NATIONAL INSTITUTE FOR OCCUPATIONAL HEALTH

Pathology Division Surveillance Report: Demographic Data and Disease Rates for January to December 2007

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EXECUTIVE SUMMARY

During 2007, 1 724 cases came to autopsy at the NIOH. Of these, 66.4% were black men, 31.3% were white, 1.2% were coloured and 1.2% were submitted without information on population group.

Overall disease rates (per 1000 autopsies) for 2007 are shown in Figure 1.

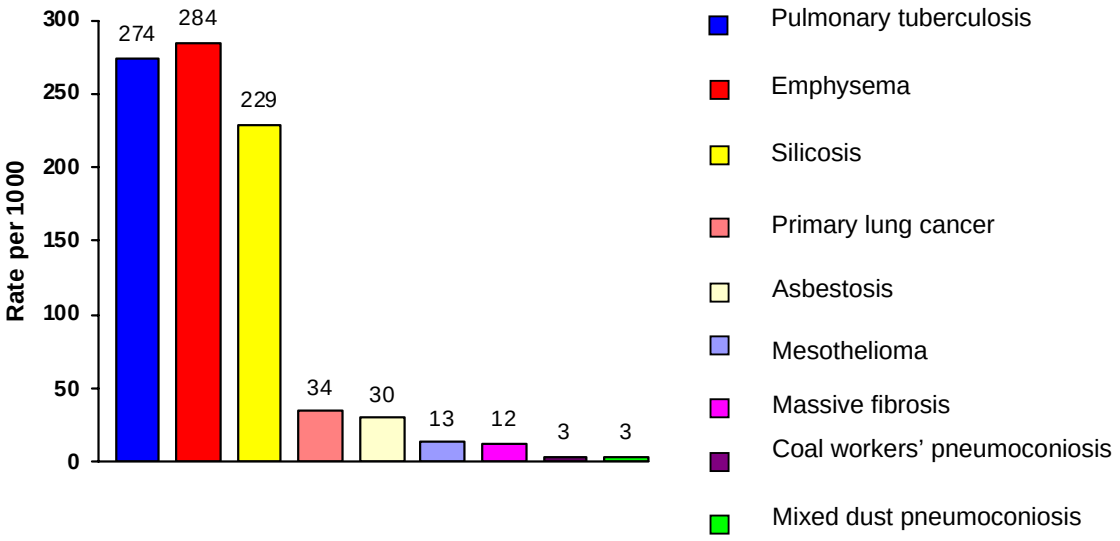

FIG.1 OVERALL DISEASE RATES FOR 2007

The overall rate of pulmonary tuberculosis (PTB) in 2007 (274/1000) was higher than that in 2006 (251/1000). The rate in black gold miners increased from 379 per thousand in 2006 to 406 per 1000 in 2007. The rate in black platinum miners increased from 275 per thousand in 2006 to 335 per thousand in 2007.

Over the last few years there has been an overall increase in the prevalence of silicosis. However, the rate decreased from 237/1000 in 2006 to 229/1000 in 2007.

For the first time, miners have been classified as current and ex-miners. In 2007, 614 cases (35.6%) were ex-miners, 1017 (59.0%) were current miners and 93 cases (5.4%) could not be classified.

Twenty four women came to autopsy in 2007. Two thirds of them had diseases related to asbestos exposure in mining or in the environment.

The proportion of cases submitted with an incomplete service history (2.7%) was slightly higher that that in 200 (1.8%).

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 in 2006 to inform miners and ex-miners of their right to autopsy examination. The division has continued to engage occupational health units on the mines, mine union representatives, undertakers, state hospitals and forensic laboratories in some of the provinces of South Africa.

During 2007, four journal articles utilising the PATHAUT data were published and research findings were presented at a number of fora (see Appendix 2). A PhD based on the PATHAUT data was registered in 2005 (University of the Witwatersrand) and is on course.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

GLOSSARY

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

SECTION 1 – BACKGROUND

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 eleventh consecutive annual report and describes autopsy cases examined during the year 2007. Some of the earlier reports and this report can be accessed at http://www.nioh.ac.za/publications/publications_pathaut_reports.htm.

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 - 2007)

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	1 062	27	99	2			12		4 003
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
2007	1 144	66	539	31	21	1.2			20	1.2	1 724
Total	66 752	69	31 891	33	1 539	1.5	3		245	0.2	100 430

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 152 600 in 2007.

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 2007. Autopsies of only the cardio-respiratory organs comprised 96.8% of all examinations.

TABLE 2-2 NUMBER AND PROPORTION OF AUTOPSIES BY TYPE AND POPULATION GROUP (2007)

Autopsy type	Black		White		Coloured		Unknown		Total	
	N	%	N	%	N	%	N	%	N	%
Cardiorespiratory organs only	1 142	99.8	485	90.0	21	100	20	100	1 668	96.8
Full autopsy	2	0.2	54	10.0	0	-	0	-	56	3.2
Total	1 144		539		21		20		1 724	

The age distribution of autopsies for 2007 is shown in Table 2-3 and Figure 2-1. The mean age at autopsy of black men was 44.5 years and has remained essentially unchanged for the last 4 years. The mean age of white men at autopsy decreased from 65.1 years in 2006 to 63.9 years in 2007.

TABLE 2-3 NUMBER AND PROPORTION OF AUTOPSIES BY AGE AND POPULATION GROUP (2007)

Age group (years)	Black		White		Coloured		Unknown		Total	
	N	%	N	%	N	%	N	%	N	%
20-29	53	4.6	6	1.1	1	4.8	0	-	60	3.5
30-39	255	22.3	15	2.8	4	19.0	0	-	274	15.9
40-49	493	43.1	55	10.2	2	9.5	0	-	550	31.9
50-59	278	24.3	124	23.0	2	9.5	0	-	404	23.4
60-69	37	3.2	141	26.2	7	33.3	0	-	185	10.7
70-79	14	1.2	136	25.2	4	19.0	0	-	154	8.9
80+	3	0.3	62	11.5	1	4.8	0	-	66	3.8
Unknown	11	1.0	0	-	0	-	20	100.0	31	1.8
Total	1 144		539		21		20		1 724	

