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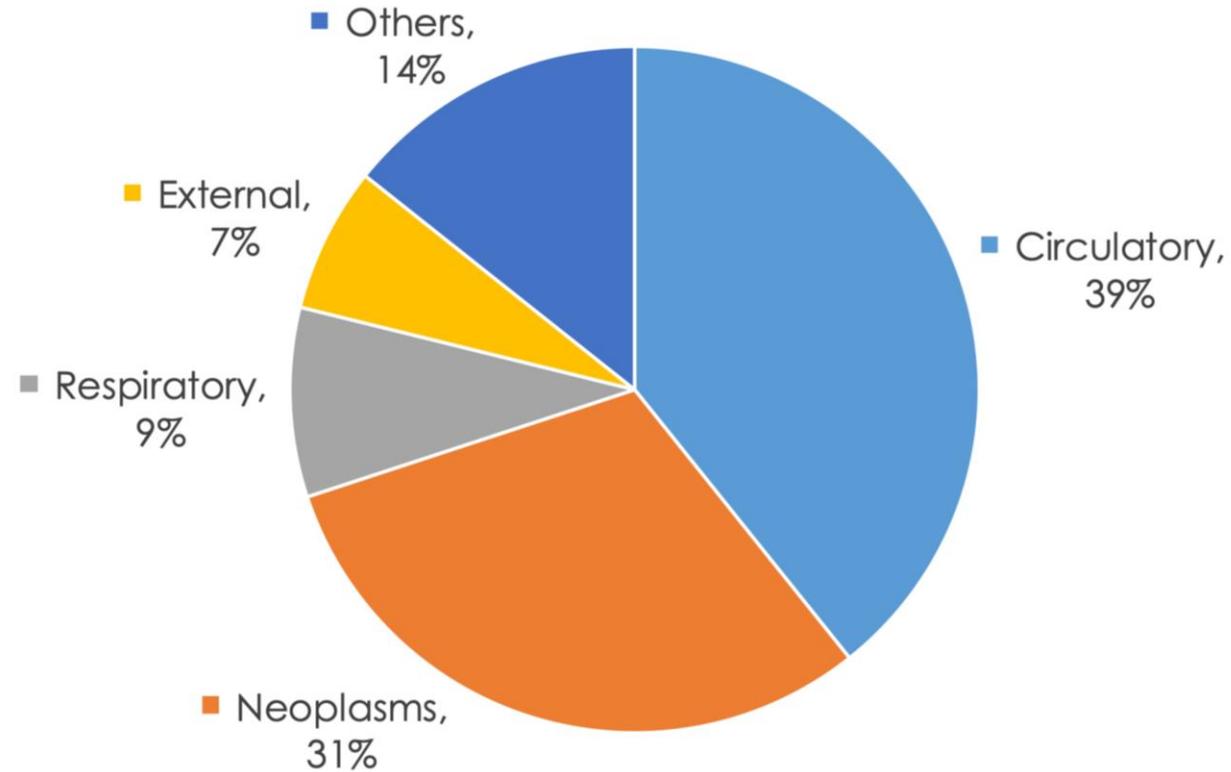
Over- and Under-classification of Underlying Cause of Death on  
Death Certificates From a Small All-autopsied Population of  
Former Nuclear Workers

