



# NATIONAL INSTITUTE FOR OCCUPATIONAL HEALTH

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**Pathology Division  
Surveillance Report:  
Demographic Data and  
Disease Rates for  
January to December  
2006**

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**NIOH Report 2/2007**

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**NATIONAL HEALTH  
LABORATORY SERVICE**



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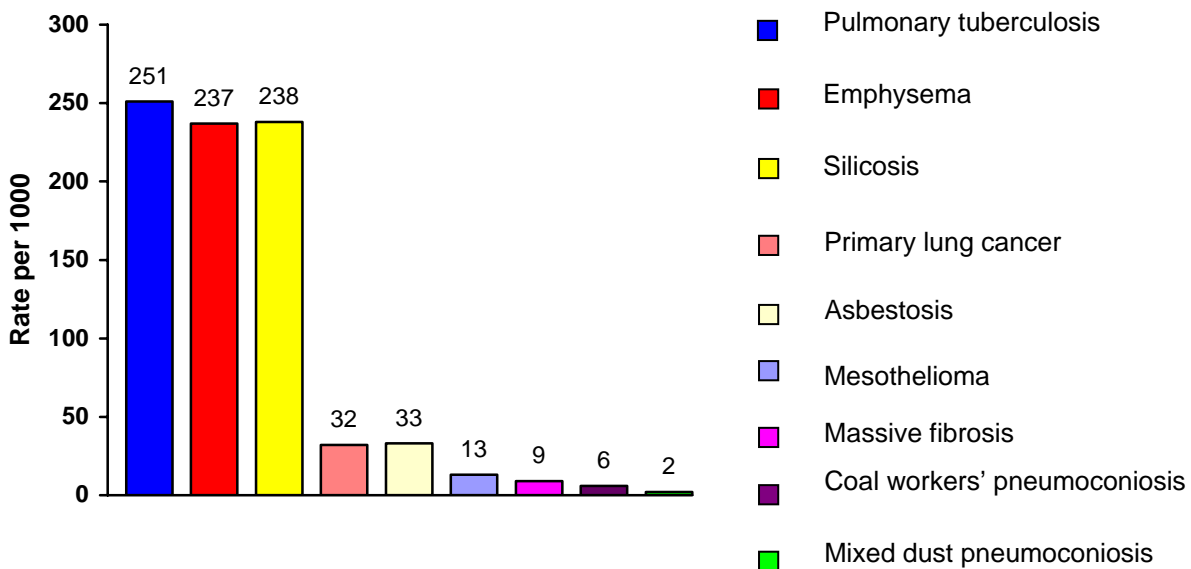
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## EXECUTIVE SUMMARY

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During 2006, 1 720 cases came to autopsy at the NIOH. Of these, 67.7% were black men, 31.1% were white, 0.6% were coloured and 0.5% were submitted without information on population group.

Overall disease rates (per 1000 autopsies) for 2006 are shown in Figure 1.



**FIG.1 OVERALL DISEASE RATES FOR 2006**

The overall rate of pulmonary tuberculosis (PTB) was the same as that in 2005. The rate in black gold miners increased from 348 per thousand in 2005 to 379 per thousand in 2006. The rate in black platinum miners, however, decreased from 315 per thousand in 2005 to 275 per thousand in 2006.

Following the trend of the last few years, the overall prevalence of silicosis increased from 216 per thousand in 2005 to 237 per thousand in 2006.

This is the second year that some data on female cases are included in the annual report (Section 10). The number of female cases submitted for autopsy decreased from 43 in 2005 to 22 in 2006. Most had diseases related to asbestos exposure.

The number of cases submitted with an incomplete service history (1.8%) is similar to that in 2005 (1.7%).

In recognition of the annual decrease in the numbers of cardio-respiratory organs submitted for autopsy (Table 2-1), the Pathology Division launched a programme to inform miners and ex-miners of their right to autopsy examination. This initiative began in the second half of 2006. Visits have been made to occupational health units on the mines, mine union representatives, undertakers, state hospitals and forensic laboratories in some of the provinces of South Africa. A poster, flier and information booklet have been made for distribution.

During 2005, three journal articles utilising the PATHAUT data were published and research findings were presented at a number of fora (see Appendix 2). A PhD which is based on the PATHAUT data was registered in 2005 (University of the Witwatersrand) and is on course.

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## GLOSSARY

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<b>Asbestosis</b>	Lung fibrosis caused by asbestos fibres
<b>Coal workers' pneumoconiosis</b>	Lung fibrosis caused by exposure to coal dust
<b>Emphysema</b>	Lung disease caused by the destruction of the alveolar walls
<b>Massive fibrosis</b>	Lung fibrosis caused by exposure to dust and measuring more than 1 cm in diameter
<b>Mesothelioma</b>	A malignant tumour of the pleural cavity of the lungs
<b>Miner</b>	A person who has worked in a controlled mine or works
<b>Mixed exposures</b>	The multiple dust types to which a miner may be exposed, having worked in several mining commodities in his lifetime
<b>Prevalence</b>	The number of cases in a defined population at a given time
<b>Silicosis</b>	Lung fibrosis caused by inhalation of silica dust; detected by the presence of silicotic nodules in the lung tissue
<b>Surveillance</b>	The ongoing and systematic collection, analysis and interpretation of data related to adverse health outcomes

## SECTION 1 – BACKGROUND

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The Occupational Diseases in Mines and Works Act, 1973 (Act 78 of 1973) requires that the cardio-respiratory organs of a deceased person who has worked at a controlled mine or a controlled works be examined for the presence of occupational disease, regardless of the clinical cause of death and provided that the next of kin agrees. These examinations are performed by pathologists at the National Institute for Occupational Health (NIOH). A detailed report on each case examined is sent to the Medical Bureau for Occupational Diseases (MBOD). Cases certified as having a compensable disease are then referred to the Compensation Commissioner's office, where the payment for compensation is managed.

Since 1975, the pathological findings from the autopsy examinations have been recorded on the computerised PATHAUT database. PATHAUT comprises data from autopsy examinations and clinical files which include occupational histories. The database is unique and provides an important resource for both surveillance and research. These data are the only comprehensive surveillance data on occupational lung disease in the South African mining industry.

The data presented in this report summarise the PATHAUT system surveillance results, i.e. the results of the systematic collection, collation, and analysis of the pathology findings in the cardio-respiratory organs of mine workers. Data from PATHAUT are exported into, and analysed, using SAS v9.1.

This is the tenth consecutive annual report and describes autopsy cases examined during the year 2006. Some of the earlier reports and this report can be accessed at [www.nioh.ac.za](http://www.nioh.ac.za).

Throughout this report the term 'men' and all data include both men and women, with the exception of Section 10 which reports findings in women only.

Many of the cases had "mixed" exposures in that they had been employed in more than one commodity. For simplicity, cases are categorised according to the commodity in which most years of service were recorded, i.e. the commodity in which the miners had worked for the longest period. In Appendix 1, however, the cases are listed according to the most recent (last) mine at which the miners worked.

All disease rates reported in this document are expressed per 1000. In all calculations, the denominators used are the total numbers of autopsies in specific commodities, age groups or population groups. Some of these rates must be viewed with caution, as the denominators are very small. This applies, for example, to those commodities where few workers are employed (such as manganese mining), and to the older age groups in some instances.



## SECTION 2 – DEMOGRAPHIC DATA

The number of autopsies performed since 1975 is presented in Table 2-1.

