NATIONAL INSTITUTE FOR OCCUPATIONAL HEALTH

Pathology Division Surveillance Report: Demographic Data and Disease Rates for January to December 2008

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EXECUTIVE SUMMARY

During 2008, 1 800 cases came to autopsy at the NIOH. Of these, 65.8% were black men, 30.9% were white, 0.6% were coloured and 2.7% were submitted without information on population group.

In 2008, a consignment of 102 sets of cardio-respiratory organs belonging to people who had died in and around the asbestos-mining Kuruman District in the Northern Cape were sent to the NIOH for examination. The pathological findings have been included in this report and account for the higher overall rates of asbestosis and mesothelioma observed in 2008.

The overall disease rates (per 1000 autopsies) for 2008 are shown in Figure 1.

FIG.1 OVERALL DISEASE RATES FOR 2008

The overall rate of pulmonary tuberculosis (PTB) in 2008 (256/1000) was lower than that in 2007 (274/1000). The rate in black gold miners has increased annually from 379/1000 in 2006 to 437/1000 in 2008. The rate in black platinum miners decreased from 335/1000 in 2007 to 315/1000 in 2008.

Over the last three years the overall silicosis rates have decreased from 237/1000 in 2006 to 229/1000 in 2007 to 216/1000 in 2008. However, over the same period, the rates in black gold miners have increased from 327/1000 in 2006 to 338/1000 in 2007 to 378/1000 in 2008.

Since 2007 miners have been classified as current and ex-miners. In 2008, 714 cases (39.7%) were ex-miners; 908 (50.4%) were current miners and 178 cases (9.9%) could not be classified.

Forty one women came to autopsy in 2008, 56% of whom had diseases related to asbestos exposure in mining or in the environment.

The type (commodity) and duration exposure was not provided for 24 (1.3%) and 34 (1.9%) of the cases respectively. For 52 (2.9%) of the cases the last mine worked was not provided.

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 2008, staff from the Pathology Division attended two meetings in Lesotho with various organisations and representatives from the Ministries of Health and Social Welfare, and Labour and Employment. The aim was to inform them about autopsy compensation. Procedures are now in place for the removal of cardio-respiratory organs in Lesotho and submission to the NIOH

During 2008, one journal article utilising the PATHAUT data was published and research findings were presented at a number of fora (see Appendix 2). PATHAUT data was used for a research project for A PhD based on the PATHAUT data was registered in 2005 (University of the Witwatersrand) and is on course.

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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 simultaneous 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
Environmental asbestos exposure	This is non-occupational asbestos exposure. Such cases are examined at the NIOH but are not submitted to the MBOD for compensation.

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 twelfths consecutive annual report and describes autopsy cases examined during the year 2008. 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 - 2008)

Year of autopsy	Black		White		Coloured		Indian		Unknown		Total
	N	%	N	%	N	%	N	%	N	%	N
1975	2 190	71.0	854	28.0	32	1.0					3 076
1976	2 335	68.0	1 072	31.0	27	1.0					3 434
1977	2 351	69.0	1 039	30.0	33	1.0					3 423
1978	2 245	67.0	1 090	32.0	32	1.0					3 367
1979	2 118	66.0	1 026	33.0	45	1.0					3 189
1980	2 338	64.0	1 274	35.0	46	1.0					3 658
1981	2 209	66.0	1 117	33.0	33	1.0					3 359
1982	2 312	63.0	1 302	36.0	44	1.0					3 658
1983	2 096	65.0	1 109	34.0	41	1.0					3 246
1984	1 966	64.0	1 098	36.0	28	1.0					3 092
1985	2 275	64.0	1 200	34.0	66	2.0					3 541
1986	2 456	68.0	1 125	31.0	45	1.0					3 626
1987	2 594	68.0	1 168	30.0	78	2.0					3 840
1988	2 518	67.0	1 165	31.0	77	2.0					3 760
1989	2 138	65.0	1 090	33.0	60	2.0					3 288
1990	2 172	64.0	1 155	34.0	51	2.0					3 378
1991	2 143	65.0	1 080	33.0	66	2.0					3 289
1992	2 144	66.0	1 049	32.0	70	2.0					3 263
1993	1 863	65.0	956	33.0	65	2.0					2 884
1994	1 737	61.0	1 021	36.0	94	3.0					2 852
1995	2 830	71.0	1 059	27.0	99	2.0					3 988
1996	2 154	66.5	960	29.6	56	1.7			69	2.1	3 239
1997	2 223	69.0	897	28.0	70	2.0			18	0.6	3 208
1998	1 977	69.0	836	29.0	49	2.0	1		17	0.6	2 880
1999	1 656	65.0	832	33.0	29	1.0			12	0.5	2 529
2000	1 798	69.0	761	29.0	41	2.0			8	0.3	2 608
2001	1 690	67.0	813	32.0	13	1.0			13	0.5	2 529
2002	1 677	67.0	763	30.0	50	2.0			28	1.1	2 518
2003	1 536	66.0	745	32.0	23	1.0	1		13	0.6	2 318
2004	1 428	69.0	596	29.0	22	1.0	1		8	0.4	2 055
2005	1 274	68.0	562	30.0	22	1.0			18	1.0	1 876
2006	1 165	67.7	535	31.1	11	0.6			9	0.5	1 720
2007	1 144	66.4	539	31.3	21	1.2			20	1.2	1 724
2008	1 185	65.8	556	30.9	11	0.6			48	2.7	1 800
Total	67 937	66.5	32 444	31.7	1 550	1.5	3		281	0.3	102 215

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 155 821 in 2008.

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 2008. Autopsies of only the cardio-respiratory organs comprised 96.9% of all examinations.

TABLE 2-2 NUMBER AND PROPORTION OF AUTOPSIES BY TYPE AND POPULATION GROUP (2008)

Autopsy type	Black		White		Coloured		Unknown		Total	
	N	%	N	%	N	%	N	%	N	%
Cardio-respiratory organs only	1 183	99.8	503	90.5	11	100	48	100	1745	96.9
Full autopsy	2	0.2	53	9.5	0	-	0	-	55	3.1
Total	1 185		556		11		48		1 800	

The age distribution of autopsies for 2008 is shown in Table 2-3 and Figure 2-1. The mean age at autopsy of black men was higher (48.0 years) than in the previous 4 years when it was around 44 years. The mean age of white men at autopsy increased from 63.9 in 2007 to 66.0 years in 2008.