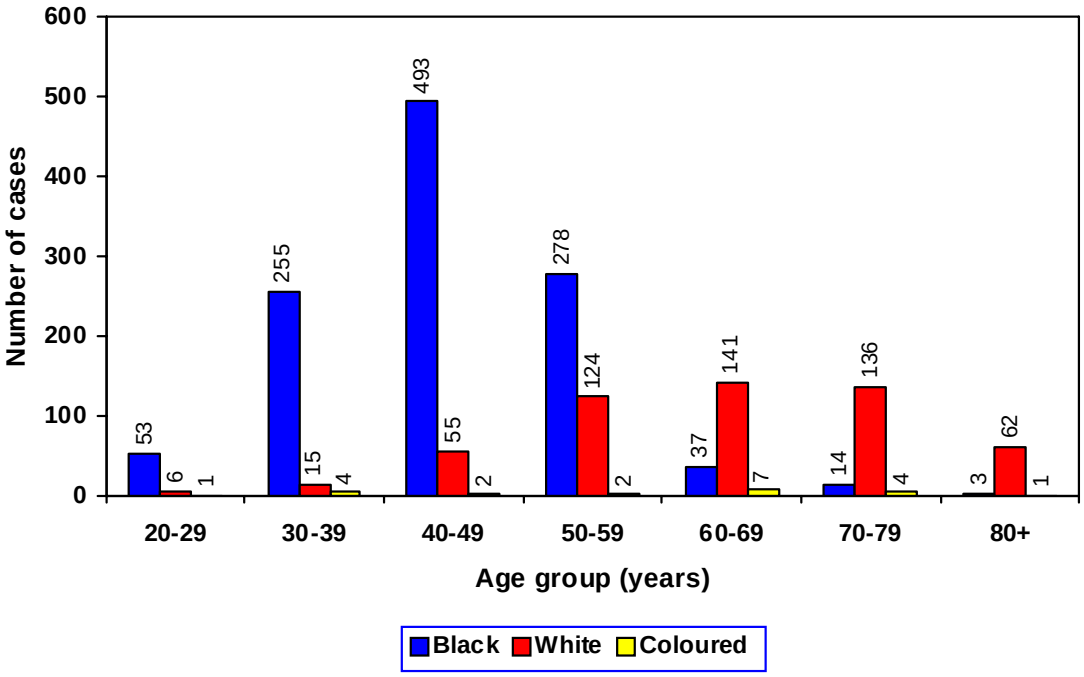

FIG 2-1 DISTRIBUTION OF AUTOPSIES BY AGE AND POPULATION GROUP (2007)

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 9 cases in blacks, 2 in whites and 1 in coloureds in 2007. 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 distributions of autopsies by commodity and population group for 2007. The percentage of autopsies received from the gold mining industry was 66.5%. The percentage of autopsies from the platinum industry doubled from 8.3% in 1999 to 16% in 2004 and increased to 18.2% in 2007. As in previous years, the majority of coloured people who came to autopsy had been exposed to asbestos: 28.6% in the asbestos mines and 14.3% in the environment.

TABLE 2-4 NUMBER AND PROPORTION OF AUTOPSIES BY COMMODITY AND POPULATION GROUP (2007)

Commodity	Black		White		Coloured		Unknown		Total	
	N	%	N	%	N	%	N	%	N	%
Gold	746	65.2	397	73.7	4	19.0	0	-	1147	66.5
Platinum	284	24.8	29	5.4	0	-	0	-	313	18.2
Coal	27	2.4	38	7.1	2	9.5	0	-	67	3.9
Asbestos	47	4.1	11	2.0	6	28.6	0	-	64	3.7
Iscor	3	0.3	13	2.4	1	4.8	0	-	17	1.0
Diamond	1	0.1	4	0.7	1	4.8	0	-	6	0.3
Copper	3	0.3	3	0.6	3	14.3	0	-	9	0.5
Manganese	8	0.7	4	0.7	1	4.8	0	-	13	0.8
Industry	2	0.2	6	1.1	0	0.0	0	-	8	0.5
Other	17	1.5	13	2.4	3	14.3	0	-	33	1.9
Unknown	6	0.5	21	3.9	0	-	20	100.0	47	2.7
Total	1 144		539		21		20		1 724	

Note: this table shows only those commodities where a total of 6 or more cases were received

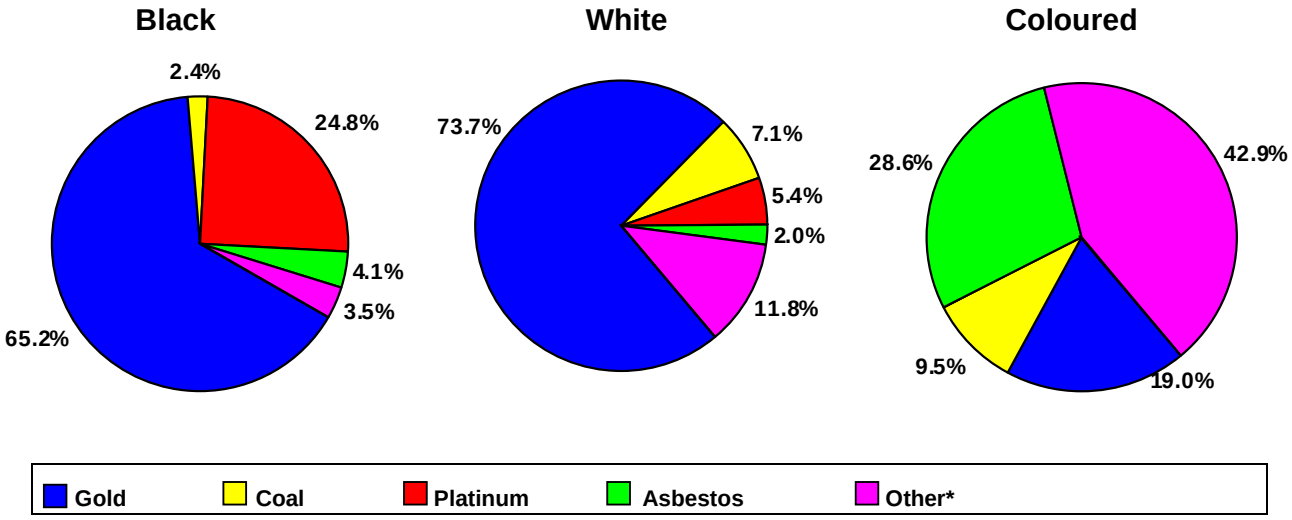

FIG 2-2 DISTRIBUTION OF AUTOPSIES BY COMMODITY AND POPULATION GROUP (2007)

* Includes copper, chrome, diamond, foundry, industry, iron, Iscor, lead, lime, phosphate, quarry, manganese, steel, 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 2007, the duration of service was obtained for all but 6% of the cases. This figure is the same as that for 2006.

