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The evaluation of health programmes based on death registers from the local health office of Antananarivo, Madagascar, 1984-1994 *

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What is the present situation regarding mortality, in other words the health situation, and the changes it is undergoing in big African cities? Is it getting worse or improving? Reliable chronological series of registrations are rare in Africa; and even rarer are registrations that include the cause of death. Several have been analyzed over periods of varying length: Dakar 1964-71 and 1950-1978. Saint Louis 1930-1988, Bamako 1974-1985, Abidjan, Libreville 1962-1972, Brazzaville 1974-1975 (Cantrelle, Diop, Silva, 1986; Fargues, Nassour, 1988; Diop, 1990; Dittgen, 1979; Garenne et al., 1995; Antoine, Cantrelle, Sodter, 1976; Duboz, Herry, 1976; Toto, 1986).

In the Madagascan capital, Antananarivo, formerly Tananarive, civil registration dates back a long way. Epidemiological monitoring, especially of the plague, justified it. These civil registries were created in their current form in 1973 by Professor Randrianarivo, Director of the Bureau Municipal d'Hygiène (BMH) of Antananarivo-ville.

In 1993, the decision was taken to make a first trial at exploiting them over the period of one year to check the validity of registration. Following the positive result, the series covering the previous ten years were used to find out about changes in the health of the population and to evaluate the effects of health programmes[1].

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* Translated from French by Paul Belle.

[1] After a first visit to the BMH during a mission in 1990, P. Cantrelle initiated the task in 1993 in the framework of a UNICEF project, analysing the data with D. Waltisperger. The coding, the data input and the checking were undertaken by SSSD, under the supervision of Dr. Ralijaona. The UNICEF Bureau of Madagascar provide a technical support as well as funding and management.

General situation

The city of Antananarivo, the administrative, political, economic and cultural capital of Madagascar, lies in the heart of the central plateau of the island at an altitude of 1,350-1,750 metres.

It covers a rectangular area of 80 square km which is drained by two rivers. The areas of marshland and valleys of the lower part of the city are surrounded by hills where the inhabitants of the higher part of the city live.

The climate in the area is a tropical high-altitude climate with two seasons: one dry and cool from April to August, the other hot and humid from November to March. Between the two seasons there is a period when the weather is hot and dry during September and October.

For the period from 1983 to 1991, the average annual temperature was 19° with a maximum of 28° and a minimum of approximately 11°. The average annual hygrometry is approximately 74%. Average annual rainfall reaches 1,267 mm with 135 days of rain.

The administrative area or Fivondronana of Antananarivo-ville is divided into six "Firaisana" or wards, each with its own civil registry bureau. These Firaisanas are divided into Fokontanys or neighbourhoods. There is a total of 192 of them.

The Direction des Affaires Sociales et Culturelles (Bureau of Social and Cultural affairs) is among the administrative structures of the city and the Bureau Municipal d'Hygiène is under the authority of this bureau.

In the 1993 census, the population of city was estimated at 676,980 inhabitants, which represented a population density of 8,679 inhabitants per square km.

It should be added that during the 80s the economic situation in Madagascar suffered deterioration and reached a trough in 1986. GNP per capita fell from $ 330 in 1984 to $ 190 in 1988, and rose again in 1994 to $ 230.

Year of reference	GNP per capita ($)
1984	260
1985	240
1986	230
1987	210
1988	190
1989	230
1990	230
1991	210
1992	230

Health policies and programmes

From the middle of the seventies until the beginning of the 90s the Health Department directed its activities in such a manner so that its medical services should benefit the greatest number of inhabitants. In addition, Madagascar, a member of WHO, has approved "The Charter for Health Development in the African Region" and implemented the policy for "Primary Health Care" (Law dated April 18th, 1982). One of the objectives in the 1986-1990 quinquennial plan was to improve the state of the population's health by ensuring more regular supplies of pharmaceutical products, by extending actions in the field of nutrition, especially that of the mother and the child, support of interventions in rural areas and the intensification of the fight against the major endemic diseases.

At the national level a series of programmes has been elaborated among which the principal ones are as follows:

- The Expanded Programme for Immunization (EPI).
- The national programme against diarrheal diseases.
- The integrated programme for Maternal and Child Health Care and Family Planning. This programme has two objectives in common with the preceding programmes: EPI and the fight against diarrhoeic diseases. Other objectives include reducing maternal mortality and morbidity due to complications during pregnancy and labour, abortions and malaria, and reducing mortality due to acute respiratory infections.
- The curative programme against tuberculosis.
- The programme against malaria.
- The programme against the plague.

At the same time the Ministry for Health has set up programmes called "Service" Programmes, such as the adoption of a list and the supplying of essential drugs.