**TABLE 2-1 DISTRIBUTION OF AUTOPSIES BY YEAR AND POPULATION GROUP (1975 - 2006)**

Year of autopsy	Black		White		Coloured		Indian		Unknown		Total N
	N	%	N	%	N	%	N	%	N	%	
1975	2 190	71	854	28	32	1					3 076
1976	2 335	68	1 072	31	27	1					3 434
1977	2 351	69	1 039	30	33	1					3 423
1978	2 245	67	1 090	32	32	1					3 367
1979	2 118	66	1 026	33	45	1					3 189
1980	2 338	64	1 274	35	46						3 658
1981	2 209	66	1 117	33	33	1					3 359
1982	2 312	63	1 302	36	44	1					3 658
1983	2 096	65	1 109	34	41	1					3 246
1984	1 966	64	1 098	36	28	1					3 092
1985	2 275	64	1 200	34	66	2					3 541
1986	2 456	68	1 125	31	45	1					3 626
1987	2 594	68	1 168	30	78	2					3 840
1988	2 518	67	1 165	31	77	2					3 760
1989	2 138	65	1 090	33	60	2					3 288
1990	2 172	64	1 155	34	51	2					3 378
1991	2 143	65	1 080	33	66	2					3 289
1992	2 144	66	1 049	32	70	2					3 263
1993	1 863	65	956	33	65	2					2 884
1994	1 737	61	1 021	36	94	3					2 852
1995	2 830	71	1 059	27	99	2					3 988
1996	2 154	67	960	30	56	2			69	2.1	3 239
1997	2 223	69	897	28	70	2	1		18	0.6	3 208
1998	1 977	69	836	29	49	2			17	0.6	2 880
1999	1 656	65	832	33	29	1			12	0.5	2 529
2000	1 798	69	761	29	41	2			8	0.3	2 608
2001	1 690	67	813	32	13	1			13	0.5	2 529
2002	1 677	67	763	30	50	2	1		28	1.1	2 518
2003	1 536	66	745	32	23	1	1		13	0.6	2 318
2004	1 428	69	596	29	22	1			8	0.4	2 055
2005	1 274	68	562	30	22	1			18	1.0	1 876
2006	1 165	68	535	31	11	0.6			9	0.5	1 720
<b>Total</b>	65 608	66	31 349	32	1 518	2	56	0	160	0.2	98 691

It is important to note that a referral bias exists: there is a low autopsy rate for black men who have left employment at the mines, whereas the majority of white retired miners come to autopsy. The numbers of miners coming to autopsy has decreased steadily over the years, probably reflecting the concomitant decrease in the number of miners. In 1994, there were around 344 000 people employed in the gold mining industry compared to approximately 149 608 in 2006.

The pathologists at the NIOH perform two types of autopsy examinations. For men dying distant from Johannesburg, the cardio-respiratory organs are removed locally, preserved in formalin and sent to the NIOH. Full autopsies are undertaken on men who die close to Johannesburg.

Table 2-2 shows the distribution of autopsies by population group for 2006. Autopsies of only the cardio-respiratory organs comprised 97.2% of all examinations.

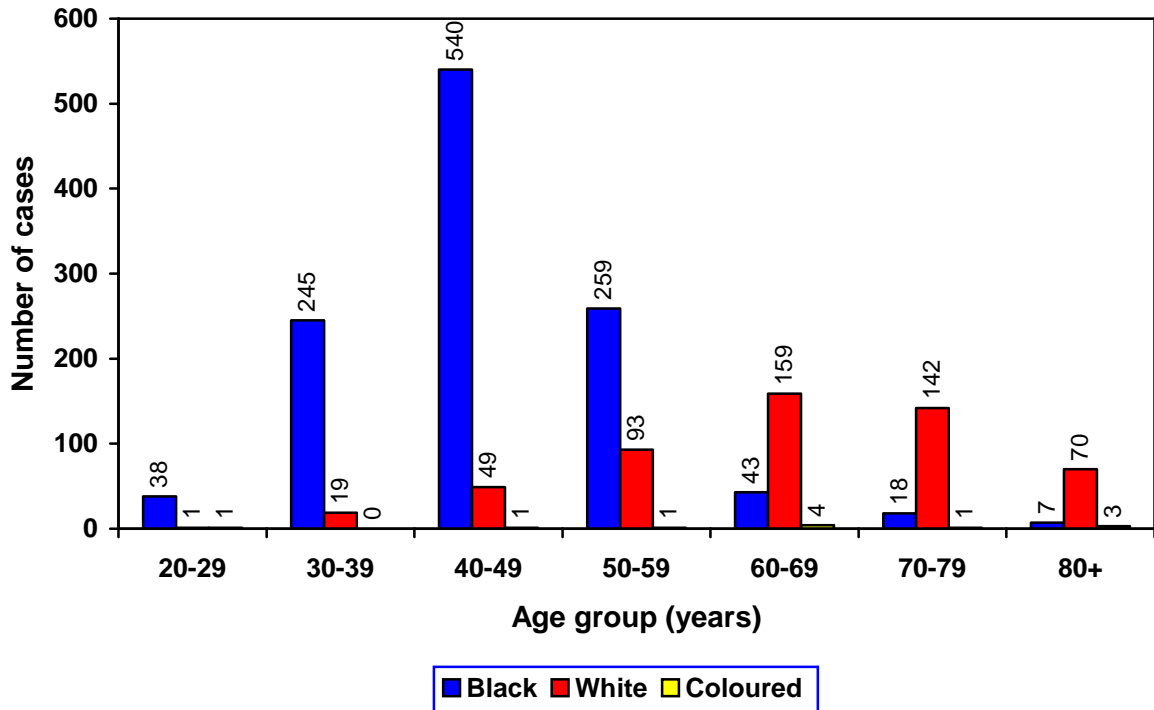
**TABLE 2-2 NUMBER AND PROPORTION OF AUTOPSIES BY TYPE AND POPULATION GROUP (2006)**

Autopsy type	Black		White		Coloured		Unknown		Total	
	N	%	N	%	N	%	N	%	N	%
Cardiorespiratory organs only	1 162	99.7	490	91.6	11	100	9	100	1 672	97.2
Full autopsy	3	0.3	45	8.4	0	-	0	-	48	2.8
Total	1 165		535		11		9		1 720	

The age distribution of autopsies for 2006 is shown in Table 2-3 and Figure 2-1. The mean age at autopsy of black men was 44.7 years and has remained essentially unchanged for the last 3 years. The mean age of white men at autopsy increased from 63.8 years in 2005 to 65.1 years in 2006.

**TABLE 2-3 NUMBER AND PROPORTION OF AUTOPSIES BY AGE AND POPULATION GROUP (2006)**

Age group (years)	Black		White		Coloured		Unknown		Total	
	N	%	N	%	N	%	N	%	N	%
20-29	38	3.3	1	0.2	1	9.1	0	-	40	2.3
30-39	245	21.0	19	3.6	0	-	0	-	264	15.3
40-49	540	46.4	49	9.2	1	9.1	0	-	590	34.3
50-59	259	22.2	93	17.4	1	9.1	0	-	353	20.5
60-69	43	3.7	159	29.8	4	36.4	0	-	206	12.0
70-79	18	1.5	142	26.6	1	9.1	1	5.6	162	9.4
80+	7	0.6	70	13.1	3	27.3	0	-	80	4.7
Unknown	15	1.3	2	0.4	0	-	8	80.0	25	1.5
Total	1 165		535		11		9		1 720	