TABLE 2-5 NUMBER AND PROPORTION OF AUTOPSIES BY YEARS OF SERVICE AND POPULATION GROUP (2007)

Years of service	Black		White		Coloured		Unknown		Total	
	N	%	N	%	N	%	N	%	N	%
<1	40	3.5	3	0.6	2	9.5	0	-	45	2.6
1-5	165	14.4	29	5.4	2	9.5	0	-	196	11.4
6-10	158	13.8	56	10.4	5	23.8	0	-	219	12.7
11-15	181	15.8	63	11.7	4	19.0	0	-	248	14.4
16-20	244	21.3	85	15.8	2	9.5	0	-	331	19.2
21-25	200	17.5	81	15.0	2	9.5	0	-	283	16.4
26-30	89	7.8	73	13.5	0	-	0	-	162	9.4
31-35	20	1.7	54	10.0	1	4.8	0	-	75	4.4
36-40	2	0.2	41	7.6	1	4.8	0	-	44	2.6
41+	2	0.2	12	2.2	0	-	0	-	14	0.8
Unknown	43	3.7	42	7.8	2	9.5	20	100	107	6.2
Total	1 144		539		21		20		1 724	

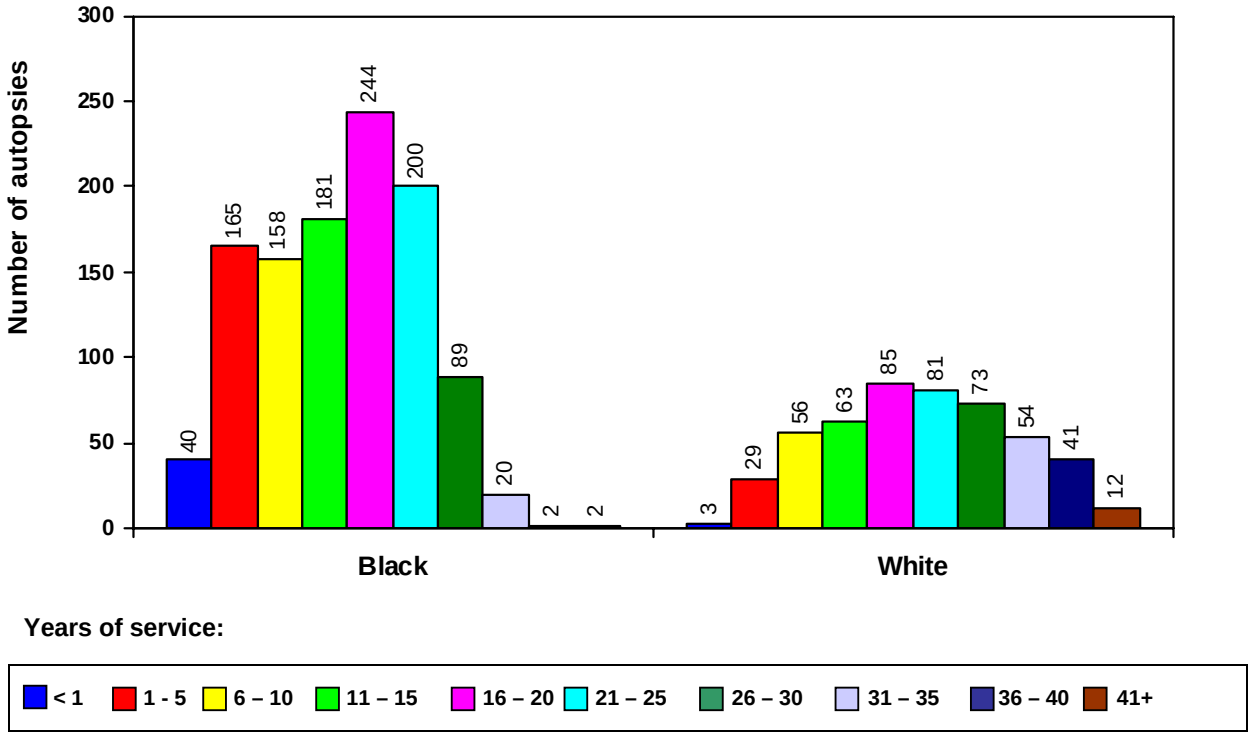

FIG 2-3 DISTRIBUTION OF AUTOPSIES BY YEARS OF SERVICE AND POPULATION GROUP (2007)

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 (2007)

Commodity	Black			White		
	N	Mean (years)	SD*	N	Mean (years)	SD*
Gold	738	44	8	397	64	13
Platinum	283	44	9	29	58	14
Coal	27	46	10	38	64	14
Asbestos	47	61	12	11	68	8
Iscor	3	59	4	13	70	7
Diamond	1	50	-	4	59	13
Copper	3	56	11	3	75	11
Manganese	8	57	8	4	62	13
Industry	2	52	5	6	59	19
Other	17	51	15	13	63	14
Unknown	4	49	9	21	62	19
Total	1 133	45	9	539	64	13

* Standard deviation

TABLE 2-7 MEAN DURATION OF SERVICE BY COMMODITY AND POPULATION GROUP (2007)

Commodity	Black			White		
	N	Mean (years)	SD*	N	Mean (years)	SD*
Gold	730	16	8	387	23	10
Platinum	278	14	9	27	17	9
Coal	25	21	10	36	19	10
Asbestos	44	6	6	10	12	11
Iscor	3	11	7	10	18	11
Diamond	1	30	-	4	15	11
Copper	2	22	3	3	20	13
Manganese	7	3	2	4	17	6
Industry	2	20	7	5	23	17
Other	8	9	9	10	18	11
Unknown	1	21	-	1	4	-
Total	1 101	15	8	497	21	11

*Standard deviation

SECTION 3 – ACTIVE TUBERCULOSIS

The distribution of active tuberculosis (TB) by anatomical site is presented in Figure 3-1 (n=550). Active pulmonary TB (PTB) was diagnosed in 27.4% (472) of all cases autopsied in 2007, compared to 16.4% (416) in 2000. Most of the men with PTB were black (89.2%; 421 cases), 9.5% (45 cases) were white, 0.6% (3 cases) were coloured and in 0.6% (3 cases) the population group was unknown.