The capital has benefited from these different programmes in addition to the medical assistance provided in the following health infrastructures: 4 hospitals and 3 specialized establishments; 12 free health centres; 1 general clinic and 1 medical centre; and the Bureau Municipal d'Hygiène.

In the private sector there are the following facilities: 4 private clinics and maternity clinics; 16 Company Medical Services; 9 church infirmaries and free health centres; 17 different infirmaries and health centres; 4 different social centres; and surgeries.

During the period of economic crisis, deficiencies in the public service drove people to using private medical centres that were better equipped.

Method and data description

Death registration procedure

The death registration procedure, established since the plague epidemic of 1921, seems to provide sufficiently complete registration. The cemeteries are guarded and burial cannot be carried out without a burial permit. This permit is delivered by the civil registration bureau (Firaisana) upon presentation of a death certificate issued by the BMH. If the death occurred at home, then a BMH agent is informed, goes to the home of the deceased and makes a certificate based on information supplied by the family and the medical documents available. If the death occurred at the hospital, then the family presents the death certificate made out by the hospital to the BMH. Whether deaths occur at home or in hospital they are registered in the same BMH registry as and when they are reported.

The time allowed for recording civil registration information is 12 days. The great majority of deaths are declared in less than three days following the death. The coding and the input of information is carried out by SSSD staff under the management of the department head. The total cost in personnel for this specific operation, is 1,500 French Francs or 300 US $ on average, per year of death registration covered.

Causes of death certification

Although knowing the cause of death is not a problem in obvious cases: accidents, maternal deaths, measles, diarrhoea, etc., in other cases, like malaria and tuberculosis, the diagnostic is often far from accurate and the figures reported only have a value as an indication.

In general the cause reported is the initial or the principal cause. The code used is that of the WHO International Classification of Diseases (ICD-9), with four figure numbers (WHO, 1977). Two possibilities were provided for, the first concerns the main cause of death and the second the associated causes. In the case of a trauma, the first is reserved according to localization (i.e. fracture of the skull), the second for the cause or the aetiology (i.e. road accident). The cause is registered with a detailed code and classifications under 41 different headings. The details are supplied in the annex.

It would appear that for deaths occurring in hospitals information about the cause is of better quality than for deaths at home. However, both sources are classified here. Finally, it may be noted that the same person, a physician, was responsible for the coding of the cause of death, thereby guaranteeing the consistency of the series.

Geographical coverage

The BMH does not cover the 6th *Arrondissement* (Firaisana d'Ambohimanarina). Under the 1st Republic this area was an autonomous urban district which was not under BMH control. Under the 2nd Republic (1975-1991) the area was attached to Fivondronana in Antananarivo-Ville but its situation with the BMH remained the same. This area represents 10.2 % of the population, and is not included in the present study.

Completeness of death registration

The completeness of coverage has been verified in different ways:

- The rate of registration of deaths has been evaluated with the Brass technique. It gives a favourable result.
- The death rate recorded by the BMH was compared with that of the civil registry. The numbers are very similar. This indicates that there is no substantial under-registration of one list compared to the other.
- The numbers of deaths registered by the BMH having occurred in hospital have been compared with hospital statistics and have shown no major discrepancy.
- Finally, age-specific deaths in days during the first week, in weeks during the first month and in months for the first year seem consistent and contradict the hypothesis of a under-registration of deaths of young children.

Reference population

- The results only concern nationals. As the number of deaths of foreigners was low (81 in 1990), they were not included in the current statistics.

- The population at risk has been established by separating deaths of resident from deaths of non-residents. The number of cases without any details concerning place of residence is negligible. The indicators only concern the resident population, which corresponds to approximately 80% of registered cases.

It should be added that for the residents of Antananarivo the absence of information on the neighbourhood is minimal, for example: in 1992, 24 out of 5,675. The degree of precision achieved by the Fokontany within an *Arrondissement* in Antananarivo is remarkable.

- The size of the reference population is that of the census of August 1993[2]. To obtain the average population for previous years an estimation was made based on the intercensal growth rates between 1975 and 1993, which gives an average annual rate of 27.4 per thousand for men and 28.4 for women.

Results

Trends in mortality from all causes

Precision regarding age at death in most cases makes comparisons in time more reliable. Life tables have been calculated for four periods covering the whole series.

[2] Recensement général de la population et des habitats 1993. Résultats Préliminaires. Décembre 1993 (Forthcoming). Recensement général de la population et des habitats 1975. Données démographiques en milieu urbain. Institut National de la Statistique et des Recherches Economiques.

Table 1
Mortality trends over the study period, based on registration of deaths in Antananarivo-ville (BMH), 1984-94.

