

Use of Death Certificates to Identify Tuberculosis-related Deaths in Washington State

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**Abstract**

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**OBJECTIVE:** To compare the accuracy of ICD-10 coded and text cause of death data in identifying tuberculosis (TB)-related deaths in Washington State.

**DESIGN:** A cross-sectional study was performed comparing TB-related deaths identified through death certificates using either text fields or ICD-10 codes to TB-related deaths identified in the TB registry.

**RESULTS:** All methods using death certificate data overestimated the number of TB-related deaths and had low to moderate agreement with the tuberculosis registry. Several subjects assigned a TB ICD-10 code had no evidence of TB on the death certificate.

**CONCLUSION:** Death certificates are not highly predictive of TB-related deaths. If death certificates are utilized, then TB-related deaths should be identified using direct cause of death text fields.

## BACKGROUND

Death certificate data are often used to estimate tuberculosis (TB) mortality and to identify risk factors associated with death from TB<sup>1-5</sup>. Most studies rely on underlying or multiple cause of death International Statistical Classification of Diseases (ICD) codes to identify a TB-related death<sup>1-5</sup>. In the United States, accuracy of death certificates for identifying true TB-related deaths has only been evaluated once, by Washko and Frieden in New York City in 1992.<sup>6</sup> These investigators found that only 59% of death certificates with an underlying or multiple cause of death ICD-9 TB-related code were confirmed TB cases in the New York City tuberculosis registry.<sup>6</sup> To our knowledge, no studies have compared the accuracy of ICD-10 codes and text cause of death fields for determining true TB-related deaths. The current study assesses the sensitivity and positive predictive value of ICD-10 coded and text cause of death data for identifying TB-related deaths.

## METHODS

We performed a cross-sectional study comparing TB-related deaths detected through Washington State death certificates using four different definitions to TB-related deaths identified in the Washington State TB registry during 2009-2010.

In Washington State, healthcare providers report conditions directly causing death and conditions contributing to death in two separate text fields on the death certificate. Coding algorithms consider both text fields when ICD-10 codes are assigned to the death certificate.<sup>7</sup> One underlying plus multiple cause of death codes may be assigned for each death certificate. In the National Vital Statistics Report, a TB-related death is defined as a death with ICD-10 code A16-A19 as the underlying cause of death.<sup>8</sup>

Death certificate data were obtained from the Washington State Department of Health Center for Health Statistics for all deaths occurring in the state during 2009 and 2010. TB-related deaths were identified using the following four definitions: (1) records with a TB ICD-10 code (A16-A19) as the underlying cause of death, (2) records with a TB ICD-10 code (A16-A19) as the underlying or any multiple cause of death, (3) records with "tuberculosis" listed in either the direct cause of death or contributing condition text fields, excluding those with inactive or history of TB noted, and (4) records with "tuberculosis" listed in the direct cause of death text field only, excluding subjects with inactive or history of TB noted. The reviewer matched TB-related deaths identified using each death certificate definition to deaths in the Washington State TB registry with the assistance of LinkPlus software (Centers for Disease Control and Prevention, Atlanta, GA, USA). Subjects were matched by the following criteria: last and first name, zip code of residence, gender, and date of birth.

The sensitivity and positive predictive value of each death certificate definition was determined using TB-related deaths identified in the Washington State TB registry as the gold standard. In the TB registry, a death was defined as TB-related if TB was the immediate or underlying cause of death, or a significant condition contributing to death.<sup>9</sup> Cohen's kappa concordance statistic was computed to determine the amount of agreement beyond chance of each death certificate definition and the TB registry. Stata 11.2 (STATA Corporation, College Station, TX, USA) was

used for data analysis. The Washington State Institutional Review Boards exempted this protocol from full review since the data were fully linked and de-identified prior to analysis.