**FIG 2-1 DISTRIBUTION OF AUTOPSIES BY AGE AND POPULATION GROUP (2006)**

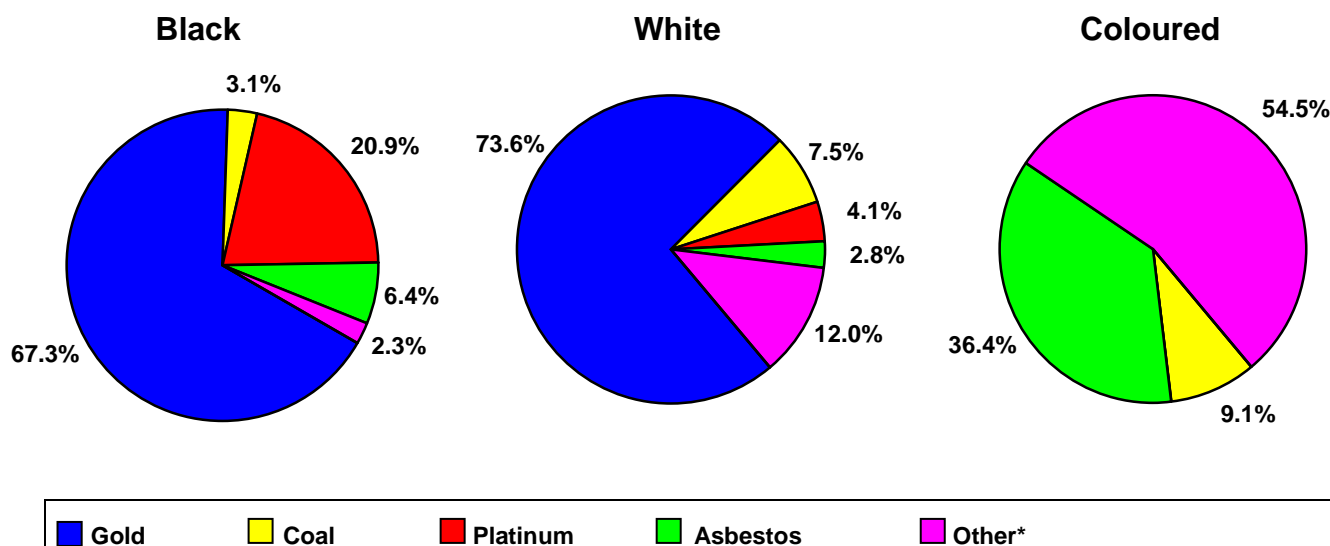
Cases were placed in categories according to the commodity in which they had worked for the longest duration (most exposure). In 2006, a new category called ‘environmental asbestos’ exposure was introduced on the database. Cases with this exposure have been grouped under ‘other’ exposure for analysis and comprise 7 cases in blacks and 2 in coloureds. Many men, however, worked in a number of different mining commodities during their lifetimes and had “mixed” exposures. This was not taken into account in the analysis of exposure type (commodity).

Table 2-4 and Figure 2-2 show the distribution of autopsies by commodity and population group for 2006. The percentage of autopsies received from the gold mining industry has been consistent over the last five years, at around 69%. The percentage of autopsies from the platinum industry doubled from 8.3% in 1999 to 16% in 2004 and remained fairly constant at approximately 15% in 2005 and 2006. As in previous years, the majority of coloured men who came to autopsy had exposure to asbestos: 36.4% on the asbestos mines and 18.2% from the environment

**TABLE 2-4 NUMBER AND PROPORTION OF AUTOPSIES BY COMMODITY AND POPULATION GROUP (2006)**

Commodity	Black		White		Coloured		Unknown		Total	
	N	%	N	%	N	%	N	%	N	%
Gold	784	67.3	394	73.6	0	0.0	1	11.1	1 179	68.5
Platinum	244	20.9	22	4.1	0	0.0	3	33.3	269	15.6
Coal	36	3.1	40	7.5	1	9.1	0	0.0	77	4.5
Asbestos	74	6.4	15	2.8	4	36.4	0	0.0	93	5.4
Iscor	0	0.0	17	3.2	0	0.0	0	0.0	17	1.0
Diamond	4	0.3	4	0.7	0	0.0	0	0.0	8	0.5
Copper	1	0.1	10	1.9	3	27.3	0	0.0	14	0.8
Manganese	5	0.4	3	0.6	0	0.0	0	0.0	8	0.5
Industry	1	0.1	6	1.1	0	0.0	0	0.0	7	0.4
Other	7	0.6	8	1.5	2	18.2	0	0.0	17	1.0
Unknown	9	0.8	16	3.0	1	9.1	5	55.6	31	1.8
<b>Total</b>	<b>1 165</b>		<b>535</b>		<b>11</b>		<b>9</b>		<b>1 720</b>	

Note: this table shows only those commodities where a total of 7 or more cases were received



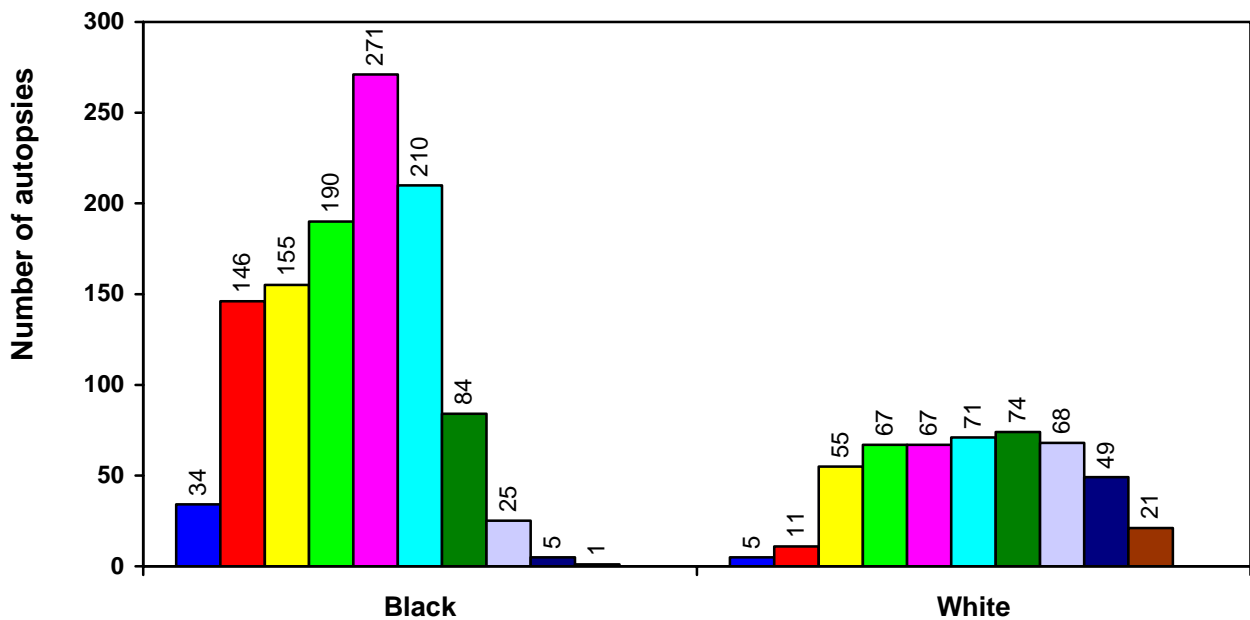
**FIG 2-2 DISTRIBUTION OF AUTOPSIES BY COMMODITY AND POPULATION GROUP (2006)**

\* Includes chrome, tin, lead, construction, railways, Eskom, environmental asbestos, as well as cases where service histories were not obtained.

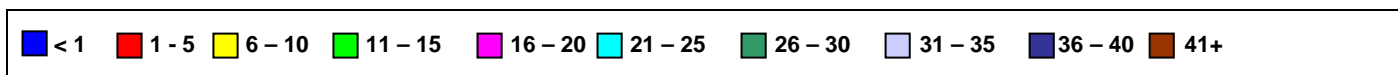
Detailed information about the years in mining service by population group is presented in Table 2-5 and Figure 2-3. In 2006, the duration of service was obtained for all but 6% of the cases. This figure is higher than that for 2004 (4.4%) and 2005 (3.5%) but is still far below that of previous years (e.g. 21.8% in 2003).

**TABLE 2-5 NUMBER AND PROPORTION OF AUTOPSIES BY YEARS OF SERVICE AND POPULATION GROUP (2006)**

Years of service	Black		White		Coloured		Unknown		Total	
	N	%	N	%	N	%	N	%	N	%
<1	34	2.9	5	0.9	0	-	0	-	39	2.3
1-5	146	12.5	11	2.1	2	18.2	0	-	159	9.2
6-10	155	13.3	55	10.3	1	9.1	0	-	211	12.3
11-15	190	16.3	67	12.5	3	27.3	0	-	260	15.1
16-20	271	23.3	67	12.5	1	9.1	0	-	339	19.7
21-25	210	18.0	71	13.3	0	0.0	0	-	281	16.3
26-30	84	7.2	74	13.8	0	0.0	0	-	158	9.2
31-35	25	2.1	68	12.7	1	9.1	0	-	94	5.5
36-40	5	0.4	49	9.2	0	0.0	0	-	54	3.1
41+	1	0.1	21	3.9	0	0.0	0	-	22	1.3
Unknown	44	3.8	47	8.8	3	27.3	9	100	103	6.0
Total	1 165		535		11		9		1 720	



Years of service:



**FIG 2-3 DISTRIBUTION OF AUTOPSIES BY YEARS OF SERVICE AND POPULATION GROUP (2006)**

The mean age and duration of service by commodity type and population group for those cases for which information was available are shown in Tables 2-6 and 2-7.