TABLE 2-3 NUMBER AND PROPORTION OF AUTOPSIES BY AGE AND POPULATION GROUP (2008)

Age group	Black		White		Coloured		Unknown		Total	
(years)	N	%	N	%	N	%	N		N	%
20-29	40	3.4	3	0.5	0	-	0	-	43	2.4
30-39	207	17.5	11	2.0	0	-	0	-	218	12.1
40-49	427	36.0	54	9.7	1	9.1	0	-	482	26.8
50-59	345	29.1	93	16.7	3	27.3	0	-	441	24.5
60-69	77	6.5	155	27.9	5	45.5	1	2.1	238	13.2
70-79	37	3.1	154	27.7	1	9.1	0	0.0	192	10.7
80+	14	1.2	79	14.2	1	9.1	0	-	94	5.2
Unknown	38	3.2	7	1.3	0	-	47	97.9	92	5.1
Total	1 185		556		11		48		1 800	

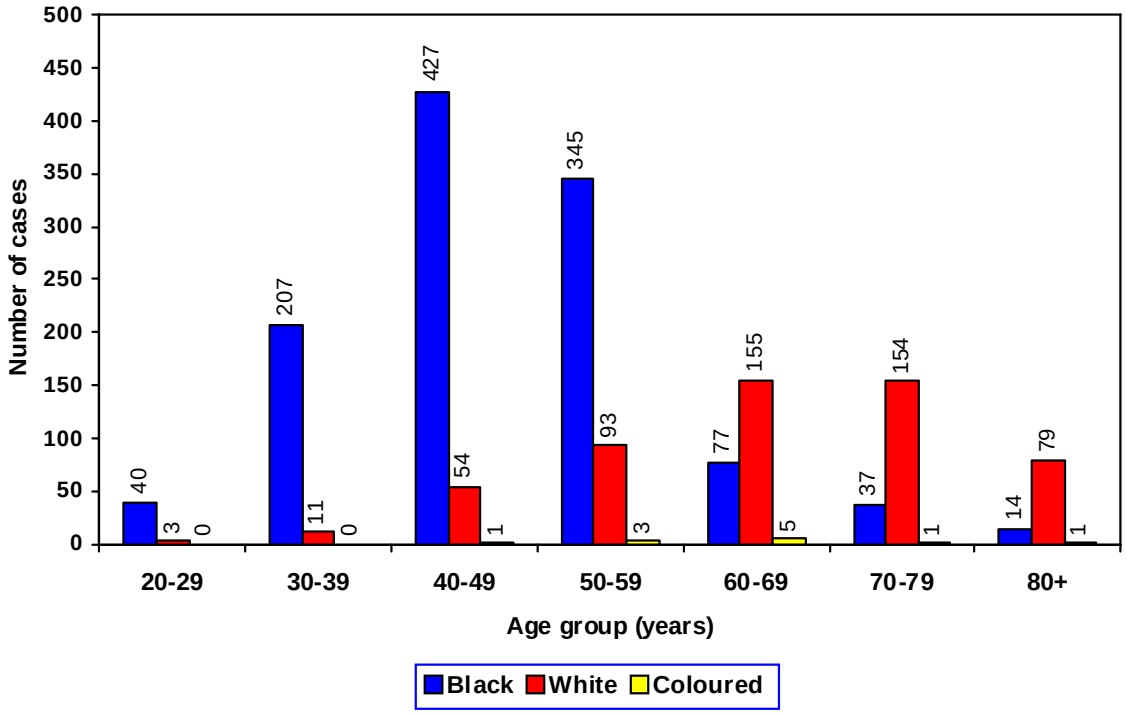

FIG 2-1 DISTRIBUTION OF AUTOPSIES BY AGE AND POPULATION GROUP (2008)

Cases were placed in categories according to the commodity in which they had worked for the longest duration (most exposure). 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).

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 in 2008, comprise 27 cases in blacks, five in whites, one in coloureds and 14 with unknown population group.

Table 2-4 and Figure 2-2 show the distributions of autopsies by commodity and population group for 2008. The percentage of autopsies received from the gold mining industry was 56.3% compared to 66.5% in 2007. The percentage of autopsies from the platinum industry has increased over the years, from 8.3% in 1999 to 16.4% in 2008. Unlike in previous years, few of the coloured people who came to autopsy had been exposed to asbestos: 2 (18.2%) in the asbestos mines and 1 (9.1%) in the environment.

TABLE 2-4 NUMBER AND PROPORTION OF AUTOPSIES BY COMMODITY AND POPULATION GROUP (2008)

Commodity	Black		White		Coloured		Unknown		Total	
	N	%	N	%	N	%	N	%	N	%
Gold	643	54.3	369	66.4	1	9.1	1	2.1	1014	56.3
Platinum	251	21.2	44	7.9	0	-	0	-	295	16.4
Coal	48	4.1	42	7.6	0	-	0	-	90	5.0
Asbestos	182	15.4	23	4.1	2	18.2	18	37.5	225	12.5
Iscor	3	0.3	13	2.3	0	0.0	0	-	16	0.9
Diamond	2	0.2	8	1.4	1	9.1	0	-	11	0.6
Copper	1	0.1	9	1.6	2	18.2	0	-	12	0.7
Manganese	12	1.0	5	0.9	2	18.2	0	-	19	1.1
Industry	4	0.3	6	1.1	1	9.1	0	-	11	0.6
Other	35	3.0	21	3.8	2	18.2	15	31.3	73	4.1
Unknown	4	0.3	16	2.9	0	-	14	29.2	34	1.9
Total	1 185		556		11		48		1 800	

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

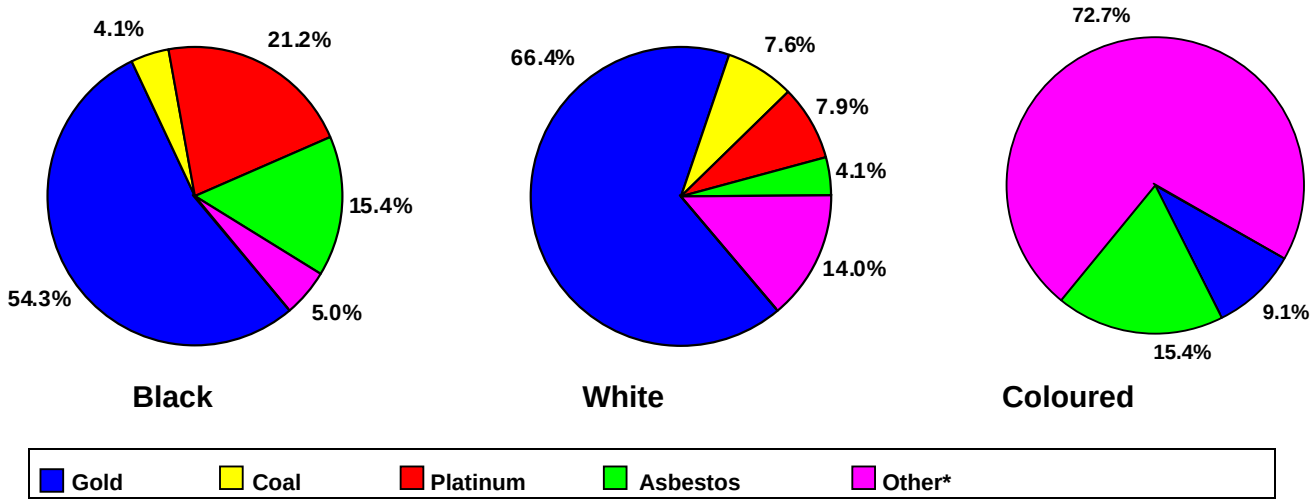

FIG 2-2 DISTRIBUTION OF AUTOPSIES BY COMMODITY AND POPULATION GROUP (2008)