Probabilities of dying	1984-85	1986-87	1988-89	1990-91	1992-94	Difference 85-93 (%)
Males						
1q0	93.0	76.0	77.5	64.6	55.7	-40.1
4q1	123.3	105.0	79.3	62.8	61.7	-50.0
5q0	204.8	173.0	151.1	123.4	113.9	-44.4
35q15	274.4	312.1	208.9	201.7	192.4	-29.9
1q0/4q1	0.75	0.72	0.98	1.03	0.90	
Life expectancy at birth	46.0	45.4	52.0	54.5	55.4	+20.4
Females						
1q0	73.4	66.7	67.3	52.1	49.1	-33.1
4q1	123.2	100.7	84.1	62.6	58.0	-52.9
5q0	187.5	160.7	145.7	111.4	104.3	-44.4
35q15	161.8	188.4	172.8	134.6	134.8	-16.7
1q0/4q1	0.60	0.66	0.80	0.83	0.85	
Life expectancy at birth	52.6	52.3	55.2	59.9	60.4	+14.8

The fall in child mortality between the ages of 1 and 4 years is very marked, 50% in approximately eight years, more so than infant mortality (37%). The ratio of infant mortality (1q0) to juvenile mortality (4q1) is quite low, as is the case in general in Sub-Saharan Africa, and tends towards 1. This fast transition phase is typical of the region.

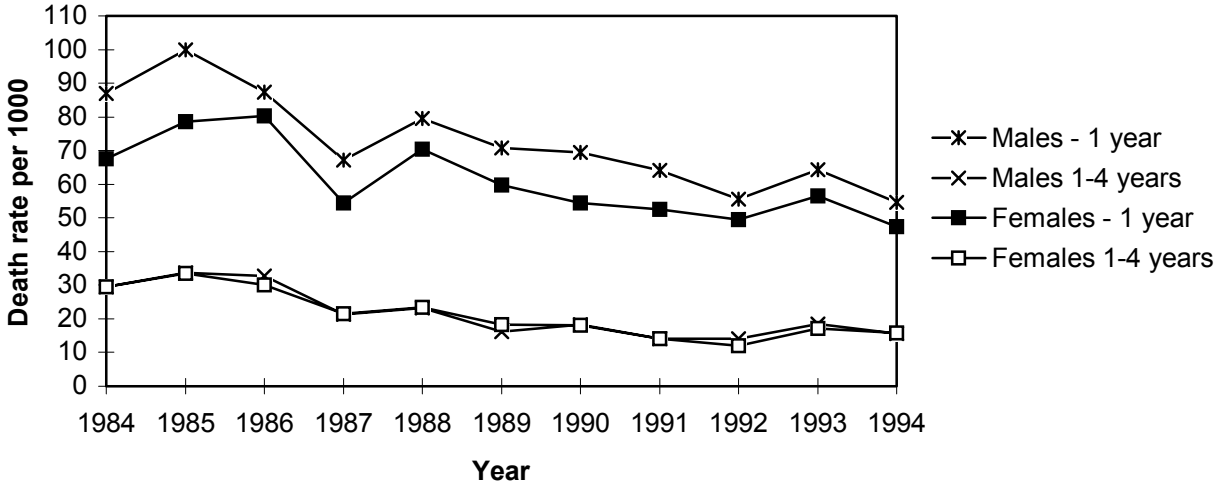

Figure 1. Changes in child death rates.

Less marked among adults, 15-49 years, there remains, nonetheless, an apparent fall, more than 20%; more so among men, whose mortality rate used to be higher, than among women (a 30% decrease versus a 17% decrease).

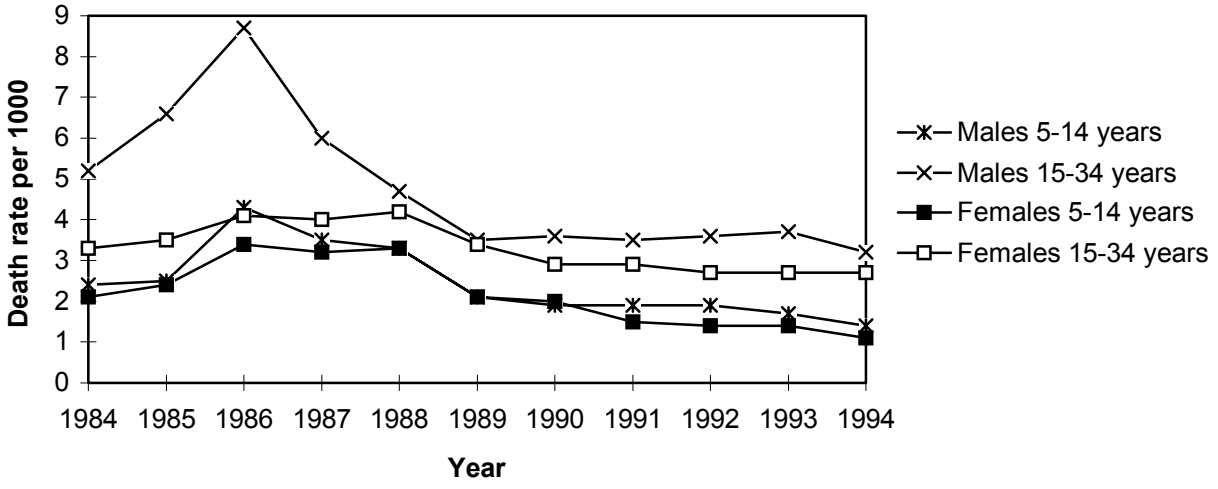

Figure 2. Changes in young adults death rates.