## RESULTS

During 2009-2010, 11 TB-related deaths were recorded in the Washington State TB registry. Of the 96,183 Washington State death certificates reviewed from 2009-2010, 20 had an ICD-10 code indicating TB as the underlying cause of death, 51 had an ICD-10 code indicating TB as the underlying or any multiple cause of death, 30 had “tuberculosis” in either the direct cause of death or contributing condition text fields and 16 had “tuberculosis” in the direct cause of death text field (Table 1). Although all four death certificate definitions had high sensitivity (82% - 100%), each definition had poor to moderate positive predictive value (22% - 56%) and poor to moderate agreement ( $\kappa = 0.35-0.67$ ) with the TB registry. Compared to the other definitions, indication of “tuberculosis” in the direct cause of death text field had the highest positive predictive value and agreement with the TB registry.

Several subjects assigned TB ICD-10 codes had no evidence of TB infection in the death certificate text fields and were not confirmed TB cases in the TB registry. Four subjects were assigned underlying cause of death ICD-10 code A18.0 (TB of bone or joints) and another five subjects were assigned multiple cause of death ICD-10 code A18.0 because of text indicating “vertebral abscess”; none had evidence of TB infection in either death certificate cause of death text field. One misclassified death had underlying cause of death ICD-10 code A16.2 (TB of lung, bacteriological or histological examination not done) and another four subjects were assigned multiple cause of death ICD-10 code A16.2 because of text indicating “pulmonary cavitation” without evidence of TB infection in either text field. Also, seven (18%) of the misclassified TB-related deaths identified through multiple cause of death ICD-10 codes had “treated TB” or “history of TB” listed in the contributing cause of death text field.

## DISCUSSION

All death certificate definitions had high sensitivity but low positive predictive value and low agreement with the TB registry for detecting TB-related deaths. The death certificate’s low positive predictive value may in part be due to latent TB infections that do not contribute to the person’s death. Use of the direct cause of death text field had the highest positive predictive value and agreement with the TB registry. The current study found two TB ICD-10 codes were assigned to subjects with no evidence of TB on the death certificate. According to national coding algorithms, death certificates indicating lung cavitation in cause of death text fields are assigned ICD-10 code A16.2 (TB of lung, bacteriological or histological examination not done) unless the lung cavitation is specified as nontuberculous.<sup>10</sup> In addition, subjects with vertebral abscesses are assigned ICD-10 code A18.0 (TB of bone or joints).<sup>10</sup> While these coding rules may be appropriate in countries where the incidence of TB is high, they may not be appropriate in counties with low incidence of tuberculosis.

There are a few limitations to the current study. First, only data for 2009 and 2010 were available leading to a small number of possible TB-related deaths. There also may be a limitation in using the Washington State TB registry as the gold standard for a TB-related death. A full medical

chart review may give a more accurate account of true TB-related deaths. However, the Washko and Frieden study found the NYC TB registry to be nearly as accurate as a medical chart review<sup>6</sup>.

In Washington State, use of death certificates to identify TB-related deaths resulted in a two- to five-fold overestimate of TB-related deaths identified in the TB registry. Future researchers should avoid utilizing death certificates to detect TB-related deaths. If death certificates are used, TB-related deaths should be identified using the direct cause of death text field rather than ICD-10 cause of death codes.

Table 1. Characteristics of Death Certificate Definitions in Identifying TB-Related Deaths Compared to the Washington State TB Registry (n=11), 2009-2010

Death certificate definition	# of TB deaths detected through death certificates	# of deaths in TB registry	Sensitivity	Positive predictive value	Cohen's kappa (95% CI)
TB ICD-10 code in multiple cause of death	51	11	100%	22%	0.35 (0.35, 0.36)
TB listed in the direct cause of death or contributing condition text fields*	30	11	100%	37%	0.54 (0.53, 0.54)
TB ICD-10 code as underlying cause of death	20	9	82%	45%	0.58 (0.57, 0.59)
TB listed in the direct cause of death text field*	16	9	82%	56%	0.67 (0.66, 0.67)

\* Records with inactive TB or a history of TB excluded.

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