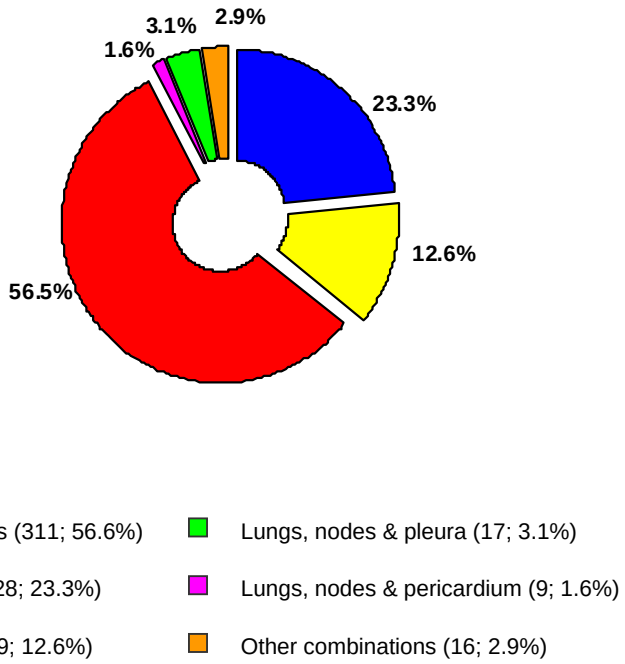

FIG 3-1 DISTRIBUTION OF ACTIVE TB BY SITE (2007)

The overall rate of PTB in 2007 (274/1000) increased from 251/1000 in 2006. The increase in PTB rates observed in previous years is attributed to the increased rate in black men from 217/1000 in 2000 to 368/1000 in 2007 (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 406/1000 in 2007. In black platinum miners the rates increased from 275/1000 in 2006 to 335/1000 in 2007.

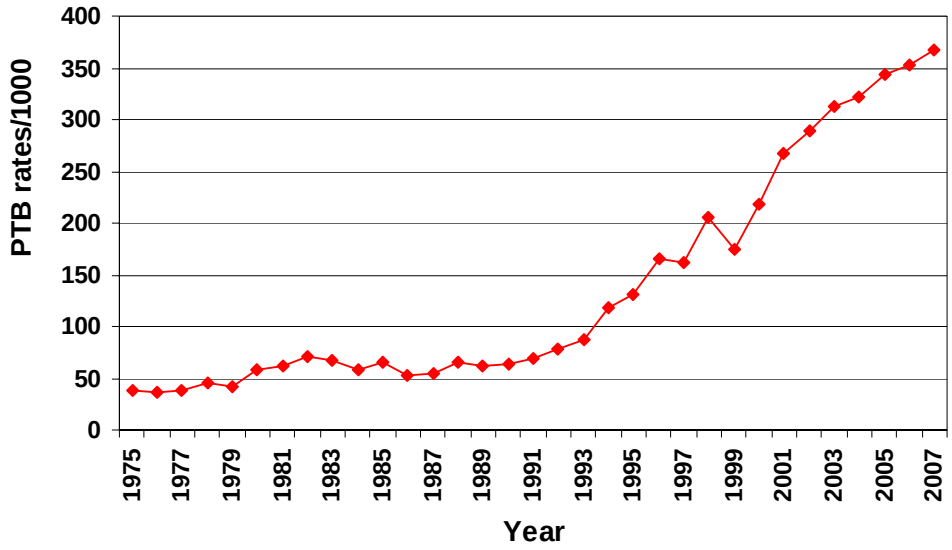

FIG 3-2 ACTIVE PTB RATES IN BLACK MINERS AT AUTOPSY (1975 to 2007)

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 (72.7%) came from the gold mining industry (66.5% of all autopsy cases came from that commodity).

TABLE 3-1 NUMBER OF CASES AND PREVALENCE OF ACTIVE PTB BY COMMODITY AND POPULATION GROUP (2007)

Commodity	Black		White		Coloured		Unknown		Total	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
Gold	303	406	39	98	1	250	0	-	343	299
Platinum	95	335	1	34	0	-	0	-	96	307
Coal	3	111	0	-	0	-	0	-	3	45
Asbestos	13	277	2	182	1	167	0	-	16	250
Iscor	0		1		0		0		1	
Copper	1		0		1		0		2	
Manganese	2		0		0		0		2	
Industry	0		1		0		0		1	
Other	2		0		0		0		2	
Unknown	2		1		0		3		6	
Total	421	368	45	83	3	143	3	150	472	274

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=211; 44.7%) were in the age group 40-49 years, followed by those in the 30-39 year age group (n=105; 22.2%).

TABLE 3-2 NUMBER OF CASES AND PREVALENCE OF ACTIVE PTB BY AGE AND POPULATION GROUP (2007)

Age group	Black		White		Coloured		Unknown		Total	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
20-29	18	340	0	-	0	-	0	-	18	300
30-39	105	412	0	-	0	-	0	-	105	383
40-49	204	414	6	109	1	500	0	-	211	384
50-59	80	288	17	137	0	-	0	-	97	240
60-69	7	189	8	57	1	143	0	-	16	86
70-79	2	143	10	74	1	250	0	-	13	84
80+	1	333	4	65	0	-	0	-	5	76
Unknown	4	364	0	-	0	-	3	150	7	226
Total	421	368	45	83	3	143	3	150	472	274

SECTION 4 – SILICOSIS

Silicotic nodules were found in the lungs of 395 cases (22.9% of all autopsies), 88% of which came from the gold mining industry. Of all cases of silicosis, occasional silicotic nodules were found in 57.7% of cases, a few in 13.7%, a moderate number in 25.5% and a large number in 3.3%.

The distribution of cases with silicosis by commodity and population group is presented in Table 4-1. The rate of silicosis in gold miners increased from 191/1000 in 2000 to 316/1000 in 2006 but decreased to 303/1000 in 2007.