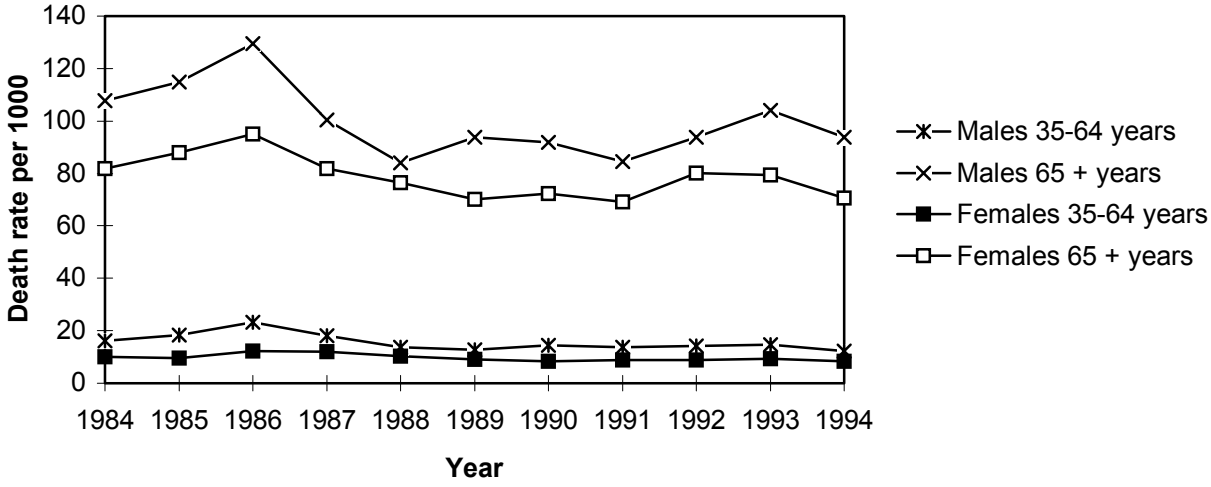

Figure 3. Changes in adults death rates.

In 1986, a fertility survey was carried out in the Madagascan capital (Rabetsitonta, 1988) which also provided information about mortality of children under five (5q0). The retrospective information collected in this survey showed that 5q0 had constantly increased since 1977-80, and the level estimated for 1984-85 was close to that obtained with death registration. The fall observed after 1986 probably corresponds to the improved economic situation during this period.

The curve of cumulated deaths, on the Bourgeois-Pichat logarithmic scale, makes it possible to situate the critical period in childhood, between the two points of inflection of the curve, between 7 and 25 months.

Does knowing the causes of death make it possible to explain this change? A general table with 41 headings is presented for each year (Table 2), as well as more detailed information corresponding to specific programmes. The codes are listed in the annex.

Table 2
Numbers of cause-specific deaths (not including stillbirths), resident nationals, Antananarivo-ville (BMH), 1984-94.

Cause of death	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1.Diarrhoea	735	885	1290	855	753	613	703	576	485	597	599
2.Other infectious intestinal diseases	95	102	131	129	79	73	70	65	73	47	38
3.Tuberculosis	174	226	199	149	79	107	149	119	159	152	127
4.Plague	1	0	0	0	0	0	12	12	12	17	7
5.Diphtheria	12	7	5	3	4	1	3	3	0	3	1
6.Whooping cough	53	68	32	20	16	14	15	5	4	13	8
7.Tetanus	17	20	11	12	11	8	10	7	6	8	5
8.Poliomyelitis	0	1	1	0	0	0	0	0	1	0	0
9. Measles	354	447	124	11	185	52	30	32	7	85	11
10.Viral hepatitis	9	11	20	22	19	3	13	16	15	13	11
11.Malaria	58	84	172	288	701	378	224	198	233	216	163
12.Other infectious and parasitic diseases	86	88	67	69	52	54	43	52	38	55	48
13.Tumours	172	212	190	185	219	241	237	237	242	241	276
14.Endocrine and diabetic diseases	75	45	44	54	49	62	47	72	51	69	64
15.Malnutrition	515	671	1313	890	472	383	425	306	315	384	376
16.Diseases of the Metabolism	74	96	112	80	73	42	55	60	32	43	44
17.Diseases of the blood	32	24	10	29	25	17	32	25	14	24	28
18.Mental disorders, including alcoholism	37	60	43	42	48	54	73	73	82	84	54
19.Nervous system	150	134	122	94	86	107	93	91	110	139	117
20.Ear infections, including otitis	2	1	3	6	4	3	6	1	3	3	5
21.Hypertensive diseases	99	90	76	80	70	78	74	91	98	112	59
22.Ischemic heart diseases	29	22	25	22	30	33	39	27	58	56	45
23.Cardiac insufficiency	341	382	418	358	271	320	320	369	355	423	446
24.Cerebro vascular diseases	390	339	341	405	333	344	392	392	442	501	446