* Includes copper, diamond, Eskom, environmental asbestos, industry, iron, Iscor, lead, lime, manganese, phosphate, quarry, railways, silica, steel, 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 2008, the duration of service was obtained for all but 9.3% of the cases. This figure is higher than that for 2007 (6.0%).

TABLE 2-5 NUMBER AND PROPORTION OF AUTOPSIES BY YEARS OF SERVICE AND POPULATION GROUP (2008)

Years of service	Black		White		Coloured		Unknown		Total	
	N	%	N	%	N	%	N	%	N	%
<1	37	3.1	5	0.9	2	18.2	0	-	44	2.4
1-5	223	18.8	34	6.1	4	36.4	0	-	261	14.5
6-10	138	11.6	47	8.5	1	9.1	0	-	186	10.3
11-15	176	14.9	61	11.0	1	9.1	1	2.1	239	13.3
16-20	226	19.1	77	13.8	0	-	0	-	303	16.8
21-25	179	15.1	85	15.3	1	9.1	0	-	265	14.7
26-30	93	7.8	83	14.9	2	18.2	0	-	178	9.9
31-35	31	2.6	58	10.4	0	-	0	-	89	4.9
36-40	9	0.8	31	5.6	0	-	0	-	40	2.2
41+	0	-	28	5.0	0	-	0	-	28	1.6
Unknown	73	6.2	47	8.5	0	-	47	97.9	167	9.3
Total	1 185		556		11		48		1 800	

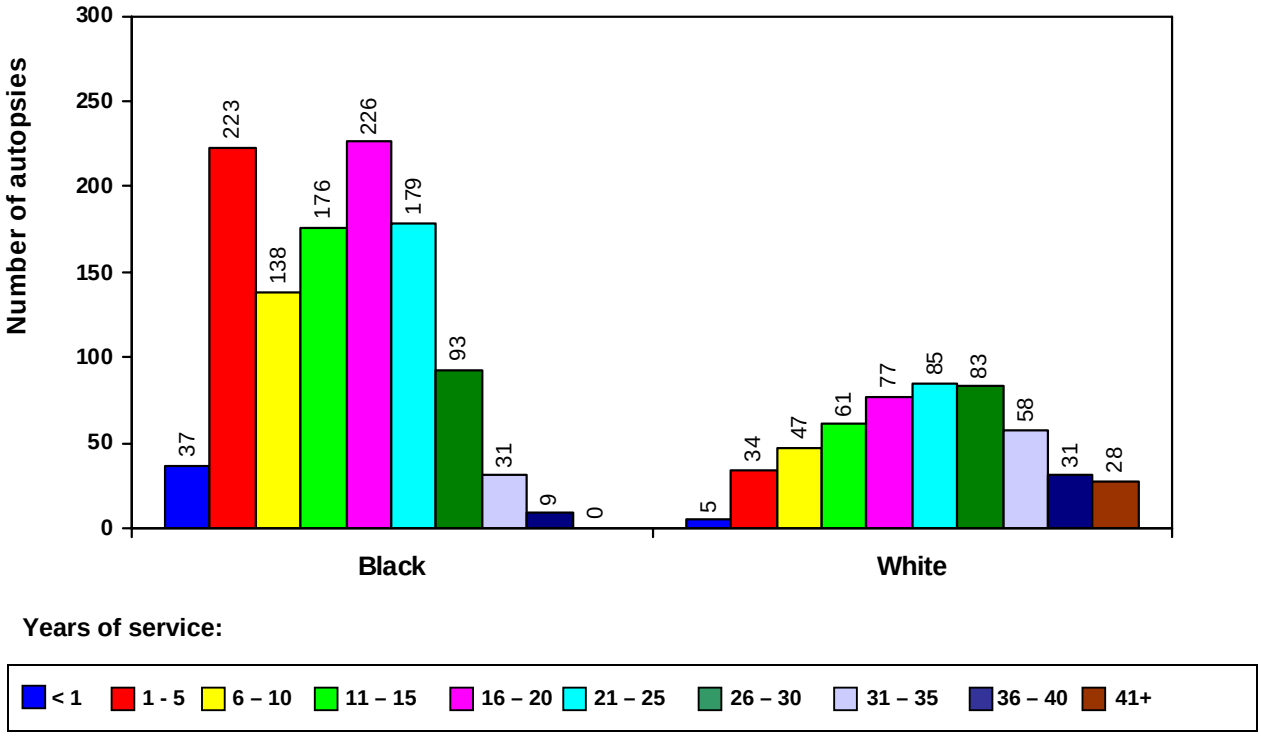

FIG 2-3 DISTRIBUTION OF AUTOPSIES BY YEARS OF SERVICE AND POPULATION GROUP (2008)

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 (2008)

Commodity	Black			White		
	N	Mean (years)	SD*	N	Mean (years)	SD*
Gold	634	45	8	369	67	13
Platinum	250	44	9	44	59	14
Coal	48	49	8	42	63	13
Asbestos	165	61	12	21	66	11
Iscor	3	59	8	13	68	12
Diamond	2	67	6	8	62	14
Copper	1	64	-	9	75	8
Manganese	12	56	8	5	57	9
Industry	4	54	14	6	60	7
Other	26	57	16	17	67	11
Unknown	2	38	20	15	67	16
Total	1 147	48	11	549	66	13

* Standard deviation

TABLE 2-7 MEAN DURATION OF SERVICE BY COMMODITY AND POPULATION GROUP (2008)

Commodity	Black			White		
	N	Mean (years)	SD*	N	Mean (years)	SD*
Gold	635	17	8	356	24	11
Platinum	243	13	9	41	14	11
Coal	47	19	9	39	24	11
Asbestos	155	7	8	21	11	10
Iscor	3	6	7	11	24	8
Diamond	2	21	12	7	14	6
Copper	1	17	-	8	17	9
Manganese	12	16	11	5	17	7
Industry	3	12	7	6	20	9
Other	11	15	12	15	21	10
Total	1 112	16	8	509	23	11

*Standard deviation

SECTION 3 – ACTIVE TUBERCULOSIS

The distribution of active tuberculosis (TB) by anatomical site is presented in Figure 3-1 (n=522). Active pulmonary TB (PTB) was diagnosed in 25.6% (460) of all cases autopsied in 2008, compared to 16.4% (416) in 2000. Most of the men with PTB were black (92.4%; 425 cases), 5.2% (24 cases) were white, 0.4% (2 cases) were coloured and in 2.0% (9 cases) the population group was unknown.