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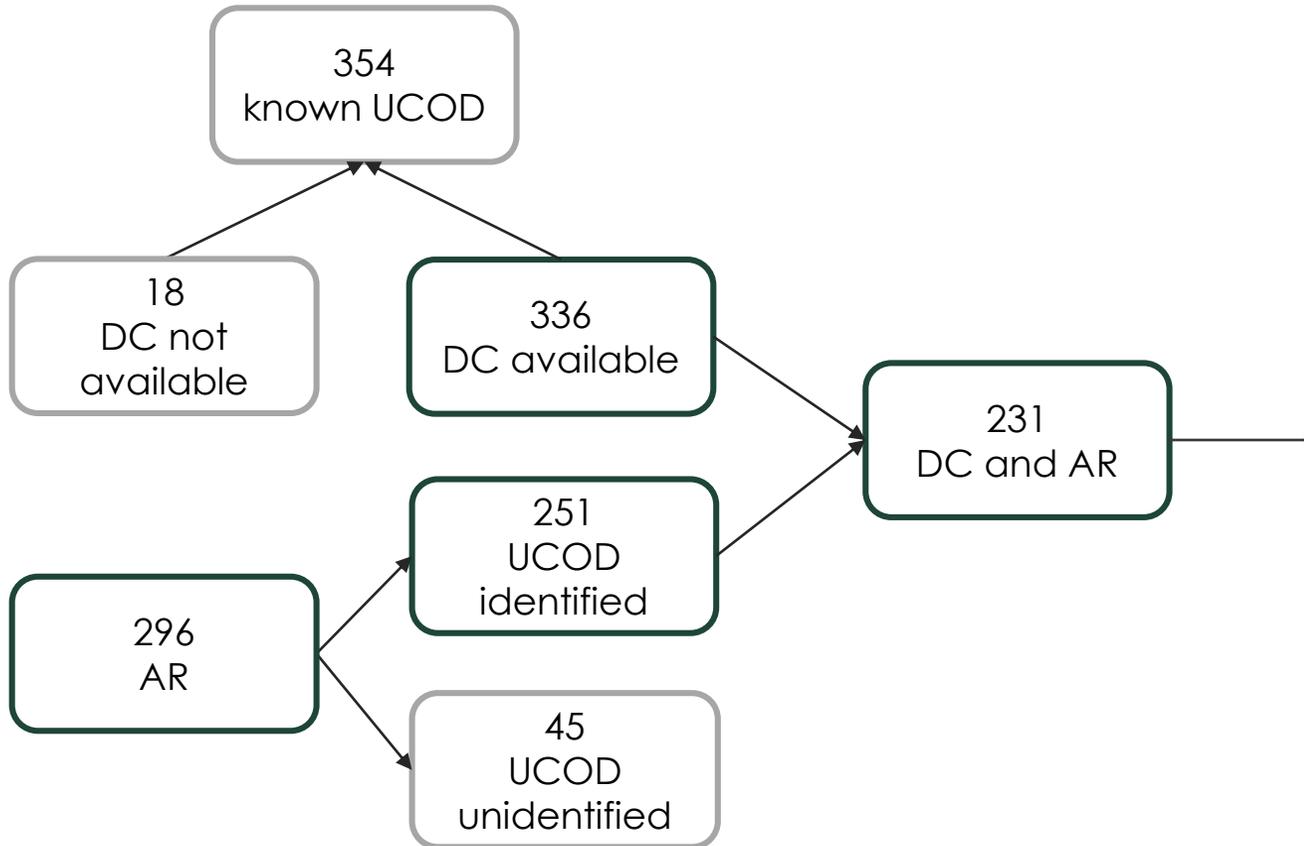
# BACKGROUND AND OBJECTIVE

- 354 cases of deceased former nuclear workers
- An autopsy is performed on each individual
- Death certificates (DC) and autopsy reports (AR) were coded independently using the 10<sup>th</sup> revision of International Classification of Diseases (ICD-10)
- The objective is to compare the underlying cause of death (UCOD) on death certificates (health outcomes for epidemiological studies) with autopsy reports