**TABLE 2-6 MEAN AGE BY COMMODITY AND POPULATION GROUP (2006)**

Commodity	Black			White		
	N	Mean (years)	SD*	N	Mean (years)	SD*
Gold	773	44	8	394	66	13
Platinum	244	44	9	22	60	13
Coal	35	47	10	40	62	14
Asbestos	74	61	11	15	67	8
Iscor	0	0	-	17	62	12
Diamond	4	59	8	4	55	18
Copper	1	58	-	10	70	7
Iscor	0	0	-	17	62	12
Manganese	5	47	6	3	71	14
Industry	1	54	-	6	67	10
Other	7	51	14	8	68	14
Unknown	6	50	12	14	66	16
Total	1 150	45	9	533	65	13

\* Standard deviation

**TABLE 2-7 MEAN DURATION OF SERVICE BY COMMODITY AND POPULATION GROUP (2006)**

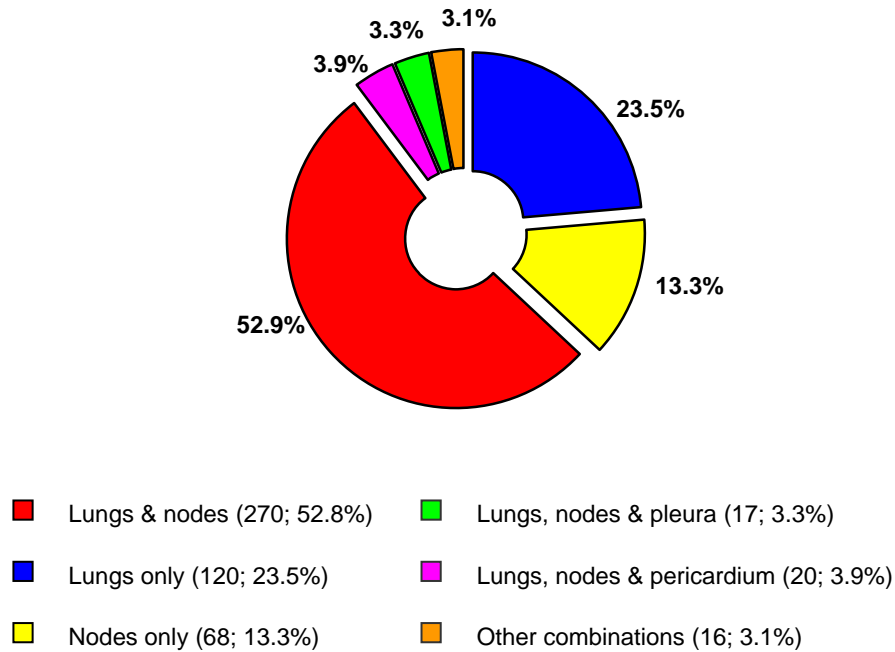
Commodity	Black			White		
	N	Mean (years)	SD*	N	Mean (years)	SD*
Gold	771	17	8	377	25	10
Platinum	235	15	9	21	20	9
Coal	34	21	10	38	20	12
Asbestos	68	8	9	12	9	9
Iscor	0	-	-	15	26	10
Diamond	4	16	15	4	10	9
Copper	1	23	-	10	20	9
Manganese	5	13	7	0	-	-
Industry	1	12	-	4	17	11
Other	0	-	-	7	20	11
Unknown	2	21	7	0	-	-
Total	1 121	16	8	488	24	11

\*Standard deviation

## SECTION 3 – ACTIVE TUBERCULOSIS

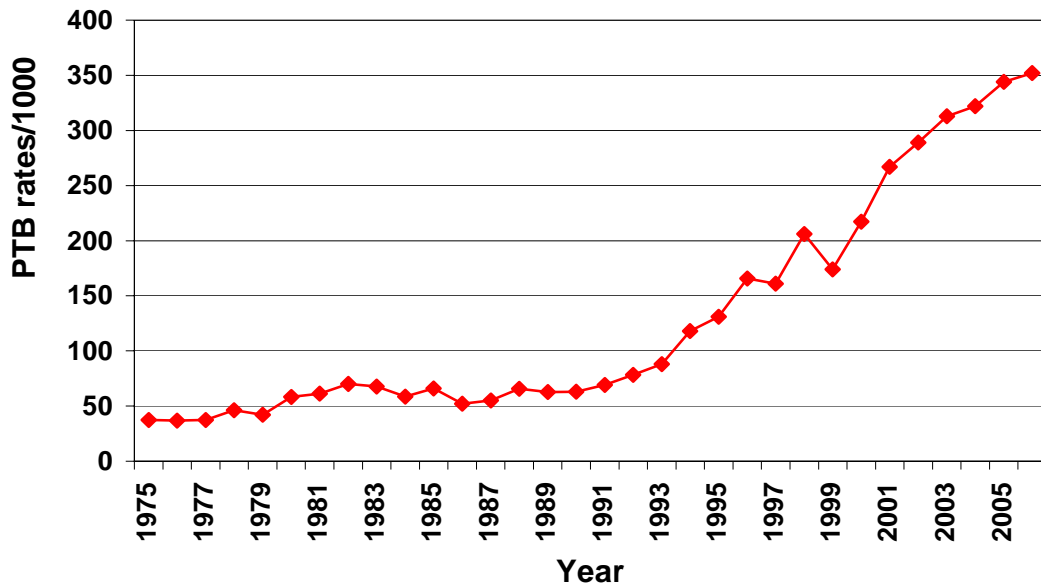
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The distribution of active tuberculosis (TB) by anatomical site is presented in Figure 3-1 (n=511). Active pulmonary TB (PTB) was diagnosed in 25.1% (432) of all cases autopsied in 2006, compared to 16.4% (416) in 2000. Most of the men with PTB were black (94.9%; 410 cases), 4.6% (20 cases) were white and in 0.5% (2 cases) the population group was unknown.



**FIG 3-1 DISTRIBUTION OF ACTIVE TB BY SITE (2006)**

The overall rate of PTB in 2006 remained the same as that in 2005 (251/1000). The increase in PTB rates observed in previous years is attributed to the increased rate in black men from 217/1000 in 2000 to 352/1000 in 2006 (Fig 3-2). As indicated previously, cases are assigned to categories according to the commodity in which the most years of service occurred. In black gold miners, the rate of PTB increased annually from 171/1000 in 1999 to 398/1000 in 2006. In black platinum miners, however, the rates have decreased in the last few years from 383/1000 in 2002 to 275/1000 in 2006.



**FIG 3-2 ACTIVE PTB RATES IN BLACK MINERS AT AUTOPSY (1975 to 2006)**

The distribution of active PTB cases by commodity is shown in Table 3-1. The rates in this and subsequent tables and figures are expressed per 1000. The majority of active PTB cases (76%) came from the gold mining industry (69% of all autopsy cases came from that commodity).