Cause of death	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
25.Other diseases of the circulatory system	281	339	356	231	220	186	205	227	207	179	142
26.Pneumonia, Bronchial Pneumonia and flu, or Acute Respiratory Infections (ARI)	519	847	609	646	593	534	616	558	531	670	599
27.Other diseases of the respiratory system	159	173	155	118	120	119	129	124	115	125	139
28.Diseases of the digestive system	450	273	413	267	253	242	297	246	296	302	258
29.Diseases of the genital and urinary organs	134	116	144	123	114	128	118	90	125	139	98
30.Pregnancies ending in abortion	30	38	26	43	46	38	37	36	34	45	39
31.Complications linked to pregnancy	17	10	23	19	36	12	7	6	10	14	11
32.Complications during labour	13	7	17	13	10	7	15	8	13	16	18
33.Complications following labour	11	15	13	4	13	8	10	10	14	7	7
34.Diseases of the skin, of the muscles	18	15	15	11	16	14	28	11	22	11	9
35.Prematurity, insufficient weight at birth	108	117	141	100	144	137	136	100	86	99	87
36.Hypoxia	30	35	48	31	48	43	44	66	43	56	35
37.Neonatal tetanus	9	11	7	14	16	19	21	8	10	7	6
38.Congenital & perinatal diseases	322	343	317	215	232	299	206	215	227	263	201
39.Senility	65	87	132	155	172	125	105	158	142	112	70
40.Other indeterminate diseases	363	480	550	427	475	343	301	250	331	380	336
41.Traumas	294	312	429	282	272	286	296	369	388	411	408
All causes	6334	7233	8144	6504	6377	5527	5637	5314	5432	6123	5458

The plague

The old programme against the plague is maintained because of the need for vigilance. Massive administrations of insecticides are made annually[3]. For the period from 1984 to 1994, they were carried out during the following periods:

Year	Month of campaign	Number of deaths caused by the plague
1984	J F M A M O N D	1
1985	J F M A M S O N D	-
1986	J F M A M J S O N D	-
1987	J F M A M J J A O N D	-
1988	J F M A M J J A S O N D	-
1989	J F J A S O N D	-
1990	J F N D	12
1991	J F M A M J J A S O	12
1992		12
1993	S O N D	17
1994	J F M A M J J A	7

In 1992 there was a total lack of products, and in 1993-1994, "the rate of refusal for insect pest control in homes was 50% because of the unpleasant smell of the new products used".

It should be noted that the period from 1984 to 1989 during which there was only one death caused by the plague contrasts with the period from 1990 to 1994 during which there were 60 deaths. Even if the impact on the mortality rate is small, one can see here the effect of a deficiency in a health programme.

Diseases targeted by the EPI

Several phases followed each other:

- 1976-1981: beginning of the EPI with vaccination against diphtheria, tetanus, whooping cough and tuberculosis.
- 1982: introduction of the vaccination against polio and tetanus of pregnant women.
- 1985: introduction of the measles vaccination.
- 1987-1991: plan for the acceleration of the EPI against the six target diseases.

Among childhood diseases, such as measles, whooping cough and diphtheria, there is a relatively short time lapse between the vaccination and the risk of contagion, therefore the effects of the vaccination programme are soon felt.

[3] Memo issued by the Department of Insect Control of the city of Antananarivo.

The number of vaccinations carried out per year is available for the BCG, vaccination against measles and anti-tetanus injections of pregnant women in the *Circonscription Médicale (CM)* (Medical Area)[4]. This district stretches beyond the capital itself which represented 65% of the population of the CM in the 1993 census.

Table 3
The number of deaths for each target disease of the EPI, by year, resident nationals, Antananarivo (BMH), 1984-94.