TABLE 4-1 NUMBER OF CASES AND PREVALENCE OF SILICOSIS BY COMMODITY AND POPULATION GROUP (2007)

Commodity	Black		White		Coloured		Unknown		Total	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
Gold	252	338	96	242	0	-	0	-	348	303
Platinum	16	56	3	103	0	-	0	-	19	61
Coal	2	74	1	26	0	-	0	-	3	45
Asbestos	6	128	2	182	1	167	0	-	9	141
Copper	1		2		1		0		4	
Manganese	2		0		0		0		2	
Other	1		0		0		0		1	
Unknown	1		5		0		3		9	
Total	281	246	109	202	2	95	3	150	395	229

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 (2007)

Age group (years)	Black		White		Coloured		Unknown		Total	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
20-29	2	63	0	-	0	-	0	-	2	56
30-39	16	95	0	-	0	-	0	-	16	90
40-49	145	388	4	103	0	-	0	-	149	361
50-59	85	559	18	184	0	-	0	-	103	412
60-69	3	273	28	269	0	-	0	-	31	267
70-79	0	-	28	286	0	-	0	-	28	280
80+	0	-	18	391	0	-	0	-	18	391
Unknown	1	125	0	-	0	-	0	-	1	125
Total	252	338	96	242	0		0		348	303

TABLE 4-3 NUMBER OF CASES AND PREVALENCE OF SILICOSIS IN THE GOLD MINING INDUSTRY, BY YEARS OF SERVICE AND POPULATION GROUP (2007)

Years of service	Black		White		Coloured		Unknown		Total	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
<1	1	91	0	-	0	-	0	-	1	77
1-5	12	152	1	63	0	-	0	-	13	135
6-10	19	179	3	83	0	-	0	-	22	155
11-15	28	203	7	149	0	-	0	-	35	188
16-20	76	396	16	239	0	-	0	-	92	355
21-25	74	548	15	246	0	-	0	-	89	454
26-30	27	529	21	344	0	-	0	-	48	429
31-35	11	733	21	412	0	-	0	-	32	478
36-40	1	1000	7	189	0	-	0	-	8	211
41+	0	-	2	200	0	-	0	-	2	167
Unknown	3	188	3	300	0	-	0	-	6	231
Total	252	338	96	242	0		0		348	303

SECTION 5 – OTHER PNEUMOCONIOSES

MASSIVE FIBROSIS

There were 20 (1.1%) cases of massive fibrosis (10 black, 10 white). All were from the gold mining industry.

COAL WORKERS' PNEUMOCONIOSIS

There were 5 (0.3%) cases of coal workers' pneumoconiosis. All were from the coal mining industry.

MIXED DUST PNEUMOCONIOSIS

There were 5 (0.3%) cases of mixed dust pneumoconiosis. All were from the gold mining industry.

ASBESTOSIS AND PLEURAL PLAQUES

There were 52 cases of asbestosis of which 53.8% (n=28) had slight, 32.7% (n=17) moderate and 13.5% (n=7) marked fibrosis. Forty two (80.8%) of these cases had worked in the asbestos mining industry at some time in their lives and one (1.9%) had had exposure to asbestos in the environment.

There were 24 cases which had asbestos plaques and of these nine 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.

TABLE 5-1 NUMBER OF CASES AND PREVALENCE OF ASBESTOSIS BY AGE AND POPULATION GROUP (2007)

Age group (years)	Black		White		Coloured		Unknown		Total	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
40-49	2	4	0	-	0	-	0	-	2	4
50-59	13	47	2	16	1	500	0	-	16	40
60-69	11	297	2	14	4	571	0	-	17	92
70-79	8	571	1	7	1	250	0	-	10	65
80+	2	667	1	16	1	1000	0	-	4	61
Unknown	0	-	0	-	0	-	3	150	3	97
Total	36	31	6	11	7	333	3	150	52	30

SECTION 6 – EMPHYSEMA

There were 490 cases of emphysema, the extent of which was mild in 88.6% (n=434), moderate in 9.8% (n=48) and marked in 1.6% (n=8). The overall rate of emphysema was higher (284/100) than that in 2006 (237/1000). 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 (2007)

Age group (years)	Black		White		Coloured		Unknown		Total	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
20-29	2	38	0	-	0	-	0	-	2	33
30-39	21	82	0	-	1	250	0	-	22	80
40-49	85	172	12	218	1	500	0	-	98	178
50-59	84	302	41	331	1	500	0	-	126	312
60-69	19	514	72	511	5	714	0	-	96	519
70-79	8	571	80	588	4	1000	0	-	92	597
80+	0	-	43	694	1	1000	0	-	44	667
Unknown	1	91	0	-	0	-	9	450	10	323
Total	220	192	248	460	13	619	9	450	490	284

The majority of black and white men with emphysema were from the gold mining industry (63.9%, n=313) (Table 6-2).

TABLE 6-2 NUMBER OF CASES AND PREVALENCE OF EMPHYSEMA BY COMMODITY AND POPULATION GROUP (2007)

Commodity	Black		White		Coloured		Unknown		Total	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
Gold	131	176	179	451	3	750	0	-	313	273
Platinum	43	151	10	345	0	-	0	-	53	169
Coal	12	444	19	500	0	-	0	-	31	463
Asbestos	24	511	9	818	3	500	0	-	36	563
Diamond	0		0		1		0		1	
Copper	0		3		2		0		5	
Iscor	3		9		1		0		13	
Manganese	3		4		1		0		8	
Industry	2		2		0		0		4	
Other	0		2		2		0		4	
Unknown	2		11		0		9		22	
Total	220	192	248	460	13	619	9	450	490	284

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 (2007)

Years of service	Black		White		Coloured		Unknown		Total	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
<1	5	125	0	-	0	-	0	-	5	111
1 - 5	26	158	13	448	1	500	0	-	40	204
6-10	16	101	26	464	3	600	0	-	45	205
11-15	26	144	29	460	4	1000	0	-	59	238
16-20	56	230	41	482	1	500	0	-	98	296
21-25	53	265	33	407	2	1000	0	-	88	311
26-30	23	258	31	425	0	-	0	-	54	333
31-35	4	200	29	537	1	1000	0	-	34	453
36-40	0	-	20	488	0	-	0	-	20	455
41+	0	-	5	417	0	-	0	-	5	357
Unknown	11	256	21	500	1	500	9	450	42	393
Total	220	192	248	460	13	619	9	450	490	284

SECTION 7 – MESOTHELIOMA

The number of cases of mesothelioma in 2007 (n=22) was similar to 2006 (n=23) but lower than those in previous years.