**TABLE 3-1 NUMBER OF CASES AND PREVALENCE OF ACTIVE PTB BY COMMODITY AND POPULATION GROUP (2006)**

Commodity	Black		White		Unknown		Total	
	N	Rate	N	Rate	N	Rate	N	Rate
Gold	312	398	16	41	0	-	328	278
Platinum	67	275	0	-	2	667	69	257
Coal	7	194	1	25	0	-	8	104
Asbestos	16	216	2	133	0	-	18	194
Manganese	3		0		0		3	
Other	3		0		0		3	
Unknown	2		1		0		3	
<b>Total</b>	<b>410</b>	<b>352</b>	<b>20</b>	<b>37</b>	<b>2</b>	<b>222</b>	<b>432</b>	<b>251</b>

Note: rates have not been calculated where numbers are small



The age distribution of cases with active PTB is shown in Table 3-2. Most of the cases (n=219; 50.7%) were in the age group 40-49 years, followed by those in the 30-39 year age group (n=89; 20.6%).

**TABLE 3-2 NUMBER OF CASES AND PREVALENCE OF ACTIVE PTB BY AGE AND POPULATION GROUP (2006)**

Age group (years)	Black		White		Unknown		Total	
	N	Rate	N	Rate	N	Rate	N	Rate
20-29	11	289	0	-	0	-	11	275
30-39	89	363	0	-	0	-	89	337
40-49	217	402	2	41	0	-	219	371
50-59	80	309	5	54	0	-	85	241
60-69	7	163	8	50	0	-	15	73
70-79	2	111	3	21	0	-	5	31
80+	1	143	2	29	0	-	3	38
Unknown	3	200	0	-	2	222	5	200
<b>Total</b>	<b>410</b>	<b>352</b>	<b>20</b>	<b>37</b>	<b>2</b>	<b>222</b>	<b>432</b>	<b>251</b>

## SECTION 4 – SILICOSIS

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Silicotic nodules were found in the lungs of 409 cases (23.8% of all autopsies), 91% of which came from the gold mining industry. Of all cases of silicosis, occasional silicotic nodules were found in 54.8% of cases, a few in 20.8%, a moderate number in 21.8% and a large number in 2.7%.

The distribution of cases with silicosis by commodity and population group is presented in Table 4-1. The rate of silicosis in gold miners has increased from 191/1000 in 2000 to 316/1000 in 2006.

**TABLE 4-1 NUMBER OF CASES AND PREVALENCE OF SILICOSIS BY COMMODITY AND POPULATION GROUP (2006)**

Commodity	Black		White		Coloured		Total	
	N	Rate	N	Rate	N	Rate	N	Rate
Gold	256	327	116	294	0	-	372	316
Platinum	14	57	3	136	0	-	17	63
Coal	1	28	3	75	0	-	4	52
Asbestos	5	68	0	-	0	-	5	54
Diamond	0		1		0		1	
Copper	0		4		1		5	
Iscor	0		1		0		1	
Manganese	0		1		0		1	
Other	0		1		0		1	
Unknown	1		1		0		2	
<b>Total</b>	<b>277</b>	<b>238</b>	<b>131</b>	<b>245</b>	<b>1</b>	<b>91</b>	<b>409</b>	<b>238</b>

Note: rates have not been calculated where numbers are small

Although the silicosis rates increased with increasing age in both black and white men, the age distribution of cases with silicosis differed between the two population groups (Table 4-2). Silicosis was diagnosed in men who were young (<40 years) and in men who were exposed to silica for a few years (< 10 years) (Table 4-3).

**TABLE 4-2 NUMBER OF CASES AND PREVALENCE OF SILICOSIS IN THE GOLD MINING INDUSTRY, BY AGE AND POPULATION GROUP (2006)**

Age group (years)	Black		White		Coloured		Unknown		Total	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
30-39	15	86	1	71	0	-	0	-	16	85
40-49	150	380	7	200	0	-	0	-	157	365
50-59	77	475	14	222	0	-	0	-	91	404
60-69	6	667	37	301	0	-	0	-	43	326
70-79	0	-	36	360	0	-	0	-	36	343
80+	1	500	21	356	0	-	0	-	22	361
Unknown	7	636	0	-	0	-	0	-	7	636
Total	256	327	116	294	0		0		372	316

**TABLE 4-3 NUMBER OF CASES AND PREVALENCE OF SILICOSIS IN THE GOLD MINING INDUSTRY, BY YEARS OF SERVICE AND POPULATION GROUP (2006)**

Years of service	Black		White		Coloured		Unknown		Total	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
<1	3	231	0	-	0	-	0	-	3	214
1-5	2	31	0	-	0	-	0	-	2	29
6-10	14	125	10	263	0	-	0	-	24	160
11-15	38	264	9	196	0	-	0	-	47	247
16-20	77	358	11	229	0	-	0	-	88	335
21-25	72	497	25	455	0	-	0	-	97	485
26-30	30	536	19	302	0	-	0	-	49	412
31-35	12	667	16	276	0	-	0	-	28	368
36-40	2	667	21	438	0	-	0	-	23	451
41+	1	1000	3	200	0	-	0	-	4	250
Unknown	5	385	2	118	0	-	0	-	7	226
Total	256	327	116	294	0		0		372	316

## SECTION 5 – OTHER PNEUMOCONIOSES

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### MASSIVE FIBROSIS

There were 16 (1%) cases of massive fibrosis (8 black, 8 white). All were from the gold mining industry.

### COAL WORKERS' PNEUMOCONIOSIS

There were 2 (0.1%) cases of coal workers' pneumoconiosis. Both were from the coal mining industry.

### MIXED DUST PNEUMOCONIOSIS

There were 4 (0.2%) cases of mixed dust pneumoconiosis. All were from the gold mining industry.

### ASBESTOSIS AND PLEURAL PLAQUES

There were 56 cases of asbestosis of which 53.6% (n=30) had slight, 35.7% (n=20) moderate and 10.7% (n=6) marked fibrosis. Forty seven (83.9%) of these cases had worked in the asbestos mining industry at some time in their lives and three (5.3%) had had exposure to asbestos in the environment.

There were 28 cases which had asbestos plaques and of these 12 had asbestosis. However, the parietal pleura (the site where plaque formation usually occurs) is seldom submitted with the lungs.

The distribution of asbestosis by age and population group is shown in Table 5-1. Only one case was below 40 years.

**TABLE 5-1 NUMBER OF CASES AND PREVALENCE OF ASBESTOSIS BY AGE AND POPULATION GROUP (2006)**

Age group (years)	Black		White		Coloured		Unknown		Total	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
30-39	1	4	0	-	0	-	0	-	1	4
40-49	8	15	0	-	0	-	0	-	8	14
50-59	8	31	1	11	0	-	0	-	9	25
60-69	15	349	6	38	1	250	0	-	22	107
70-79	10	556	1	7	1	1000	0	-	12	74
80+	3	429	0	-	1	333	0	-	4	50
Total	45	39	8	15	3	273	0		56	33

## SECTION 6 – EMPHYSEMA

There were 408 cases of emphysema, the extent of which was mild in 83.6% (n=341), moderate in 15.2% (n=62) and marked in 1.2% (n=5). The distribution of emphysema by age and population group is presented in Table 6-1.

**TABLE 6-1 NUMBER OF CASES AND PREVALENCE OF EMPHYSEMA BY AGE AND POPULATION GROUP (2006)**

Age group (years)	Black		White		Coloured		Unknown		Total	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
30-39	14	57	0	-	0	-	0	-	14	53
40-49	63	117	13	265	0	-	0	-	76	129
50-59	69	266	30	323	0	-	0	-	99	280
60-69	15	349	76	478	3	750	0	-	94	456
70-79	7	389	68	479	1	1000	0	-	76	469
80+	3	429	38	543	1	333	0	-	42	525
Unknown	3	200	2	1000	0	-	2	250	7	280
<b>Total</b>	<b>174</b>	<b>149</b>	<b>227</b>	<b>424</b>	<b>5</b>	<b>455</b>	<b>2</b>	<b>222</b>	<b>408</b>	<b>237</b>

The majority of black and white men with emphysema were from the gold mining industry (67.4%, n=275) (Table 6-2).