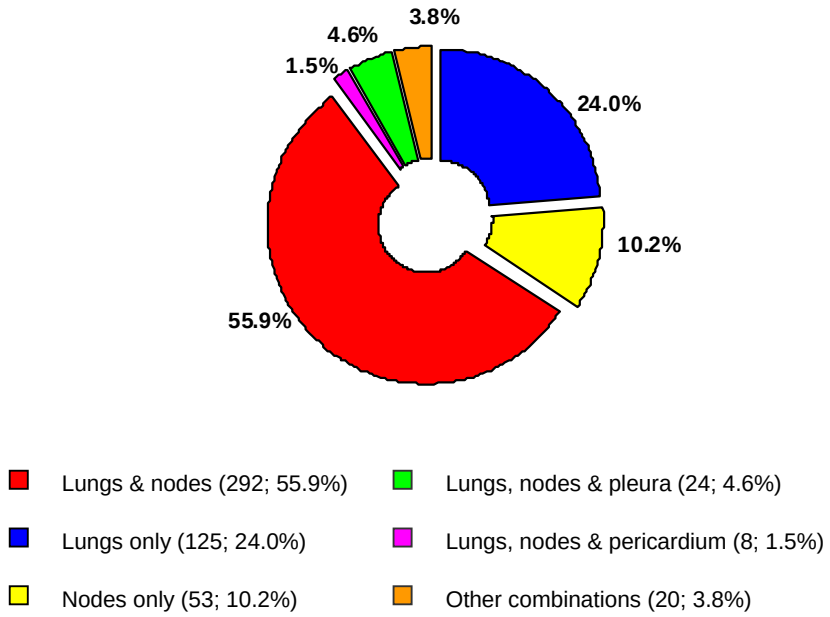

FIG 3-1 DISTRIBUTION OF ACTIVE TB BY SITE (2008)

The rates in subsequent tables and figures are expressed per 1000.

In previous years, annual increases in PTB rates were observed and these were attributed to the increased rates in black men. In 2008, however, the overall rate of PTB decreased to 256/1000 from 274/1000 in 2007 (Fig 3-2). Decreased PTB rates were observed in both black (359/1000 in 2008 compared to 368/1000 in 2007) and white men (43/1000 compared to 83/1000 in 2007). While the rate in black gold miners increased (437/1000 in 2008 from 406/1000 in 2007), it decreased in black platinum miners (315/1000 in 2008 from 335/1000 in 2007)

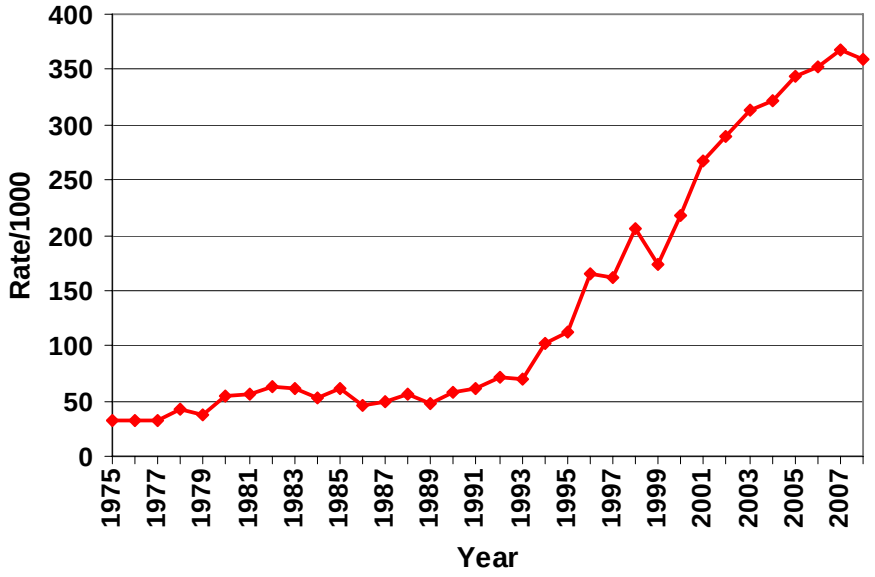

FIG 3-2 ACTIVE PTB RATES IN BLACK MINERS AT AUTOPSY (1975 to 2008)

The distribution of active PTB cases by commodity is shown in Table 3-1. The majority of active PTB cases (64.8%) came from the gold mining industry (56.3% of all autopsy cases came from that commodity).

TABLE 3-1 NUMBER OF CASES AND PREVALENCE OF ACTIVE PTB BY COMMODITY AND POPULATION GROUP (2008)

Commodity	Black		White		Coloured		Unknown		Total	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
Gold	281	437	17	46	0	-	0	-	298	294
Platinum	79	315	3	68	0	-	0	-	82	278
Coal	13	271	0	-	0	-	0	-	13	144
Asbestos	41	225	2	87	0	-	6	333	49	218
Other	8	229	2	95	0	-	3	200	13	178
Copper	0		0		1		0		1	
Diamond	1		0		0		0		1	
Manganese	1		0		0		0		1	
Industry	0		0		1		0		1	
Unknown	1		0		0		0		1	
Total	425	359	24	43	2	182	9	188	460	256

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 PTB cases (n=175; 38.0%) were in the age group 40-49 years, followed by those in the 50-59 year age group (n=124; 27.0%).

