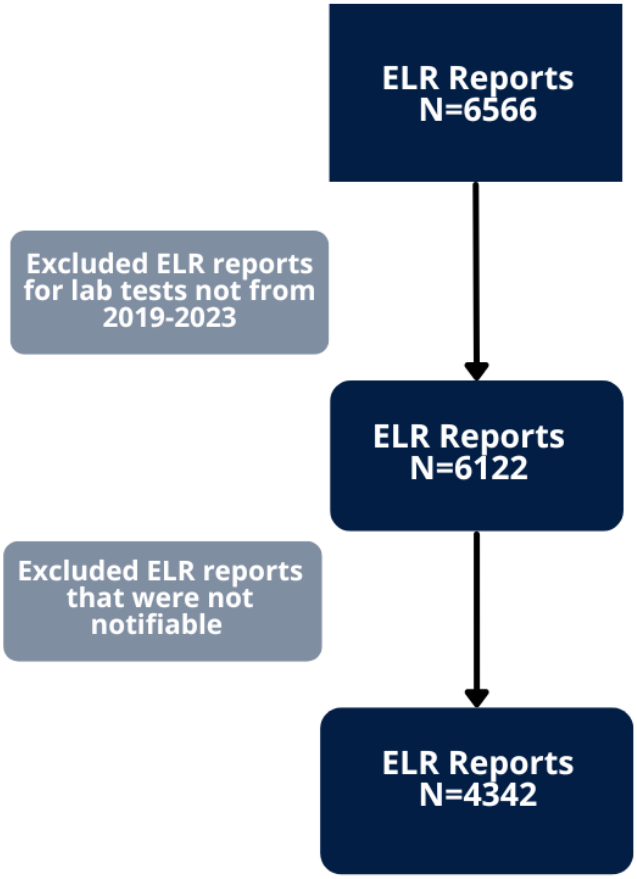

Figure 2. Total N in study population for ELR reports

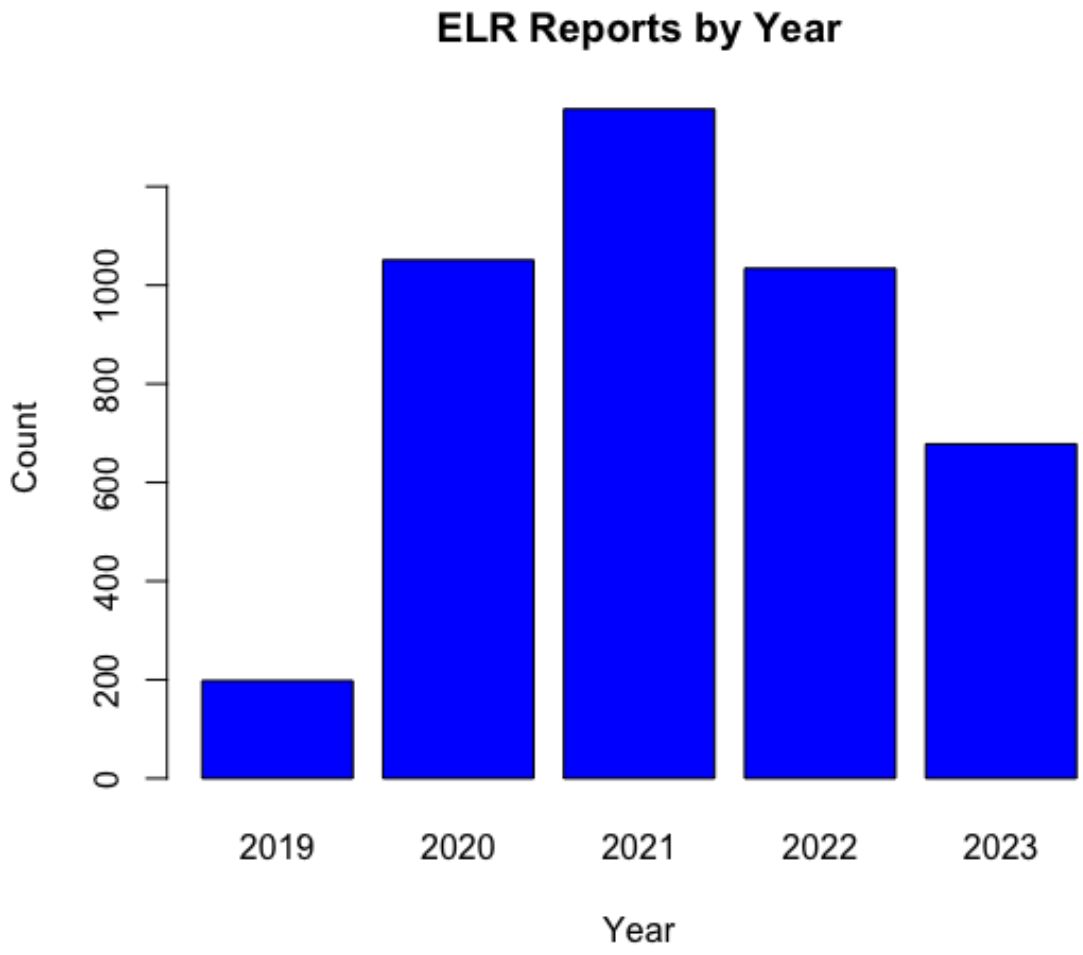

Figure 3. Counts of TB test results reported through