**TABLE 6-2 NUMBER OF CASES AND PREVALENCE OF EMPHYSEMA BY COMMODITY AND POPULATION GROUP (2006)**

Commodity	Black		White		Coloured		Unknown		Total	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
Gold	107	136	168	426	0	-	1	-	276	234
Platinum	27	111	5	227	0	-	0	-	32	119
Coal	11	306	19	475	0	-	0	-	30	390
Asbestos	26	351	8	533	2	-	0	-	36	387
Diamond	0		3		0		0		3	
Copper	0		6		2		0		8	
Isacor	0		9		0		0		9	
Industry	0		1		0		0		1	
Other	1		1		1		0		3	
Unknown	2		7		0		1		10	
<b>Total</b>	<b>174</b>	<b>149</b>	<b>227</b>	<b>424</b>	<b>5</b>	<b>455</b>	<b>2</b>	<b>222</b>	<b>408</b>	<b>237</b>

Note: rates have not been calculated where numbers are small

**TABLE 6-3 NUMBER OF CASES AND PREVALENCE OF EMPHYSEMA BY YEARS OF SERVICE AND POPULATION GROUP (2006)**

Years of service	Black		White		Coloured		Unknown		Total	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
<1	3	88	0	-	0	-	0	-	3	77
1 - 5	15	103	4	364	0	-	0	-	19	119
6-10	17	110	22	400	0	-	0	-	39	185
11-15	20	105	27	403	2	667	0	-	49	188
16-20	37	137	28	418	1	1000	0	-	66	195
21-25	39	186	28	394	0	-	0	-	67	238
26-30	25	298	35	473	0	-	0	-	60	380
31-35	5	200	30	441	1	1000	0	-	36	383
36-40	1	200	22	449	0	-	0	-	23	426
41+	1	1000	11	524	0	-	0	-	12	545
Unknown	11	250	20	426	1	333	2	222	34	330
Total	174	149	227	424	5	455	2	222	408	237

## SECTION 7 – MESOTHELIOMA

The number of cases of mesothelioma in 2006 (n=23) was lower than in 2005 (n=41) but similar to that in previous years (14 in 2000, 17 in 2001, 25 in 2002, 36 in 2003 and 25 in 2004).

**TABLE 7-1 NUMBER AND PROPORTION OF MESOTHELIOMA CASES BY AGE AND POPULATION GROUP (2006)**

Age group (years)	Black		White		Coloured		Total	
	N	%	N	%	N	%	N	%
40-49	4	31	0	-	0	-	4	17
50-59	0	-	3	38	1	50	4	17
60-69	5	38	1	13	0	-	6	26
70-79	3	23	4	50	1	50	8	35
80+	1	8	0	-	0	-	1	4
Total	13		8		2		23	

The distribution of mesothelioma by commodity and population group is presented in Table 7.2. Thirteen (56.5%) of the miners had worked in asbestos mines at some stage in their careers and two (8.7%) had been exposed to asbestos in the environment.

**TABLE 7-2 NUMBER AND PROPORTION OF MESOTHELIOMA CASES BY COMMODITY AND POPULATION GROUP (2006)**

Commodity	Black		White		Coloured		Total	
	N	%	N	%	N	%	N	%
Asbestos	8	67	2	25	2	100	12	52
Gold	1	8	1	13	0	-	2	9
Platinum	1	8	0	-	0	-	1	4
Diamond	1	8	0	-	0	-	1	4
Manganese	0	-	1	13	0	-	1	4
Iscor	0	-	1	13	0	-	1	4
Industry	0	-	2	25	0	-	2	9
Other	2	17	1	13	0	-	3	13
Total	13		8		2		23	

## SECTION 8 – PRIMARY LUNG CANCER

Fifty five cases of primary lung cancer were found at autopsy, 30.9% of which were in black, 67.3% in white and 1.8% in men whose population group was not known. Most of the cases were adenocarcinomas (38.2%; n = 21), followed by small cell lung carcinoma (25.4%; n = 14), squamous cell type (20.0%; n=11) and large cell lung carcinoma (16.4%; n = 9).

The distribution of primary lung cancer by age and population group is presented in Table 8-1.

**TABLE 8-1 NUMBERS OF CASES AND PREVALENCE OF PRIMARY LUNG CANCER BY AGE AND POPULATION GROUP (2006)**

Age group (years)	Black		White		Coloured		Unknown		Total	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
30-39	1	4	0	-	0	-	0	-	1	4
40-49	5	9	0	-	0	-	0	-	5	8
50-59	7	27	4	43	0	-	0	-	11	31
60-69	2	47	17	107	0	-	0	-	19	92
70-79	2	111	15	106	0	-	0	-	17	105
80+	0	-	1	14	0	-	0	-	1	13
Unknown	0	-	0	-	0	-	1	125	1	40
<b>Total</b>	<b>17</b>	<b>15</b>	<b>37</b>	<b>69</b>	<b>0</b>		<b>1</b>	<b>111</b>	<b>55</b>	<b>32</b>

The distribution of primary lung cancer by commodity and population group is presented in Table 8-2. The majority of cases came from the gold mining industry.

**TABLE 8-2 NUMBER OF CASES AND PREVALENCE OF PRIMARY LUNG CANCER BY COMMODITY AND POPULATION GROUP (2006)**

Commodity	Black		White		Coloured		Unknown		Total	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
Gold	8	10	27	69	0	-	0	-	35	30
Platinum	2	8	3	136	0	-	0	-	5	19
Coal	2	56	1	25	0	-	0	-	3	39
Asbestos	3	41	2	133	0	-	0	-	5	54
Diamond	1		0		0		0		1	
Copper	0		1		0		0		1	
Iscor	0		2		0		0		2	
Other	1		1		0		0		2	
Unknown	0		0		0		1		1	
<b>Total</b>	<b>17</b>	<b>15</b>	<b>37</b>	<b>69</b>	<b>0</b>		<b>1</b>	<b>111</b>	<b>55</b>	<b>32</b>

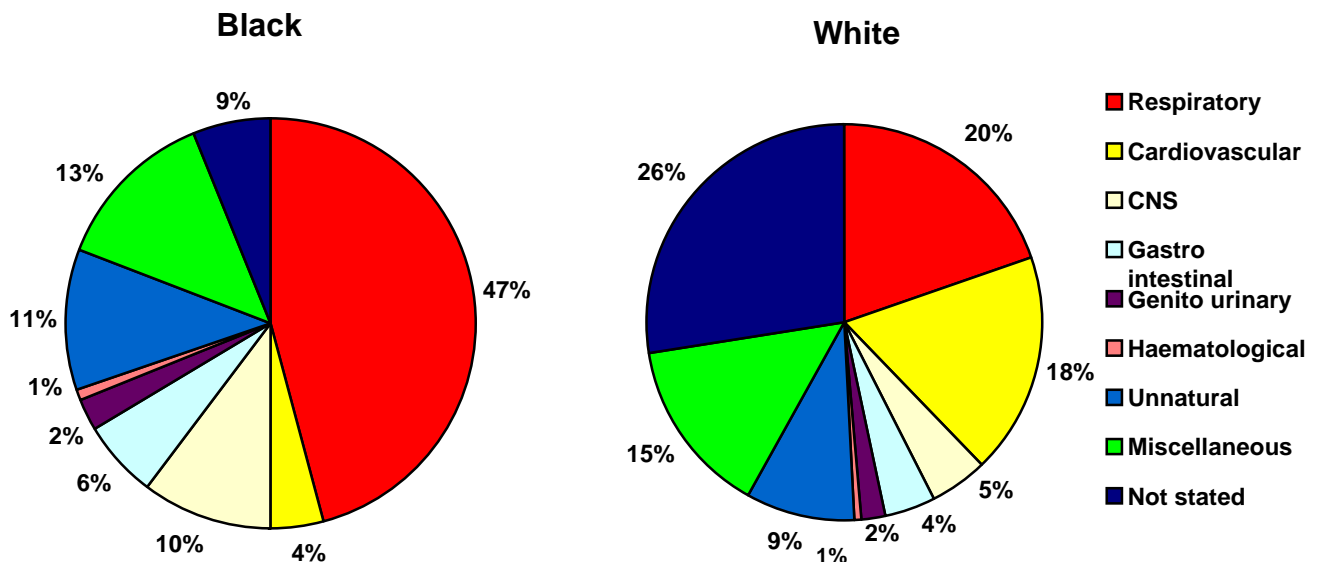


## SECTION 9 – CLINICAL CAUSES OF DEATH

Table 9-1 and Figure 9-1 show the clinical causes of death as stated in the accompanying documents submitted with the cardio-respiratory organs, by population group. Diseases of the respiratory system were the most frequent (37.6%) overall. Black men had the highest proportion of unnatural causes of death (11.3%), similar to that in 2005 (11.6%). In 13.2% of all cases, the cause of death was not stated.