TABLE 3-2 NUMBER OF CASES AND PREVALENCE OF ACTIVE PTB BY AGE AND POPULATION GROUP (2008)

Age group (years)	Black		White		Coloured		Unknown		Total	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
20-29	13	325	0	-	0	-	0	-	13	302
30-39	86	415	1	91	0	-	0	-	87	399
40-49	172	403	3	56	0	-	0	-	175	363
50-59	119	345	5	54	0	-	0	-	124	281
60-69	18	234	6	39	2	400	0	-	26	109
70-79	5	135	8	52	0	-	0	-	13	68
80+	3	214	0	-	0	-	0	-	3	32
Unknown	9	237	1	143	0	-	9	191	19	207
Total	425	359	24	43	2	182	9	188	460	256

SECTION 4 – SILICOSIS

Silicotic nodules were found in the lungs of 388 cases (21.6% of all autopsies), 86.1% of which came from the gold mining industry. Of all cases of silicosis, occasional silicotic nodules were found in 49.1% of cases, a few in 22.2%, a moderate number in 25.8% and a large number in 2.8%.

The distribution of cases with silicosis by commodity and population group is presented in Table 4-1.

TABLE 4-1 NUMBER OF CASES AND PREVALENCE OF SILICOSIS BY COMMODITY AND POPULATION GROUP (2008)

Commodity	Black		White		Coloured		Unknown		Total	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
Gold	243	378	91	247	0	-	0	-	334	329
Platinum	11	44	2	45	0	-	0	-	13	44
Coal	3	63	1	24	0	-	0	-	4	44
Asbestos	15	82	1	43	1	500	4	222	21	93
Iscor	1		0		0		0		1	
Diamond	0		1		0		0		1	
Copper	0		0		2		0		2	
Manganese	1		0		0		0		1	
Other	2		3		0		2		7	
Unknown	0		2		0		2		4	
Total	276	233	101	182	3	273	8	167	388	216

Note: rates have not been calculated where numbers are small

Silicosis in gold miners is shown in the following tables. The rate of silicosis in gold miners increased from 303/1000 in 2007 to 329/1000 in 2008. 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). In black men, silicosis was diagnosed among younger men (<40 years) and in those who were exposed to silica for only 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 (2008)

Age group (years)	Black		White		Coloured		Unknown		Total	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
20-29	1	43	0	-	0	-	0	-	1	42
30-39	10	75	0	-	0	-	0	-	10	70
40-49	121	419	3	88	0	-	0	-	124	384
50-59	103	592	7	135	0	-	0	-	110	487
60-69	5	500	25	236	0	-	0	-	30	259
70-79	3	750	35	318	0	-	0	-	38	333
80+	0	-	21	362	0	-	0	-	21	356
Total	243	378	91	247	0		0		334	329

TABLE 4-3 NUMBER OF CASES AND PREVALENCE OF SILICOSIS IN THE GOLD MINING INDUSTRY, BY YEARS OF SERVICE AND POPULATION GROUP (2008)

Years of service	Black		White		Coloured		Unknown		Total	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
<1	2	222	0	-	0	-	0	-	2	200
1-5	6	80	0	-	0	-	0	-	6	68
6-10	13	194	6	214	0	-	0	-	19	198
11-15	31	292	8	211	0	-	0	-	39	271
16-20	73	453	12	226	0	-	0	-	85	397
21-25	66	508	14	246	0	-	0	-	80	428
26-30	35	565	19	264	0	-	0	-	54	403
31-35	14	667	13	283	0	-	0	-	27	403
36-40	2	500	7	292	0	-	0	-	9	321
41+	0	-	8	333	0	-	0	-	8	333
Unknown	1	125	4	308	0	-	0	-	5	227
Total	243	378	91	247	0		0		334	329

SECTION 5 – OTHER PNEUMOCONIOSES

MASSIVE FIBROSIS

There were 19 (1.1%) cases of massive fibrosis (10 black, 9 white). Sixteen were from the gold mining industry, one from coal, one from asbestos and one from platinum.

COAL WORKERS' PNEUMOCONIOSIS

There were five (0.3%) cases of coal workers' pneumoconiosis. Four were from coal and one was from the platinum mining industry.

MIXED DUST PNEUMOCONIOSIS

There were seven (0.4%) cases of mixed dust pneumoconiosis. Five were from gold, one from copper and one from the diamond mining industry.

ASBESTOSIS AND PLEURAL PLAQUES

There were 152 cases of asbestosis compared to 52 in 2008. The increase is due to the large consignment of cases that were submitted from the Kuruman District, a former asbestos mining area. Most of these cases did not have complete accompanying information and this accounts for the higher number of cases with unknown age and service. Of the asbestosis cases, 58.6% (n=89) had slight, 34.2% (n=52) moderate and 7.2% (n=11) marked fibrosis. One hundred and twenty four (81.6%) of these cases had worked in the asbestos mining industry at some time in their lives and 12 (7.9%) had been exposed to asbestos in the environment.

There were 62 cases with asbestos plaques and of these 31 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 (2008)

Age group (years)	Black		White		Coloured		Unknown		Total	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
40-49	9	21	0	-	0	-	0	-	9	19
50-59	31	90	3	32	0	-	0	-	34	77
60-69	38	494	4	26	0	-	1	1000	43	181
70-79	24	649	8	52	1	1000	0	-	33	172
80+	5	357	2	25	0	-	0	-	7	74
Unknown	13	342	1	143	0	-	12	255	26	283
Total	120	128	18	33	1	91	13	271	152	84

SECTION 6 – EMPHYSEMA

There were 508 cases of emphysema, the extent of which was mild in 88.4% (n=449), moderate in 11.0% (n=56) and marked in 0.6% (n=3). The overall rate of emphysema (282/1000) was similar to that in 2007 (284/1000). 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 (2008)

Age group (years)	Black		White		Coloured		Unknown		Total	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
20-29	1	25	0	-	0	-	0	-	1	23
30-39	14	68	0	-	0	-	0	-	14	64
40-49	81	190	8	148	0	-	0	-	89	185
50-59	111	322	28	301	2	667	0	-	141	320
60-69	26	338	63	406	2	400	1	1000	92	387
70-79	16	432	84	545	1	1000	0	-	101	526
80+	3	214	39	494	1	1000	0	-	43	457
Unknown	10	263	3	429	0	-	14	298	27	293
Total	262	221	225	405	6	545	15	313	508	282

The majority of black and white men with emphysema were from the gold mining industry (57.7%, n=293) (Table 6-2).