TABLE 7-1 NUMBER AND PROPORTION OF MESOTHELIOMA CASES BY AGE AND POPULATION GROUP (2007)

Age group (years)	Black		White		Total	
	N	%	N	%	N	%
30-39	1	11	0	-	1	5
40-49	1	11	0	-	1	5
50-59	4	44	1	8	5	23
60-69	2	22	5	38	7	32
70-79	0	-	6	46	6	27
80+	1	11	1	8	2	9
Total	9		13		22	

The distribution of mesothelioma by commodity and population group is presented in Table 7.2. Six (27.3%) of the miners had worked in asbestos mines at some stage in their careers and six (27.3%) had been exposed to asbestos in the environment.

TABLE 7-2 NUMBER AND PROPORTION OF MESOTHELIOMA CASES BY COMMODITY AND POPULATION GROUP (2007)

Commodity	Black		White		Total	
	N	%	N	%	N	%
Asbestos	1	11	4	31	5	23
Gold	1	11	3	23	4	18
Platinum	1	11	1	8	2	9
Coal	0	-	1	8	1	5
Copper	1	11	0	-	1	5
Other	5	56	3	23	8	36
Unknown	0	-	1	8	1	5
Total	9		13		22	

SECTION 8 – PRIMARY LUNG CANCER

Fifty eight cases of primary lung cancer were found at autopsy, 25.9% of which were in black, 62.1% in white, 6.9% in coloured and 5.2% in men whose population group was not known. Most of the cases were squamous cell lung carcinomas (n = 19; 32.8%), followed by large cell lung carcinomas (n = 14; 24.1%) and adenocarcinomas (n = 14; 24.1%) and small cell lung carcinomas (n = 11; 9.0%).

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 (2007)

Age group (years)	Black		White		Coloured		Unknown		Total	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
40-49	6	12	1	18	0	-	0	-	7	13
50-59	6	22	6	48	0	-	0	-	12	30
60-69	1	27	9	64	2	286	0	-	12	65
70-79	2	143	17	125	2	500	0	-	21	136
80+	0	-	3	48	0	-	0	-	3	45
Unknown	0	-	0	-	0	-	3	150	3	97
Total	15	13	36	67	4	190	3	150	58	34

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 (2007)

Commodity	Black		White		Coloured		Unknown		Total	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
Gold	5	7	25	63	1	250	0	-	31	27
Platinum	3	11	1	34	0	-	0	-	4	13
Coal	0	-	3	79	0	-	0	-	3	45
Asbestos	3	64	0	-	0	-	0	-	3	47
Diamond	0		2		0		0		2	
Copper	0		0		1		0		1	
Iscor	1		0		0		0		1	
Manganese	1		2		1		0		4	
Industry	1		0		0		0		1	
Other	1		2		1		0		4	
Unknown	0		1		0		3		4	
Total	15	13	36	67	4	190	3	150	58	34

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 (41.2%) overall. Black men had the highest proportion of unnatural causes of death (10.8%), similar to that in 2006 (11.3%). In 12.4% of all cases, the cause of death was not stated.

TABLE 9-1 CLINICAL CAUSES OF DEATH BY POPULATION GROUP (2007)

System	Black		White		Coloured		Unknown		Total	
	N	%	N	%	N	%	N	%	N	%
Respiratory	580	50.7	124	23.0	6	28.6	0	-	710	41.2
Cardio-vascular	28	2.4	87	16.1	4	19.0	0	-	119	6.9
Central Nervous System	104	9.1	11	2.0	0	-	0	-	115	6.7
Gastro intestinal	65	5.7	15	2.8	0	-	0	-	80	4.6
Genito urinary	23	2.0	14	2.6	0	-	0	-	37	2.1
Haematological	9	0.8	2	0.4	0	-	0	-	11	0.6
Unnatural	124	10.8	62	11.5	3	14.3	0	-	189	11.0
Miscellaneous	136	11.9	107	19.9	7	33.3	0	-	250	14.5
Not stated	75	6.6	117	21.7	1	4.8	20	100.0	213	12.4
Total	1 144		539		21		20		1 724	

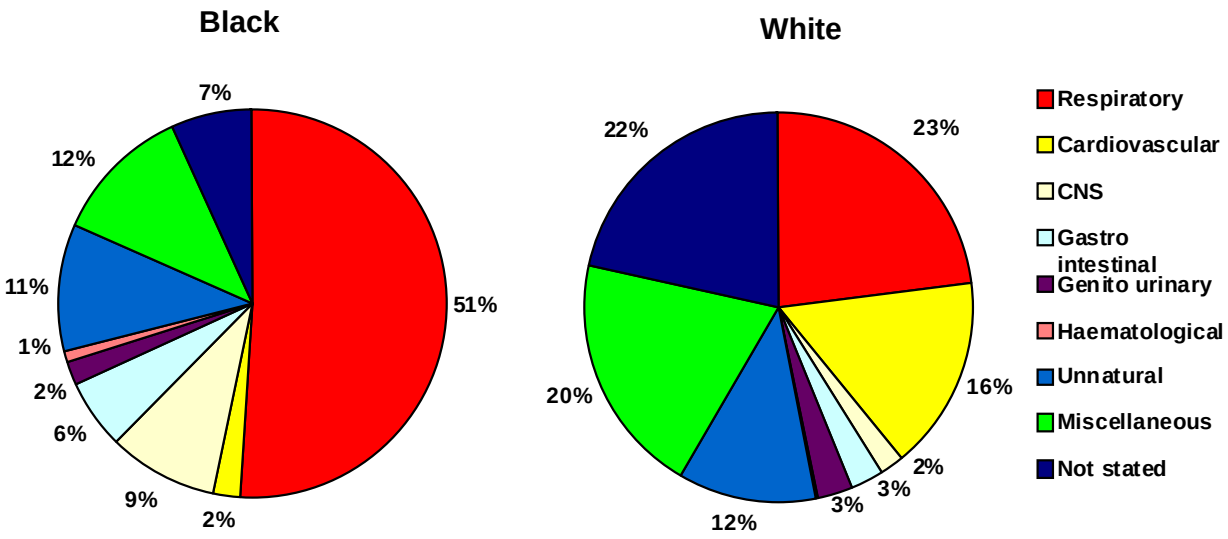

FIGURE 9-1 CLINICAL CAUSE OF DEATH AS STATED BY THE CLINICIANS WHO SUBMIT THE ORGANS OF THE DECEASED TO THE NIOH (2007)