**TABLE 9-1 CLINICAL CAUSES OF DEATH BY POPULATION GROUP (2006)**

System	Black		White		Coloured		Unknown		Total	
	N	%	N	%	N	%	N	%	N	%
Respiratory	533	45.8	106	19.8	7	63.6	1	11.1	647	37.6
Cardio-vascular	48	4.1	96	17.9	1	9.1	0	-	145	8.4
Central Nervous System	122	10.5	26	4.9	0	-	0	-	148	8.6
Gastro intestinal	72	6.2	22	4.1	0	-	0	-	94	5.5
Genito urinary	27	2.3	10	1.9	1	9.1	0	-	38	2.2
Haematological	10	0.9	3	0.6	0	0.0	0	-	13	0.8
Unnatural	131	11.3	47	8.8	1	9.1	0	-	179	10.4
Miscellaneous	151	13.0	78	14.6	0	-	0	-	229	13.3
Not stated	71	6.1	147	27.5	1	9.1	8	88.9	227	13.2
<b>Total</b>	<b>1 165</b>		<b>535</b>		<b>11</b>		<b>9</b>		<b>1 720</b>	



**FIGURE 9-1 CLINICAL CAUSE OF DEATH AS STATED BY THE CLINICIANS WHO SUBMIT THE ORGANS OF THE DECEASED TO THE NIOH (2006)**

## SECTION 10 – AUTOPSY FINDINGS IN WOMEN

Of the 1 720 cases examined in 2006, 22 (1.3%) were women compared to 43 (2.3%) in 2005. Of these 13 (59.1%) were black, 5 (22.7%) were white and 4 (18.2%) were coloured. The women who were autopsied were, on average, older (65.2 years) than the men (51.0 years).

**TABLE 10.1 NUMBERS AND PROPORTIONS OF AUTOPSIES IN WOMEN BY AGE AND POPULATION GROUP (2006)**

Age group (years)	Black		White		Coloured		Total	
	N	%	N	%	N	%	N	%
20-29	1	7.7	0	-	0	-	1	4.5
30-39	0	-	0	-	0	-	0	-
40-49	4	30.8	0	-	1	25.0	5	22.7
50-59	1	7.7	0	-	0	-	1	4.5
60-69	4	30.8	1	20.0	0	-	5	22.7
70-79	2	15.4	4	80.0	0	-	6	27.3
80+	1	7.7	0	-	3	75.0	4	18.2
Unknown	0	-	0	-	0	-	0	-
<b>Total</b>	<b>13</b>		<b>5</b>		<b>4</b>		<b>22</b>	

Table 10.2 summarises the distribution of autopsies in women by commodity and population group. The majority of the women (17 cases; 77.2%) had most exposure to asbestos with 12 (54.5%) exposed on the mines and 5 (22.7%) having had environmental exposure.

**TABLE 10.2 NUMBER AND PROPORTION OF AUTOPSIES IN WOMEN BY COMMODITY AND POPULATION GROUP (2006)**

Commodity	Black		White		Coloured		Total	
	N	%	N	%	N	%	N	%
Gold	1	7.7	1	12.5	0	-	2	9.1
Platinum	1	7.7	0	-	0	-	1	4.5
Asbestos	8	61.5	3	37.5	1	25.0	12	54.5
Other	3	23.1	0	-	2	50.0	5	22.7
Unknown	0	-	1	12.5	1	25.0	2	9.1
<b>Total</b>	<b>13</b>		<b>5</b>		<b>4</b>		<b>22</b>	

The predominant diseases in women were related to asbestos exposure. There were 4 cases of asbestosis and 6 of mesothelioma (Table 10.3). There were two cases which had asbestos plaques but only one case had both asbestos plaques and asbestosis.

**TABLE 10.3 NUMBER AND PROPORTION OF DISEASES IN WOMEN (2006)**

<b>Disease</b>	<b>N</b>	<b>%</b>
Mesothelioma	6	27.3
Asbestosis	4	18.2
Emphysema	4	18.2
PTB	3	13.6
Silicosis	2	9.1
Lung cancer	2	9.1
No lung disease	1	4.5
Total	22	

**APPENDIX 1: DISTRIBUTION OF AUTOPSIES ACCORDING TO THE LAST MINE WHERE THE DECEASED WORKED (2006)**

<b>Commodity</b>	<b>Last mine worked</b>	<b>Black</b>	<b>White</b>	<b>Coloured</b>	<b>Unknown</b>	<b>Total</b>	
<b>Asbestos</b>	African Chrysolite Asbestos	1				1	
	Asbestos Mine		2			2	
	Black Rock Asbestos Mine	1				1	
	Cape Blue		3	2		5	
	Danielskuil Asbestos mine	2				2	
	Gefco	67	3	1		71	
	Havelock Asbestos Mine		1			1	
	Koegas	4	3	1		8	
	Penge Asbestos	1	1			2	
	Pomfret Asbestos Mine	1	2			3	
	Warrendale Asbestos Mine		1			1	
	<b>Total from asbestos mines</b>		<b>77</b>	<b>16</b>	<b>4</b>	<b>0</b>	<b>97</b>
	<b>Chrome</b>	Chrome Mine		1			1
Eastern Chrome Mine			1			1	
Mooinooi Chrome			1			1	
Samancor Western Chrome			1			1	
<b>Total from chrome mines</b>		<b>0</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>	
<b>Coal</b>	Arnot Colliery	5				5	
	Bank Colliery	2				2	
	Barbrook Colliery		2			2	
	Black Wattle Colliery	1	1			2	
	Carolina Colliery		1			1	
	Coronation Colliery		1			1	
	Douglas Colliery		1			1	
	Durban Navigation Colliery		2			2	
	Forzando Colliery	1				1	
	Goedehoop Colliery	1				1	
	Greenside Colliery	3	1			4	
	Hlobane Colliery		1			1	
	Kilbarchen Colliery		1			1	
	Kleinkopje Colliery	6	1			7	
	Koornfontein Coal		1			1	
	Kriel Colliery	3				3	
	Khutala Colliery	1				1	
	Landau Colliery	1	1			2	
	Matla Coal	7	3			10	
	New Denmark	2	1			3	
	New Largo Colliery	1				1	
	Optimum Colliery		2			2	
	Rietspruit Colliery		1			1	

<b>Commodity</b>	<b>Last mine worked</b>	<b>Black</b>	<b>White</b>	<b>Coloured</b>	<b>Unknown</b>	<b>Total</b>
<b>Coal (continued)</b>	Sasol Coal Mine		2			2
	S A Coal Estates		2			2
	Secunda Colliery		1			1
	Sigma Colliery		2			2
	Slater Coal Mine			1		1
	Springbok Colliery		2			2
	Springfield Colliery		1			1
	Tselentis Coal Mine		1			1
	Witbank Collieries	1	1			2
<b>Total from coal mines</b>		<b>35</b>	<b>33</b>	<b>1</b>	<b>0</b>	<b>69</b>
<b>Copper</b>	O'Kiep Copper		3	3		6
	Oamites Copper		1			1
	Prieska		1			1
	Phalaborwa	1				1
	Tsumeb Copper Mine		3			3
<b>Total from copper mines</b>		<b>1</b>	<b>8</b>	<b>3</b>	<b>0</b>	<b>12</b>
<b>Diamond</b>	Cullinan Diamond Mine	1				1
	De Beers Consolidated	1	3			4
	Messina Diamond Mine	1				1
	Unknown Diamond Mine		2			2
<b>Total from diamond mines</b>		<b>3</b>	<b>5</b>	<b>0</b>	<b>0</b>	<b>8</b>
<b>Gold</b>	African Rainbow Minerals & Exploration	6				6
	Afrikaaner GM		1			1
	Anglo American GM		1			1
	Anglogold Ashanti GM		1			1
	Anglogold Business Service		1			1
	Anglogold Great Noligwa GM	6	1			7
	Anglogold Health Service (Free State)		1			1
	Bambanani GM	13	1			14
	Barberton GM		1			1
	Beatrix Gold	89	5			94
	Blyvoorquizicht	1	10			11
	Bracken Mines	1	5			6
	Buffelsfontein Gold	2	16			18
	Cementation	2	1			3
	City Deep		2			2
	Consolidated Modderfontein		2			2
	Crown Mines		1			1
	Daggasfontein		2			2
	Deelkraal		5			5
	Doornfontein		2			2