# CAUSES OF DEATH OF 354 USTUR CASES



# CASE SELECTION (I)

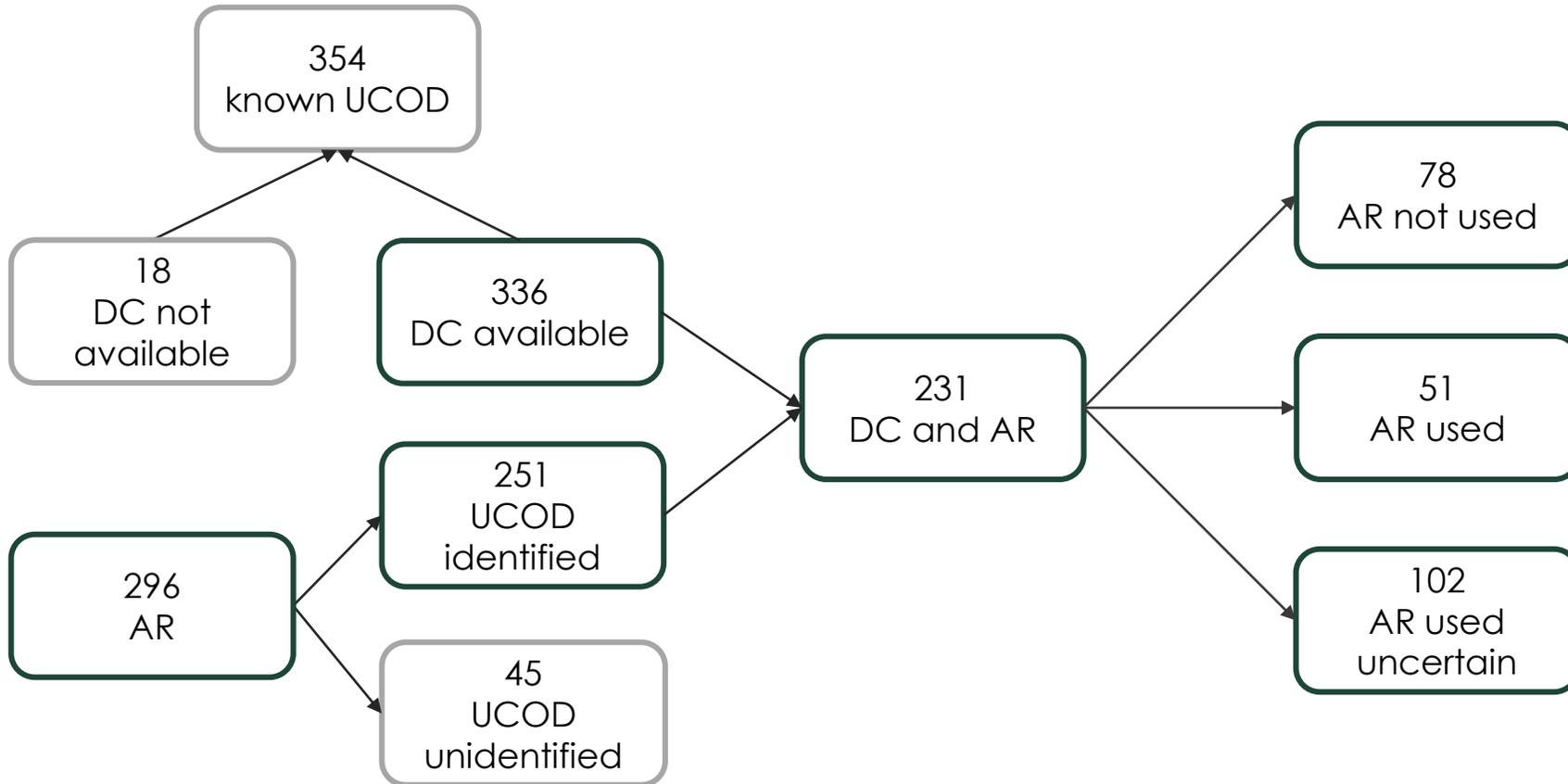


Fields on Standard Death Certificate

AR status	Autopsy performed?	Autopsy finding considered?	Cases
AR Not used	No	---	52
AR Used	Yes	No	26
AR Used	Yes	Yes	51
AR Use Uncertain	Yes	Blank/missing	95
AR Use Uncertain	Blank/missing	Blank/missing	7