TABLE 6-2 NUMBER OF CASES AND PREVALENCE OF EMPHYSEMA BY COMMODITY AND POPULATION GROUP (2008)

Commodity	Black		White		Coloured		Unknown		Total	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
Gold	133	207	159	431	1	1000	0	-	293	289
Platinum	35	139	18	409	0	-	0	-	53	180
Coal	23	479	9	214	0	-	0	-	32	356
Asbestos	53	291	9	391	2	1000	7	389	71	316
Diamond	0		3		0		0		3	
Copper	1		5		2		0		8	
Iscor	1		7		0		0		8	
Manganese	4		0		1		0		5	
Industry	1		4		0		0		5	
Other	9		6		0		2		17	
Unknown	2		5		0		6		13	
Total	262	221	225	405	6	545	15	313	508	282

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 (2008)

Years of service	Black		White		Coloured		Unknown		Total	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
<1	5	135	3	600	0	-	0	-	8	182
1 - 5	35	157	8	235	2	500	0	-	45	172
6-10	30	217	16	340	1	1000	0	-	47	253
11-15	29	165	27	443	1	1000	1	1000	58	243
16-20	45	199	32	416	0	-	0	-	77	254
21-25	55	307	38	447	0	-	0	-	93	351
26-30	33	355	32	386	2	1000	0	-	67	376
31-35	11	355	20	345	0	-	0	-	31	348
36-40	2	222	16	516	0	-	0	-	18	450
41+	0	-	14	500	0	-	0	-	14	500
Unknown	17	233	19	404	0	-	14	298	50	299
Total	262	221	225	405	6	545	15	313	508	282

SECTION 7 – MESOTHELIOMA

The number of cases of mesothelioma in 2008 (n=48) was higher than that in 2007 (n=22). Fourteen of these were from the consignment of cardio-respiratory organs received from Kuruman.

TABLE 7-1 NUMBER AND PROPORTION OF MESOTHELIOMA CASES BY AGE AND POPULATION GROUP (2008)

Age group (years)	Black		White		Coloured		Unknown		Total	
	N	%	N	%	N	%	N	%	N	%
40-49	6	19	0	-	0	-	0	-	6	13
50-59	13	42	1	9	1	100	0	-	15	31
60-69	5	16	4	36	0	-	0	-	9	19
70-79	4	13	3	27	0	-	0	-	7	15
80+	1	3	2	18	0	-	0	-	3	6
Unknown	2	6	1	9	0	-	5	100	8	17
Total	31		11		1		5		48	

The distribution of mesothelioma by commodity and population group is presented in Table 7.2. Thirty (62.5%) of the miners had worked in asbestos mines at some stage in their careers and seven (14.6%) had been exposed to asbestos in the environment.

TABLE 7-2 NUMBER AND PROPORTION OF MESOTHELIOMA CASES BY COMMODITY AND POPULATION GROUP (2008)

Commodity	Black		White		Coloured		Unknown		Total	
	N	%	N	%	N	%	N	%	N	%
Asbestos	19	61	3	27	0	-	0	-	22	46
Platinum	3	10	0	-	0	-	0	-	3	6
Coal	0	-	3	27	0	-	0	-	3	6
Diamond	0	-	1	9	0	-	0	-	1	2
Iscor	1	3	0	-	0	-	0	-	1	2
Manganese	4	13	0	-	1	100	0	-	5	10
Industry	1	3	0	-	0	-	0	-	1	2
Other	3	10	4	36	0	-	4	80	11	23
Unknown	0	-	0	-	0	-	1	20	1	2
Total	31		11		1		5		48	

SECTION 8 – PRIMARY LUNG CANCER

Sixty four cases of primary lung cancer were found at autopsy, 40.6% of which were in black, 56.3% in white and 3.1% in men whose population group was not known. Most of the cases were squamous cell lung carcinomas (n = 24; 37.5%), followed by large cell lung carcinomas (n = 16; 25.0%), adenocarcinomas (n = 16; 25.0%) and small cell lung carcinomas (n = 8; 12.5%).

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 (2008)

Age group (years)	Black		White		Unknown		Total	
	N	Rate	N	Rate	N	Rate	N	Rate
40-49	2	5	0	-	0	-	2	4
50-59	7	20	6	65	0	-	13	29
60-69	9	117	11	71	0	-	20	84
70-79	4	108	11	71	0	-	15	78
80+	2	143	7	89	0	-	9	96
Unknown	2	53	1	143	2	43	5	54
Total	26	22	36	65	2	42	64	36

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 and asbestos mining industries.

TABLE 8-2 NUMBER OF CASES AND PREVALENCE OF PRIMARY LUNG CANCER BY COMMODITY AND POPULATION GROUP (2008)

Commodity	Black		White		Unknown		Total	
	N	Rate	N	Rate	N	Rate	N	Rate
Gold	4	6	24	65	0	-	28	28
Platinum	1	4	1	23	0	-	2	7
Coal	2	42	0	-	0	-	2	22
Asbestos	14	77	3	130	2	111	19	84
Copper	0		1		0		1	
Iscor	0		1		0		1	
Manganese	0		1		0		1	
Industry	0		1		0		1	
Other	5		3		0		8	
Unknown	0		1		0		1	
Total	26	22	36	65	2	42	64	36

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 (38.6%) overall. The proportion of unnatural deaths decreased from 11.0% in 2007 to 5.6% in 2008. The clinical cause of death was not stated in 18.1% of all cases.

TABLE 9-1 CLINICAL CAUSES OF DEATH BY POPULATION GROUP (2008)

System	Black		White		Coloured		Unknown		Total	
	N	%	N	%	N	%	N	%	N	%
Respiratory	549	46.3	137	24.6	7	63.6	1	2.1	694	38.6
Cardio-vascular	37	3.1	93	16.7	2	18.2	0	-	132	7.3
Central Nervous System	100	8.4	19	3.4	0	-	0	-	119	6.6
Gastro-intestinal	63	5.3	30	5.4	0	-	0	-	93	5.2
Genito-urinary	26	2.2	15	2.7	0	-	0	-	41	2.3
Haematological	6	0.5	2	0.4	0	-	0	-	8	0.4
Unnatural	65	5.5	35	6.3	0	-	1	2.1	101	5.6
Miscellaneous	198	16.7	87	15.6	1	9.1	0	-	286	15.9
Not stated	141	11.9	138	24.8	1	9.1	46	95.8	326	18.1
Total	1 185		556		11		48		1 800	