Year	DIPHT.	WHOO. COUGH.	POLIO.	MEAS.	TETANUS		TUBER.
					Neonatal	Others	
1984	12	53	-	354	9	17	174
1985	7	68	1	447	11	20	226
1986	5	32	1	124	7	11	199
1987	3	20	-	11	14	12	149
1988	4	16	-	185	16	11	79
1989	1	14	-	52	19	8	107
1990	3	15	-	30	21	10	149
1991	3	5	-	32	8	7	119
1992	-	4	1	7	10	6	159
1993	3	13	-	85	7	8	152
1994	1	8	-	11	6	5	127

Measles

For measles, one injection is enough, from the age of 9 months. The results are spectacular, with an almost tenfold reduction in the number of deaths from measles. The same observation had been made in other countries, notably in Senegal. But it is obvious that vaccination coverage has not reached its full efficiency since there are still some deaths (Table 4). Deaths from measles occur on the average at age 2 (1.9 years in 1984-85; 1.8 years in 1986-87; 2.3 years in 1988-94).

[4]Annual reports issued by the Ministry of Health Vaccination Department from 1988 to 1994.

Table 4
Number of antimorbillous vaccinations and the number of deaths caused by measles, by year, resident nationals, Antananarivo-ville (BMH), 1984-94.

Year	Number of vaccinations (Medical Area)			Number of deaths		
	at 0 year	at 1 year and over	Both	at 0 year	at 1 year and over	All ages
1983	-	-	-			
1984	367	-	367	62	292	354
1985	5 152	-	5 152	88	359	447
1986	6 464	27 525	33 989	21	103	124
1987	11 781	20 537	32 318	4	7	11
1988	16 228	20 302	36 530	31	154	185
1989	15 173	14 414	26 587	10	42	52
1990	27 814	24 637	52 451	5	25	30
1991	16 941	10 322	27 263	7	32	32
1992	22 466	12 602	35 068	3	4	7
1993	25 118	7 654	32 772	13	72	85
1994	26 402	6 381	32 783	3	8	11

Whooping Cough

Complete vaccination requires three injections, as with diphtheria, tetanus and polio. The fall in the number of deaths from whooping cough gradually reaches the same proportion as that due to measles from the intensification of the EPI, 1987-1991.

Poliomyelitis

Death statistics do not appear to be significant for the evaluation of a programme. A more significant measure would be the prevalence of motor deficiencies.

Tetanus

Vaccination concerns two different categories of the population:

1) Children with D. T. COQ Vaccine: the risk of contagion is less immediate than for the previous diseases. However, a definite reduction of deaths has been noted which can be attributed to vaccination.

2) Pregnant women with only the anti-tetanus vaccination with the objective of avoiding neonatal tetanus of infants. Two injections are needed to ensure immunity, therefore the figures taken into account are those of the second injection (Table 5).

Table 5
Number of anti-tetanus vaccinations among pregnant women and the number of deaths caused by neonatal tetanus, by year, resident nationals, Antananarivo-ville (BMH), 1984-94.

Year	Number of second injections (Medical Area)	Number of deaths from neonatal tetanus
1983	5 446	
1984	9 403	9
1985	9 569	11
1986	8 970	7
1987	12 379	14
1988	17 283	16
1989	11 707	19
1990	16 323	21
1991	7 400	8
1992	10 265	10
1993	9 606	7
1994	9 323	6

The apparent lack of improvement would indicate that vaccination coverage of pregnant women, following prenatal consultations, remains insufficient.

Tuberculosis

There are two combined actions directed against tuberculosis which correspond to different programmes. BCG vaccination was developed within the EPI, at the beginning, 1976-1981, and was extended in the accelerated phase of EPI, 1987-1991(Table 6). The under 1 year population targeted was 31,178 children in 1984 and 40,956 in 1990. The vaccination coverage of the BCG therefore substantially improved, rising from 39% in 1984 to 99% in 1990. During the period covered, the improvement should benefit a greater number of children. The curative programme against tuberculosis is entrusted to another department. It is intended to ensure complete treatment of all infectious cases detected, most of which are among the adult population.

Table 6
Number of BCG injections (CM) and number of deaths caused by tuberculosis, by year and by age, national residents, Antananarivo-ville (BMH), 1984-94.

Year	Number of vaccinations		Number of deaths (Capital)						
	at 0 year	at 1 year and over	at 0 year	at 1-4 years	at 5-14 years	at 15-34 years	at 35-64 years	at 65+ years	at all ages
1983	9 202	16 223							
1984	12 113	21 513	3	10	3	81	68	9	174
1985	11 333	17 174	2	17	11	87	88	21	226
1986	14 210	17 045	3	5	5	101	71	14	199
1987	18 970	47 736	4	12	10	67	49	7	149
1988	33 189	30 959	4	2	4	32	28	9	79
1989	25 327	20 675	4	5	10	37	38	13	107
1990	40 464	40 282	6	6	7	45	71	14	149
1991	23 865	10 866	3	9	7	41	52	7	119
1992	33 029	8 766	5	5	12	52	67	18	159
1993	34 243	9 132	7	7	5	55	60	18	152
1994	37 355	5 435	7	11	5	42	55	7	127

Diarrhoea

Diarrhoea is the single most important cause of death, accounting for approximately 10% of the total, and the proportion exceeds 30% in the 1-4-year age group. The proportion in relation to all deaths due to diarrhoea for all ages remains fairly stable at approximately 50% (Table 7).