Commodity	Last mine worked	Black	White	Coloured	Unknown	Total
<b>Gold (continued)</b>	Driefontein Cons GM	33	7			40
	Durban Roodepoort Deep	1	8			9
	East Driefontein	3	10			13
	East Geduld		3			3
	East Rand Prop		13			13
	Elandsrand	3	2			5
	Evander GM	31	4			35
	Freddies Gold	4				4
	Free State Geduld	2	16			18
	Free State Saaiplaas	4	1			5
	Gold Mine	1				1
	Goldfields	4	3			7
	Grinaker GM		1			1
	Grootvlei Prop	1	2			3
	Harmony	168	28			196
	Hartebeesfontein	2	25			27
	J.I.C. Gold Mine	3				3
	Joel	2	3			5
	Kinross	16	2			18
	Kloof	36	17			53
	Leeudoorn	1	8			9
	Libanon		4			4
	Lorraine	1	3			4
	Main Reef GM		1			1
	Marievale		1			1
	Masimong Gold Mine	9				9
	Merriespruit GM	1				1
	Moab Khotsong GM	1				1
	Oryx	39	2			41
	Placer Dome GM	1	4			5
	President Brand	1	6			7
	President Steyn	10	4			14
	Rand Mines	1				1
	Randfontein	65	13			78
	S A Land		2			2
	Saaiplaas GM		1			1
	Sallies	1	1			2
	SAMAT GM		3			3
	Simmer & Jack GM	23				23
	South Deep GM	1				1
	Springs GM		1			1
	St Helena	4	9			13
	Stilfontein		8			8
	Sub Nigel		1			1
	Tautona GM	1	1			2

<b>Commodity</b>	<b>Last mine worked</b>	<b>Black</b>	<b>White</b>	<b>Coloured</b>	<b>Unknown</b>	<b>Total</b>
<b>Gold (continued)</b>	Tshepone GM	1	1			2
	Unisel GM	1	3			4
	Vaal Reefs	146	33			179
	Ventersport		6			6
	Vlakfontein		2			2
	Welgedacht		1			1
	Welkom GM		1			1
	West Driefontein		14		1	15
	West Rand Consolidation		4			4
	West Witwatersrand		2			2
	Western Areas	2	10			12
	Western Deep Levels	13	13			26
	Western Holdings	6	7			13
	Western Reef GM		1			1
	Winkelhaak	4	6			10
<b>Total from gold mines</b>		<b>767</b>	<b>381</b>	<b>0</b>	<b>1</b>	<b>1149</b>
<b>Platinum</b>	Amadelbult Platinum (Rustenburg)	1	1			2
	Atok Platinum	1				1
	Impala Platinum	145	11			156
	Lebowa Platinum	7				7
	Modikwa Platinum Mine	1				1
	Northam Platinum	15	2		1	18
	Rustenburg Platinum	71	19		2	92
	Swartklip Platinum	5				5
	Unknown Platinum	2				2
	Waterval Platinum Mine		1			1
	Western Platinum	3				3
	Wildebessfontein	2				2
	Zondereinde Platinum	1				1
<b>Total from platinum</b>		<b>254</b>	<b>34</b>	<b>0</b>	<b>3</b>	<b>291</b>
<b>Manganese</b>	Hotazel Manganese Mine	1	1			2
	Manganese Mine		1			1
<b>Emerald</b>	Gravelotte	1				1
<b>Iron &amp; Manganese</b>	Associated Manganese	1				1
	S A Manganese	1				1
<b>Lead &amp; Minerals</b>	Blackmountain	1	1			2
<b>Sinkers</b>	Shaft Sinkers	1	4			5
<b>Steel &amp; Iron</b>	Iscor		20			20
<b>Tin</b>	Rooiberg Tin Mine		1			1
<b>Non-Miner</b>	Industry		5			5
	Non-miner	1				1
	Environmental Asbestos	10		2		12

<b>Commodity</b>	<b>Last mine worked</b>	<b>Black</b>	<b>White</b>	<b>Coloured</b>	<b>Unknown</b>	<b>Total</b>
<b>Non-Miner (contd.)</b>	Eskom		2			2
<b>Unknown</b>	Unknown	11	19	1	5	36
<b>TOTAL</b>		<b>1 165</b>	<b>535</b>	<b>11</b>	<b>9</b>	<b>1 720</b>



## **APPENDIX 2: PUBLICATIONS AND ACTIVITIES EMANATING FROM PATHAUT DATA (2006)**

### **Journal articles**

#### *Published:*

Nolan RP, Ross M, Nord GL, Raskina M, Phillips JI, Murray J, Gibbs GW. Asbestos fibre-type and mesothelioma risk in the Republic of South Africa. *Clay Science* 2006; 2:223-227.

Ndlovu N, Murray J, Candy G, Nelson G. Occupational lung diseases in South African miners at autopsy: Surveillance report 2004. *Occup Health Southern Africa* 2006; 12:20-22.

Wong ML, Back P, Candy G, Nelson G, Murray J. *Pneumocystis jirovecii* pneumonia in African miners at autopsy. *Int J Tuberc Lung Dis* 2006; 10:756-760.

#### *In press:*

Honma K, Murray J, Nelson G. Intrapulmonary lymph nodes in South African miners - an autopsy survey. [*Am J Ind Med*]

Wong ML, Back P, Candy G, Nelson G, Murray J. Cryptococcal pneumonia in African miners at autopsy. [*Int J Tuberc Lung Dis*]

### **Conference proceedings**

Ndlovu N, Nelson G, Candy G, Murray J. Thirty year silicosis trends at autopsy in South African miners. *South Afr J Epidemiol Infect* 2006; 21:104 (Suppl)

### **Reports**

Girdler-Brown G, Murray J, Wichmann J, Robinson F, Nelson G, Downs K. Respiratory disease in the South African platinum mining industry. Final report SIM 03-08-06. Safety in Mines Research Advisory Committee, 2006.

Ndlovu N, Murray J, Candy G, Nelson G. Pathology Division Report: Demographic data and disease rates for January-December 2005. NIOH report 2/2006 ISSN 1812 - 7681. National Institute for Occupational Health, National Health Laboratory Service, South Africa, 2006.

### **Congresses**

Nelson G, Ndlovu N, Candy G, Murray J. Thirty year silicosis trends at autopsy in South African miners. Public Health Association of Southern Africa (PHASA) Third National Public Health Conference. 16-17 May 2006, Eskom Conference Centre, Midrand

Ndlovu Z, Murray J, Hnizdo E. Prospective Studies of South African gold miners-the wiles cohort. 4<sup>th</sup> National Conference on Toxicology. Toxicology in Africa: Emerging Technologies. 11-14 June 2006, University of Pretoria, Pretoria

### **Higher degrees**

Gill Nelson, PhD, Occupational respiratory diseases: rates, trends and risks in platinum and diamond miners coming to autopsy from 1975 to 2004. Started 2005. School of Public Health, University of the Witwatersrand