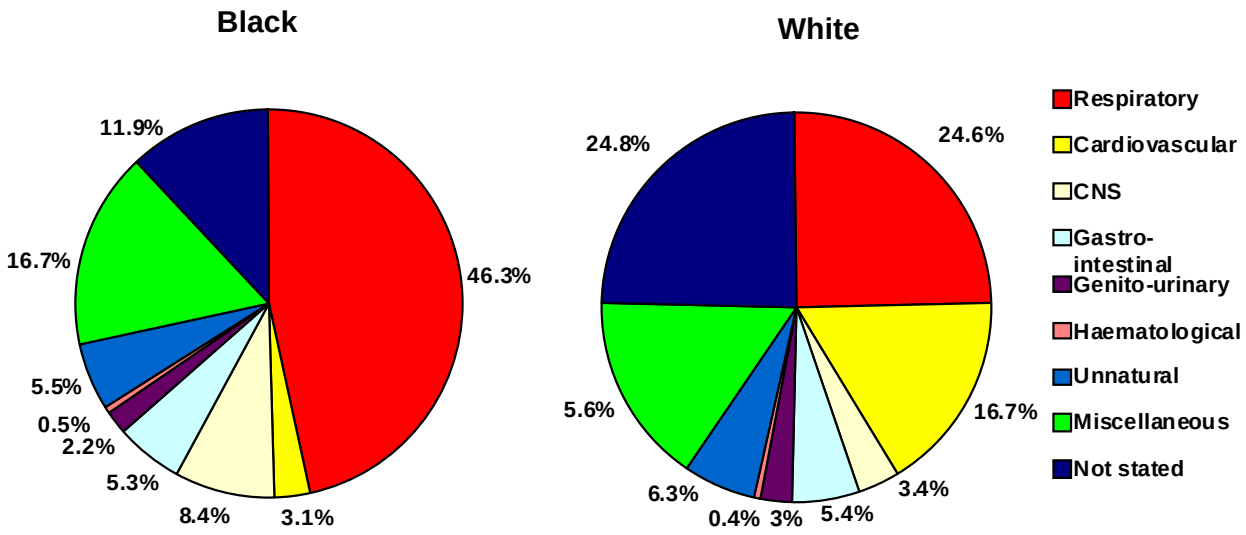

FIGURE 9-1 CLINICAL CAUSE OF DEATH AS STATED BY THE CLINICIANS WHO SUBMIT THE ORGANS OF THE DECEASED TO THE NIOH (2008)

SECTION 10 – AUTOPSY FINDINGS IN WOMEN

Of the 1 800 cases examined in 2008, 41 (2.3%) were women, compared to 24 (1.4%) in 2007. Of these, 38 (92.7%) were black, 2 (4.9%) were white and 1 (2.4%) was coloured. The women who were autopsied were, on average, older than the men (60.4 years versus 53.4 years).

TABLE 10.1 NUMBERS AND PROPORTIONS OF AUTOPSIES IN WOMEN BY AGE AND POPULATION GROUP (2008)

Age group (years)	Black		White		Coloured		Total	
	N	%	N	%	N	%	N	%
30-39	2	5.3	0	-	0	-	2	4.9
40-49	5	13.2	0	-	0	-	5	12.2
50-59	13	34.2	1	50.0	0	-	14	34.1
60-69	5	13.2	1	50.0	1	100.0	7	17.1
70-79	9	23.7	0	-	0	-	9	22.0
80+	3	7.9	0	-	0	-	3	7.3
Unknown	1	2.6	0	-	0	-	1	2.4
Total	38		2		1		41	

Table 10.2 summarises the distribution of autopsies in women by commodity and population group. The majority of the women (37 cases; 90.2%) had most exposure to asbestos with 27 (73.0%) exposed on the mines and 10 (27.0%) having had environmental exposure.

TABLE 10.2 NUMBER AND PROPORTION OF AUTOPSIES IN WOMEN BY COMMODITY AND POPULATION GROUP (2008)

Commodity	Black		White		Coloured		Total	
	N	%	N	%	N	%	N	%
Gold	3	7.9	0	-	0	-	3	7.3
Asbestos	27	71.1	0	-	0	-	27	65.9
Iscor	0	-	1	50.0	0	-	1	2.4
Environmental asbestos	8	21.1	1	50.0	1	100.0	10	24.4
Total	38		2		1		41	

There were 11 cases of asbestosis and seven of mesothelioma (Table 10.3). Two of the asbestosis cases had asbestos plaques.

TABLE 10.3 NUMBER AND PROPORTION OF DISEASES IN WOMEN (2008)

Disease	N	%
Mesothelioma	7	17.1
Asbestosis	11	26.8
Emphysema	10	24.4
PTB	5	12.2
Silicosis	2	4.9
Lung cancer	5	12.2
No lung disease	1	2.4
Total	41	

APPENDIX 1: DISTRIBUTION OF AUTOPSIES ACCORDING TO THE LAST MINE WHERE THE DECEASED WORKED (2008)

Commodity	Last mine worked	Black	White	Coloured	Unknown	Total
Asbestos	African Chrysotile Asbestos	3	2			5
	Asbestos Mine	1				1
	Black Rock Asbestos Mine			1		1
	Cape Blue	7				7
	Danielskuil Asbestos Mine	2	1			3
	Elandsfontein Asbestos Mine		1			1
	Everite	1	1			2
	Gefco	158	10	1	1	170
	Koegas	1	3	1		5
	Penge Asbestos	2	3			5
	Pomfret Asbestos Mine	1	1			2
	Prieska	1	1			2
	Wandrag Asbestos Mine	1				1
Total from asbestos mines		**178**	**23**	**3**	**1**	**205**
Chrome	Chrome Mine		2			2
Total from chrome mines		**0**	**2**	**0**	**0**	**2**
Coal	Amcoal Colliery		1			1
	Arnot Colliery	1	1			2
	Blinkpan Colliery		1			1
	Coal Mine	7	7			14
	Cornelia Colliery		1			1
	Delmas Colliery		1			1
	Douglas Colliery		2			2
	Durnacol Mine		2			2
	Duvha Opencast		1			1
	Ermelo Coal		3			3
	Goedehoop Colliery	6	2			8
	Greenside Colliery	3				3
	Hlobane Colliery		1			1
	Kleinkopje Colliery	3				3
	Koornfontein Coal	1	2			3
	Kriel Colliery	1	1			2
	Khutala Colliery		1			1
	Lakeside Colliery	2				2
	Leeufontein Colliery		1			1
	Matla Coal	13				13
	Middleburg Colliery		1			1
	Middlebult Coal Mine		1			1
	New Denmark	9				9