SECTION 10 – AUTOPSY FINDINGS IN WOMEN

Of the 1 724 cases examined in 2006, 24 (1.4%) were women, similar to 22 (1.3%) in 206 but lower than in 2005 (n=43; 2.3%). Of these, 19 (79.2%) were black, 3 (12.5%) were white and 2 (8.3%) were coloured. The women who were autopsied were, on average, slightly older (54.4 years) than the men (50.7 years).

TABLE 10.1 NUMBERS AND PROPORTIONS OF AUTOPSIES IN WOMEN BY AGE AND POPULATION GROUP (2007)

Age group (years)	Black		White		Coloured		Total	
	N	%	N	%	N	%	N	%
20-29	3	15.8	0	-	0	-	3	12.5
30-39	2	10.5	0	-	0	-	2	8.3
40-49	5	26.3	0	-	0	-	5	20.8
50-59	3	15.8	0	-	0	-	3	12.5
60-69	2	10.5	0	-	1	50.0	3	12.5
70-79	3	15.8	3	100.0	1	50.0	7	29.2
80+	1	5.3	0	-	0	-	1	4.2
Total	19		3		2		24	

Table 10.2 summarises the distribution of autopsies in women by commodity and population group. The majority of the women (16 cases; 66.7%) had most exposure to asbestos with 9 (37.5%) exposed on the mines and 7 (29.2%) having had environmental exposure.

TABLE 10.2 NUMBER AND PROPORTION OF AUTOPSIES IN WOMEN BY COMMODITY AND POPULATION GROUP (2007)

Commodity	Black		White		Coloured		Total	
	N	%	N	%	N	%	N	%
Gold	3	15.8	0	-	0	-	3	12.5
Platinum	4	21.1	0	-	0	-	4	16.7
Coal	1	5.3	0	-	0	-	1	4.2
Asbestos	6	31.6	2	66.7	1	50.0	9	37.5
Other*	5	26.3	1	33.3	1	50.0	7	29.2
Total	19		3		2		24	

*All the cases in the category 'other' had exposure to asbestos in the environment

There were 4 cases of asbestosis and 5 of mesothelioma (Table 10.3). None had asbestos plaques.

TABLE 10.3 NUMBER AND PROPORTION OF DISEASES IN WOMEN (2007)

Disease	N	%
Mesothelioma	5	20.8
Asbestosis	4	16.7
Emphysema	5	20.8
PTB	5	20.8
Silicosis	2	8.3
Lung cancer	1	4.2
No lung disease	2	8.3
Total	24	

APPENDIX 1: DISTRIBUTION OF AUTOPSIES ACCORDING TO THE LAST MINE WHERE THE DECEASED WORKED (2007)

Commodity	Last mine worked	Black	White	Coloured	Unknown	Total
Asbestos	African Chrysolite Asbestos		1			1
	Asbestos Mine		4			4
	Black Rock Asbestos Mine		1			1
	Cape Blue	1		1		2
	Danielskuil Asbestos mine	1				1
	Everite	1				1
	Gefco	51	3	3		57
	Koegas	1		3		4
	Penge Asbestos	2	2			4
	Pomfret Asbestos Mine		1			1
Total from asbestos mines		**57**	**12**	**7**	**0**	**76**
Chrome	Chrome Mine	1	2			3
	Eastern Chrome Mine	1				1
	Samancor Western Chrome		2			2
Total from chrome mines		**2**	**4**	**0**	**0**	**6**
Coal	Amcoal Colliery	1				1
	Arnot Colliery	2	1			3
	Coal Mine		2			2
	Coalbrook Colliery		1			1
	Cornelia Colliery		1			1
	Douglas Colliery		3			3
	Durban Navigation Colliery		1			1
	Duvha Opencast		1			1
	Ermelo Coal		2			2
	Gloria Colliery	1				1
	Goedehoop Colliery	2	2			4
	Greenside Colliery	1	3			4
	Hlobane Colliery		1			1
	Kleinkopje Colliery	4				4
	Koornfontein Coal		4			4
	Kriel Colliery	1				1
	Khutala Colliery		1			1
	Landau Colliery	1	1			2
	Matla Coal	9	2	1		12
	Natal Anthracite Colliery		2			2
	New Denmark	3				3
	New Vaal Colliery		1			1
	Phoenix Colliery		1			1
	Rietspruit Colliery		1			1
	Sasol Coal Mine	2				2
	Sigma Colliery		1			1

Commodity	Last mine worked	Black	White	Coloured	Unknown	Total
Coal (continued)	Spitzkop		1			1
	Springbok Colliery		1			1
	Springfield Colliery		2			2
	Tselentis Coal Mine		1			1
	Tweefontein	1		1		2
	Twistdraai		1			1
	Usutu Colliery		1			1
	Van Dyk's Drift		1			1
	Vierfontein Colliery		1			1
	Vryheid Coronation Colliery		2			2
	Witbank Collieries		1			1
Total from coal mines		**28**	**44**	**2**	**0**	**74**
Copper	Bancroft Copper		2			2
	Copper Mine	1				1
	O`Kiep Copper		3	3		6
	Oamites Copper		1			1
	Phalaborwa	1				1
Total from copper mines		**2**	**6**	**3**	**0**	**11**
Diamond	Boart Drilling Diamond		2			2
	Cullinan Diamond Mine	1				1
	De Beers Consolidated		2			2
	Diamond Mine		1	1		2
Total from diamond mines		**1**	**5**	**1**	**0**	**7**
Gold	African Rainbow Minerals & Exploration	7	2			9
	Anglogold Business Service		1			1
	Anglogold Health Service (Free State)		1			1
	Anglogold Vaal River Operation		1			1
	Bambanani GM	9	2			11
	Barberton GM	1	1			2
	Beatrix Gold	133	7			140
	Blyvoorquizicht	2	9			11
	Buffelsfontein Gold		23			23
	Cementation	5	1			6
	Consolidated Modderfontein		1			1
	Crown Mines		1			1
	Daggasfontein		2			2
	Deelkraal		1			1
	Doringkop GM		1			1
	Doornfontein		3			3
	Driefontein Cons GM	21	2			23
	Durban Roodepoort Deep		9			9