Table 7
Number of deaths caused by diarrhoea, by year, resident nationals, Antananarivo-ville (BMH) 1984-94.

Year	at all ages	at 1-4 ans	% 1-4	Population 1-4 years	Rate in 1-4 year (per 1,000)
1984	735	373	50.7	48 311	7.7
1985	885	421	47.6	49 467	8.5
1986	1 290	576	44.7	50 651	11.4
1987	855	338	39.5	51 843	6.5
1988	757	350	46.2	53 105	6.6
1989	613	336	54.8	54 376	6.2
1990	703	387	55.0	55 678	7.0
1991	576	268	46.5	57 011	4.7
1992	485	227	46.8	58 376	3.9
1993	597	318	53.3	59 973	5.3
1994	599	298	49.7	61 204	4.9

The rate of mortality from diarrhoea in the 1-4-year age group reached a maximum of 11 per thousand in 1986, at the worst of the economic crisis. It dropped the following year to 7 per 1,000. The programme against diarrhoeic diseases started afterwards, in 1988-1989. However, this is a national programme and information on the capital would be needed, especially since the programme has been combined with the existing Maternal and Child Health Programme. It would then be possible to evaluate to what extent the significant decrease observed from 1991 is linked to the programme.

Acute respiratory infections

Acute respiratory infections make up the third cause of death for the 1-4-years age group, with a proportion a little below 20%. The Department of Maternal and Child Health (Service de Santé Maternelle et Infantile - SMI) was in charge of reducing mortality due to ARI in the 1-4-year age group, and the improvement from 1990 is noticeable (Table 8). The relation with the action carried out by the SMI remains to be demonstrated.

Table 8
Number of deaths caused by acute respiratory infection, by age and by year, resident nationals, Antananarivo-ville (BMH), 1984-94.

Year	at all ages	at 0 years	at 1-4 years	Rate in 1-4 year (per 1,000)
1984	519	170	159	3.3
1985	847	261	264	5.3
1986	609	166	155	3.1
1987	646	191	148	3.0
1988	595	242	172	2.9
1989	534	194	127	2.3
1990	616	239	141	2.5
1991	558	225	121	2.1
1992	531	192	125	2.1
1993	670	245	169	2.8
1994	599	206	140	2.3

Malnutrition

Malnutrition is the second cause of death for the 1-4-year age group with a proportion nearing 20%. This information is all the more remarkable in that malnutrition appears here as a major cause whereas it is often masked by other declared causes.

In the 1-4-year age group the mortality rate due to malnutrition reached a peak of 10 per thousand in 1986 at the worst of the economic crisis, as for diarrhoeic diseases (Table 9). Although nutritional surveillance is the responsibility of the Department of Maternal and Infant Health and of the free clinics, improvements in diets are more linked to nutritional rehabilitation in health care centres for the most serious cases and more generally to improved food intake. In addition to economic indicators information about volume of food distribution to children would be useful to explain the improvement observed since 1990.

Table 9
Number of deaths caused by malnutrition by year, resident nationals, Antananarivo-ville (BMH), 1984-94.

Year	at all ages	at 1-4 years	Rate in 1-4 year (per 1,000)
1984	515	331	6.9
1985	671	339	6.9
1986	1 313	488	9.6
1987	890	356	6.9
1988	474	269	5.1
1989	383	238	4.4
1990	425	255	4.6
1991	306	191	3.4
1992	315	204	3.5
1993	385	255	4.3
1994	376	269	4.4

It should be noted that three causes: diarrhoea, acute respiratory diseases and malnutrition make up approximately 70% of the causes of death for the 1-4-year age group. Although the programmes mentioned are essentially preventive actions, deaths are also avoided through curative training, and these have to be considered in evaluation.

Malaria

"The discovery of chloroquine and DDT made it possible, from 1949 to set up a programme for the eradication of malaria based on chemoprophylaxis at pre-school and school ages, the active screening of malaria sufferers and of the carriers of the parasites, the spraying of residual insecticides in homes. In the highlands of Madagascar the results were quickly felt". "In Antananarivo between 1946 and 1951, the malarial mortality rate dropped from 6 to 0.4 per thousand. The proportion of deaths caused by malaria went from 20% to 5%". In 1957 malaria was thought to be eradicated. "Active measures against malaria were gradually reduced from 1962 to 1964. From 1975, the disease took over the control area of the highland regions", so that a new epidemic developed over the period from 1985 to 1988 in Antananarivo Province, culminating in 1988 as the cause of almost 16% of deaths (Blanchy, Rakotonjanabelo, Ranaivoson, Rajaonarivelo, 1993).