UCOD: Underlying Cause of Death  
 DC: Death Certificate  
 AR: Autopsy Report

# CASE SELECTION (II)



# DEFINITION OF MATCH AND MISMATCH

Status	ICD-10 Classification	
Complete match	C15.9	Malignant neoplasm of oesophagus: Malignant neoplasm: Oesophagus, unspecified
	C15.9	Malignant neoplasm of oesophagus: Malignant neoplasm: Oesophagus, unspecified
Disease category match	C34.9	Malignant neoplasm of bronchus and lung: Malignant neoplasm: Bronchus or lung, unspecified
	C39.9	Malignant neoplasm of other and ill-defined sites in the respiratory system and intrathoracic organs: Malignant neoplasm: Ill-defined sites within the respiratory system
Disease category mismatch	C34.9	Malignant neoplasm of bronchus and lung: Malignant neoplasm: Bronchus or lung, unspecified
	I25.1	Chronic ischaemic heart disease: Atherosclerotic heart disease

# CROSS TABLE OF CAUSE OF DEATH ON DC AND AR

Death certificate UCOD	Autopsy report underlying cause of death (UCOD)														Total	Mismatch	Mismatch %
	1	2	3	4	5	6	7	8	9	10	11	12	13	14			
1 Infectious	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
2 Neoplasms	0	55[29]	1	0	0	0	4	2	0	0	0	0	0	1	63	8	12.7%
3 Blood	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	100%
4 Metabolic	0	1	0	1[0]	0	1	1	0	0	0	0	0	0	0	4	3	75.0%
5 Mental	0	1	0	0	0	2	2	0	0	0	0	0	0	0	5	5	100%
6 Nervous	0	0	0	0	0	6[5]	3	1	0	0	0	0	0	0	10	4	40.0%
7 Circulatory	1	1	0	1	0	1	83[21]	4	1	0	1	1	1	2	97	14	14.4%
8 Respiratory	0	4	0	0	0	1	10	8[8]	0	0	0	0	0	0	23	15	65.2%
9 Digestive	0	0	0	0	0	0	0	0	1[0]	0	0	0	0	0	1	0	0.0%
10 Musculoskeletal	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	2	100%
11 Genitourinary	0	0	0	0	0	0	0	2	0	0	0	1[0]	0	0	3	2	66.7%
12 Malformations	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
13 Symptoms	0	2	0	0	0	0	0	2	0	1	0	0	0	0	5	5	100%
14 External	0	1	0	0	1	0	1	0	0	0	0	0	0	14[8]	17	3	17.6%
<b>Total</b>	1	65	1	2	1	11	109	15	4	0	3	1	1	17	231	62	26.8%
<b>Mismatch</b>	1	10	1	1	1	5	26	7	3	0	2	1	1	3	62	169[71]	
<b>Mismatch %</b>	100%	15.4%	100%	50.0%	100%	45.5%	23.9%	46.7%	75.0%	-	66.7%	100%	100%	17.6%	26.8%		
<b>Mismatch cases</b>	Match cases [Complete match]														Match cases = Complete match + Category match		

# DEFINITION OF OVER- AND UNDER-CLASSIFICATION

- Over-classification meant that DC had a FALSE-POSITIVE diagnosis
  - the possibility of using the DC to identify the cause of death when the individual was not dying from that certain disease

$$\text{Over classification rate} = \frac{\text{Number of mismatch cases for a COD on DC}}{\text{Total number of cases on DC for the COD}}$$

- Under-classification meant that DC had a FALSE-NEGATIVE diagnosis
  - the possibility of incorrectly identifying the COD assuming an individual died from the certain disease

$$\text{Under classification rate} = \frac{\text{Number of mismatch cases for a COD on AR}}{\text{Total number of cases on AR for the COD}}$$