Commodity	Last mine worked	Black	White	Coloured	Unknown	Total
Coal (continued)	New Vaal Colliery		1			1
	Phoenix Colliery		1			1
	S A Coal Estates	3	1			4
	Sasol Coal Mine	2	5			7
	Sigma Colliery		1			1
	Slater Coal Mine		1			1
	Springbok Colliery		1			1
	Transvaal Navigation Colliery		1			1
	Twistdraai	1	1			2
	Witbank Collieries	1	2			3
Total from coal mines		**53**	**45**	**0**	**0**	**98**
Copper	O`Kiep Copper		3	2		5
	Messina Copper Mine		2			2
	Phalaborwa		2			2
Total from copper mines		**0**	**7**	**2**	**0**	**9**
Diamond	Bellsbank Diamond Mine		1			1
	Boart Drilling Diamond		1			1
	Cullinan Diamond Mine		1			1
	De Beers Consolidated		2			2
	Diamond Mine		1			1
	Finch Diamond Mine			1		1
	Helam Diamond Mine		1			1
	Premier Diamond		1			1
Total from diamond mines		**0**	**8**	**1**	**0**	**9**
Gold	African Rainbow Minerals & Exploration	1				1
	Anglogold Business Service		1			1
	Anglogold Great Noligwa	1				1
	Bambanani GM	6				6
	Beatrix Gold	135	5			140
	Blyvooruitzicht		9			9
	Bracken Mine		2			2
	Brakpan Gold Mine		1			1
	Buffelsfontein Gold	5	15			20
	Cementation		2			2
	City Deep		2			2
	Concor Plant Mine		1			1
	Chamber GM	1				1
	Consolidated Modderfontein		2			2
	Crown Mines	2	1			3
	Doornfontein		6			6

Commodity	Last mine worked	Black	White	Coloured	Unknown	Total
Gold (continued)	Driefontein Cons GM	11	8			19
	Durban Roodepoort Deep	1	5			6
	East Driefontein	1	5			6
	East Rand Prop	1	11			12
	Elandsrand		7			7
	Evander GM	9	1			10
	Freddies Gold	23				23
	Free State Geduld	1	14			15
	Free State Saaiplaas	2	2			4
	Gencor	6				6
	Gold Mine		2			2
	Goldfields		1			1
	Grinaker GM	1				1
	Grootvlei Prop		6	1		7
	Harmony	138	16			154
	Hartebeesfontein	2	16			18
	J.I.C. Gold Mine	1	4			5
	Joel		1			1
	Kinross	2	4			6
	Kopanong GM	1				1
	Kloof	13	16			29
	Leeudoorn		3			3
	Leslie	1				1
	Libanon	1	5			6
	Luipaardsvlei Estate GM		1			1
	Loraine	2	2			4
	Makojwaan Imperial GM		1			1
	Marievale		1			1
	Masimong Gold Mine	6	1			7
	Middelburg GM		2			2
	Modderfontein		1			1
	New Kleinfontein GM		1			1
	Oryx	41				41
	President Brand	1	3			4
	President Steyn	12	6			18
	Rand Leases		2			2
	Randfontein	45	15			60
	S A Land		1			1
	Savuka GM		1			1
	Simmer & Jack GM	36				36
	South Roodepoort		1			1
	South Deep GM		4			4
	Springs GM		1			1
	St Helena GM	3	3			6
	Stilfontein		8			8

Commodity	Last mine worked	Black	White	Coloured	Unknown	Total
Gold (continued)	Tshepong GM		1			1
	Unisel GM		1			1
	Vaal Reefs	100	34			134
	Ventersport		2			2
	Virginia GM		3			3
	Vlakfontein		3			3
	Waterpan GM		2			2
	Welkom GM	1	2			3
	West Driefontein	1	15			16
	West Rand Consolidated		7			7
	Western Areas		10			10
	Western Deep Levels		15			15
	Western Holdings	1	7			8
	Winkelhaak	1	2			3
Total from gold mines		**616**	**333**	**1**	**0**	**950**
Platinum	Amadelbult Platinum (Rustenburg)	2	1			3
	Atok Platinum	1				1
	Bafokeng	2				2
	Eastern Platinum Mine	7	1			8
	Impala Platinum	121	12			133
	Impala Platinum Refinery	1				1
	Karee Platinum	10				10
	Lebowa Platinum	7	2			9
	Lonmin Platinum	4	7			11
	Northam Platinum	12				12
	Rustenburg Platinum	96	26			122
	Unknown Platinum		3			3
	Waterval Platinum Mine		1			1
	Western Platinum	3	4			7
Total from platinum mines		**266**	**57**	**0**	**0**	**323**
Manganese	Manganese Mine	1				1
	Hotazel Manganese Mine	2		1		3
Iron & Manganese	Associated Manganese	1	1	1		3
	S A Manganese	1	4			5
Lead & Minerals	Blackmountain		1			1
Lime	Idwala Lime	1				1
Quarries	Quarry Mine		1			1
	Hippo Quarries		1			1
Silicon	Silicon smelters	3				3
Sinkers	Shaft Sinkers	2	5			7
Steel & Vanadium	Highveld		3			3

Commodity	Last mine worked	Black	White	Coloured	Unknown	Total
Steel & Iron	Iscor		17			17
Non-miner	Environmental asbestos	16	1			17
	Eskom		1			1
	Industry	1	7	1		9
	Kuruman	13	5	1	14	33
	Non-miner		1			1
	Spoornet		1			1
Unknown	Unknown	31	32		33	96
TOTAL		**1 185**	**556**	**11**	**48**	**1 800**

APPENDIX 2: PUBLICATIONS AND ACTIVITIES EMANATING FROM PATHAUT DATA (2008)

Journal articles

Murray J, Nelson G. Health effects of amosite mining and milling in South Africa. Regul Toxicol Pharmacol 2008; 52(1):S75-81.

Reports

Ndlovu N, Murray J, Candy G, Nelson G. Pathology Division Report: Demographic data and disease rates for January-December 2007. NIOH report 14/2008. ISSN 1812-7681. National Institute for Occupational Health, National Health Laboratory Service, South Africa, 2008

Summary of a case study (Mary Ross and Gill Nelson): Investigating silicosis and tuberculosis in DBCM miners. De Beers Report to Society 2007, pg 66.

Newspaper articles

Sylvester Haskins. Research into health effects of platinum-mining. (Nelson G) Mining Weekly. Published 22/08/2008. Website: http://www.miningweekly.com/article.php?a_id=140255

Congresses

Mthombeni J, Murray J, Ndlovu N. Silicosis and Pulmonary tuberculosis in deceased South African miners. 8 February 2008. Vaal University of Technology, Vaal. Awarded first prize for best BTech (Biomedical Technology) project

Ndlovu N, Nelson G, Girdler-Brown B and Murray J, Silicosis Trends at Autopsy in South African Miners: 1975 - 2006, The 9th International Conference on Particles: Risks and Opportunities, Cape Town, 2 to 5 September 2008. Awarded 3rd Prize for Best Oral Presentations

Nelson G, Murray J, Ndlovu N, Girdler-Brown B. Respiratory diseases in South African platinum miners – an autopsy study. NIOH Research Day, 8 October 2008, NIOH, Johannesburg.

Back P, Ndlovu N, Nelson G, Murray J. Pathology Division Surveillance Report: Demographic Data and Disease Rates for January to December 2007, NIOH Research Day, 8 October 2008, NIOH, Johannesburg.

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Degrees

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