Commodity	Last mine worked	Black	White	Coloured	Unknown	Total
Gold (continued)	East Driefontein	3	8			11
	East Rand Prop		13			13
	Elandsrand	1	6			7
	Elsburg GM	4				4
	Evander GM	42	1			43
	Freddies Gold	20	2			22
	Free State Geduld	5	17	1		23
	Free State Saaiplaas	1	4			5
	Geldenhuys Gold Mine		1			1
	Gencor		1			1
	Goldfields	1	1			2
	Grootvlei Prop	2	8			10
	Harmony	125	26	1		152
	Hartebeesfontein		14			14
	J.I.C. Gold Mine	3	2			5
	Joel	2	5			7
	Kinross	6	3			9
	Kloof	34	13			47
	Leeudoorn	1	3			4
	Leslie	1				1
	Libanon		6			6
	Loraine		5			5
	Marievale		1			1
	Masimong Gold Mine	9	1			10
	Middelburg GM	1				1
	Oryx	49	1			50
	Placer Dome GM	1	1			2
	President Brand	2	5			7
	President Steyn	10	14			24
	Randfontein	65	10	1		76
	Robinson Gold Mine		1			1
	S A Land		1			1
	Sallies		2			2
	Savuka GM		2			2
	Sheba		1			1
	Simmer & Jack GM	25	3			28
	South Deep GM	1	1			2
	St Helena	12	6			18
	Stilfontein		6			6
	Sub Nigel		1			1
	Tautona GM	1	1			2
	Target Gold Mine		1			1
	Tshepone GM	2				2
	Ubuntu Small Scale GM		1			1
	Unisel GM		1			1
	Vaal Reefs	112	34			146

Commodity	Last mine worked	Black	White	Coloured	Unknown	Total
Gold (continued)	Ventersport		7			7
	Vlakfontein		2			2
	Welkom GM		3			3
	West Driefontein	1	10			11
	West Rand Consolidation		5			5
	West Witwatersrand		1			1
	Western Areas	1	11			12
	Western Deep Levels	3	19			22
	Western Holdings	1	5			6
	Winkelhaak	4	3			7
Total from gold mines		**729**	**368**	**3**	**0**	**1100**
Platinum	Amadelbult Platinum (Rustenburg)	3	4			7
	Barplats Refinery (Platinum)		1			1
	Deilmann Haniel SA (Northam)	1				1
	Eastern Platinum Mine		1			1
	Impala Platinum	161	11			172
	Impala Platinum Refinery		2			2
	Karee Platinum	1				1
	Kroondal Mine, Rustenburg	1	1			2
	Lebowa Platinum	7				7
	Lonmin Platinum		2			2
	Northam Platinum	19	2			21
	Rustenburg Platinum	103	21			124
	R.U.C. Platinum	1				1
	Swartklip Platinum		1			1
	Unknown Platinum	2	2			4
	Western Platinum		1			1
Total from platinum mines		**299**	**49**	**0**	**0**	**348**
Manganese	Manganese Mine	3				3
Aluminium	Samrec Annesley Mine	1				1
Iron	Beeshoek			1		1
Iron & Manganese	Associated Manganese	1	1			2
	S A Manganese	1	1			2
Lead & Minerals	Blackmountain	1		1		2
Lime	Union Lime			1		1
Quarries	Quarry Mine	1				1
Refinery	Rand Refinery	1	3			4
Sinkers	Shaft Sinkers	2	1			3
Steel & Vanadium	Highveld		1			1
Steel & Iron	Iscor		13	1		14
Zinc	Maranda Mine		1			1
	Zinc Corporation		1			1

Commodity	Last mine worked	Black	White	Coloured	Unknown	Total
Non-Miner	Environmental asbestos	8	2	1		11
	Eskom		1			1
	Industry		5			5
	Non-miner	1	1			2
	Spoornet		1			1
Unknown	Unknown	6	19		20	45
TOTAL		**1 144**	**539**	**21**	**20**	**1 724**

APPENDIX 2: PUBLICATIONS AND ACTIVITIES EMANATING FROM PATHAUT DATA (2007)

Journal articles

Published:

Honma K, Murray J, Nelson G. Intrapulmonary lymph nodes in South African miners - an autopsy survey. Am J Ind Med 2007; 50:261-264.

Rees D, Murray J. Silica, silicosis and tuberculosis. Int J Tuberc Lung Dis 2007; 11: 474-84.

White N, Nelson G, Murray J. South African experience with asbestos related environmental mesothelioma: Is asbestos fiber type important? Regul Toxicol Pharmacol 2007, doi:10.1016/j.yrtph.2007.09.013

Wong ML, Back P, Candy G, Nelson G, Murray J. Cryptococcal pneumonia in African miners at autopsy. Submitted to Int J Tuberc Lung Dis 2007; 11: 528-33.

Reports

Ndlovu N, Murray J, Candy G, Nelson G. Pathology Division Report: Demographic data and disease rates for January-December 2006. NIOH report 2/2007 ISSN 1812 - 7681. National Institute for Occupational Health, National Health Laboratory Service, South Africa, 2007

Congresses

Murray J, Sonnenberg P, Nelson G, Bester A, Shearer S, Glynn JR. Cause of death and respiratory disease at autopsy by duration of HIV infection in goldminers, South Africa. 38th Union World Conference on Lung Health, 8-12 November 2007, Cape Town, South Africa

Nelson G, Respiratory health risks of miners due to exposure to associated minerals in South Africa. Environmin 2007 Conference, 22-26 July 2007, Bakgatla, Pilanesberg

Ndlovu N, Mining a Database, Webster Memorial Day, 22 November 2007, NIOH, Johannesburg

Ndlovu N, Ramotse W, Ex-miners outreach campaign, Research Forum, 31 May 2007, NIOH, Johannesburg

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