ELR in Washington State from 2019-2023, by year.

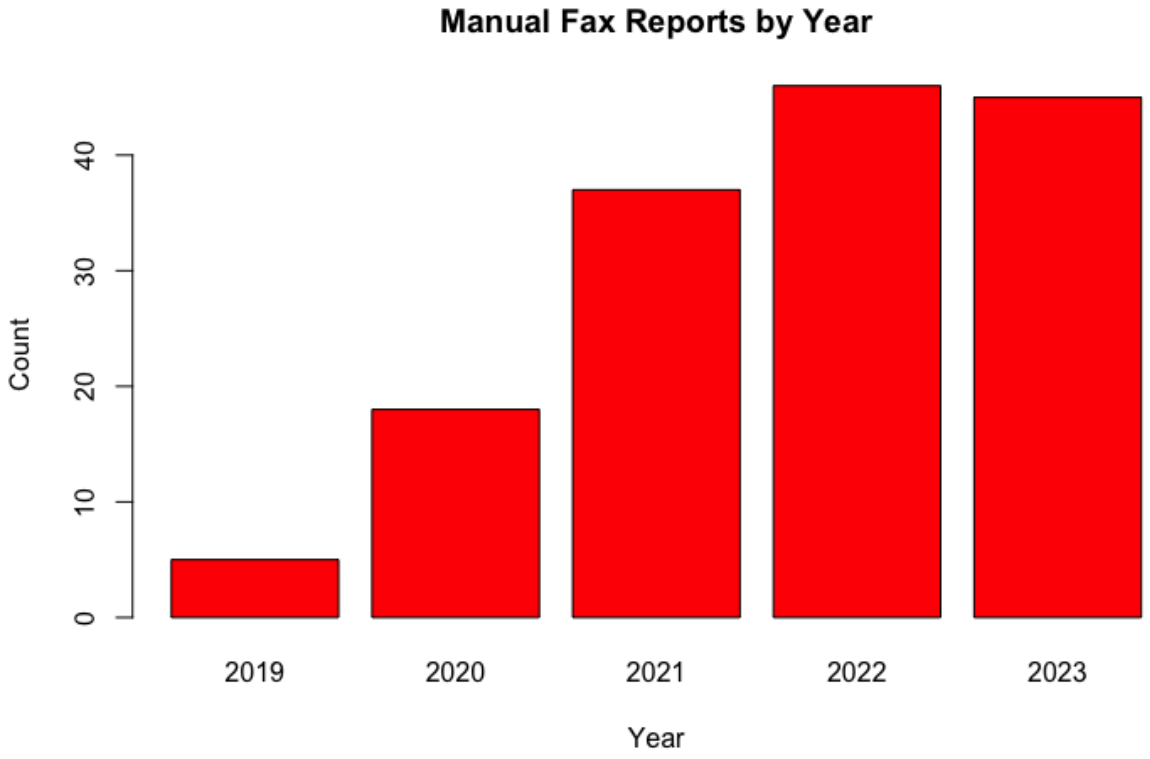

Figure 4. Counts of manually faxed reported TB NAAT results in Washington State from 2019-2023, by year.