# OVER-CLASSIFICATION

DC COD	AR Underlying Causes					Total on DC
	Circulatory	Neoplasms	Respiratory	External	Others	
Circulatory	83	1	4	2	7	97
Neoplasms	4	55	2	1	1	63
Respiratory	10	4	8	0	1	23
External	1	1	0	14	1	17
Others	11	4	1	0	15	31
Total on AR	109	65	15	17	25	231
<b>Mismatch cases</b>		Match cases = Complete match + Category match				

total number of mismatch cases in each row :

number of cases that incorrectly classified as the certain kind of disease

# OVER-CLASSIFICATION

\* the number of cases that incorrectly classified as the certain disease

DC COD	AR Underlying Causes			Total on DC
	Match	Mismatch *	Mismatch Rate	
Circulatory	83	14	14.4%	97
Neoplasms	55	8	12.7%	63
Respiratory	8	15	65.2%	23
External	14	3	17.6%	17
Others	15	16	51.6%	31
				231
<b>Mismatch cases</b>		<b>Match cases = Complete match + Category match</b>		

$$\text{Over classification rate} = \frac{\text{Number of mismatch cases for a COD on DC}}{\text{Total number of cases on DC for the COD}}$$

# UNDER-CLASSIFICATION

DC COD	AR Underlying Causes					Total on DC
	Circulatory	Neoplasms	Respiratory	External	Others	
Circulatory	83	1	4	2	7	97
Neoplasms	4	55	2	1	1	63
Respiratory	10	4	8	0	1	23
External	1	1	0	14	1	17
Others	11	4	1	0	15	31
Total on AR	109	65	15	17	25	231
<b>Mismatch cases</b>		<b>Match cases = Complete match + Category match</b>				

total number of mismatch cases in each column :

number of cases that not correctly identified as the certain kind of disease

# UNDER-CLASSIFICATION

\* the number of cases that not correctly identified as the certain disease

DC COD	AR Underlying Causes					
	Circulatory	Neoplasms	Respiratory	External	Others	
Match	83	55	8	14	15	
Mismatch *	26	10	7	3	10	
Mismatch Rate	24%	15%	47%	18%	40%	
Total on AR	109	65	15	17	25	231
Mismatch cases	Match cases = Complete match + Category match					

$$\text{Under classification rate} = \frac{\text{Number of mismatch cases for a COD on AR}}{\text{Total number of cases on AR for the COD}}$$

# OVER- AND UNDER-CLASSIFICATION

	Overall		AR not used		AR used		AR used uncertain	
	Over	Under	Over	Under	Over	Under	Over	Under
Circulatory	14.4%	23.9%	27.6%	36.4%	13.0%	13.0%	6.7%	20.8%
Neoplasms	12.7%	15.4%	12.5%	22.2%	15.4%	15.4%	11.8%	11.8%
Respiratory	65.2%	46.7%	60.0%	50.0%	66.7%	50.0%	70.0%	40.0%
External	17.6%	17.6%	0.0%	42.9%	28.6%	0.0%	16.7%	0.0%
Others	51.6%	40.0%	52.6%	25.0%	20.0%	50.0%	71.4%	60.0%
Total Mismatch	24.2%		33.3%		19.6%		19.6%	
Total Match	75.8%		66.7%		80.4%		80.4%	

- Disease category:

Neoplasms: 12.7% over-classification rate  
 15.4% under-classification rate  
 Respiratory: 65.2% over-classification rate  
 46.7% under-classification rate

- Autopsy Report:

Not used: 33.3% mismatch rate  
 Used: 19.6% mismatch rate  
 Uncertain: 19.6% mismatch rate

# SUMMARY

- For the studied group, neoplasms have the lowest overall over- and under-classification rate; respiratory diseases have the highest overall over- and under-classification rate.
- Cases that autopsy reports not used have higher mismatch rate than autopsy used or use uncertain groups.
- There is significant misclassification on death certificates when compared to autopsy reports, even for cases where an autopsy was used to determine the underlying cause of death.
- For epidemiological studies, the over- and under-misclassifications on death certificates should be taken into consideration when evaluating health outcomes.

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