For the total of deaths in Antananarivo-ville (Table 10), the evolution is similar. Deaths caused by malaria were at 1% in 1984 and reached 11% in 1988. The malarial death rate went from 0.12 per thousand in 1984 to a high of 1.34 in 1988, in fact, ten times higher. These rates should be compared with those estimated by Mouchet and Baudon for the highland region (Mouchet, Baudon, 1988): 0.07 per thousand in 1984; 1.10 in 1985; 1.30 in 1986; 1.90 in 1987.

In 1988, after the 1985-1988 epidemic which caused many deaths, a new programme against malaria was set up which integrated preventive measures and treatment in the short and medium term:

- advanced chemoprophylaxis using chloroquine, available through local and school dispensers;
- the spraying of homes with insecticide (DTT) in areas where there is an epidemiological risk;
- the chemoprophylaxis of pregnant women.

However, since 1990, the malarial death rate has remained higher than in 1984, at between 0.3 and 0.4 per thousand, the proportion remaining at 3% of deaths in 1994.

Table 10
Number of deaths caused by malaria, by year, national residents, Antananarivo-ville (BMH), 1984-94.

Year	Number of deaths caused by malaria		Population (all ages)	Mortality rate from malaria (per 1,000)
	at all ages	at 5 years and over		
1984	58	53	467 202	0.12
1985	84	72	480 505	0.17
1986	172	139	494 261	0.35
1987	288	259	508 489	0.57
1988	701	610	523 208	1.34
1989	378	332	538 437	0.70
1990	224	207	554 198	0.40
1991	198	178	570 511	0.35
1992	233	208	587 400	0.40
1993	216	188	604 888	0.36
1994	163	147	622 999	0.26

Maternal deaths

One of the objectives of the integrated Maternal and Child Health and Family Planning Programme is to reduce maternal mortality and morbidity due to complications during pregnancy and childbirth, to abortions and malaria.

The maternal mortality rate is obtained by comparing the number of maternal deaths in resident women with that of the births. This ratio has been calculated over the four-year period of 1990-1993 for which the number of births was available (92,306), 300 maternal deaths for 100,000 live births.

It should be pointed out here that an estimate including non-residents would introduce errors into the results. In fact, maternal deaths of non-residents make up a substantial proportion, 38% for the 1990-1992 period (122/317), because of the role played by health training in the maternity clinics in the capital. This is illustrated by the proportion of women who are referred to the hospital due to a difficult labor (54 %). The proportion of deaths following an abortion is much lower.

Another illustration of changes is the ratio between maternal deaths and all deaths of women from 15 to 49, which has varied little, between 10% and 14% (Table 11). But the proportion of deaths following abortion, apparently for the most part induced and illegal, is higher among the youngest women, and has increased, exceeding half in recent years (Table 12). This observation is an indication of the need to reinforce the action of the programme in this direction.

Table 11

Numbers of maternal deaths (MD) of resident women based on death registration, Antananarivo-ville (BMH), 1984-1994

Year	Abortions	Complications during pregnancy	Complications during labour	Complications following labour	All MD	All female deaths 15-49	% MD	% Abort. MD
1984	30	17	13	11	71	541	13.1	42.3
1985	38	10	7	15	70	548	12.7	54.3
1986	26	23	17	13	79	680	11.5	32.9
1987	43	19	13	4	79	723	10.9	54.4
1988	46	36	10	13	105	734	14.3	43.8
1989	38	12	7	8	65	659	9.9	58.5
1990	37	7	15	10	69	559	12.3	53.6
1991	36	6	8	10	60	587	10.2	60.0
1992	34	10	13	14	71	596	11.9	47.9
1993	45	14	16	7	82	617	13.3	54.8
1994	39	11	18	7	75	627	12.0	52.0

Table 12

Categories of maternal deaths (MD) of resident women by age based on death registration, Antananarivo-ville (BMH), 1984-1994 (percentages)

	Abortions	Complications following pregnancy	Complications during labour	Complications following labour	Number of MD	% of abortions	
						1984-88	1989-94
15-19	60.4	12.5	13.4	13.4	96	56.4	63.2
20-24	60.1	19.1	11.2	9.6	188	61.5	58.8
25-34	47.6	21.5	17.1	13.7	357	41.7	53.7
35-49	40.0	23.1	21.3	15.6	160	31.6	48.1

Conclusion

The reliability of the data provided by the death registers of the Madagascan capital has been established. There is, therefore, a body of remarkably reliable data, analysis of which reflects the impact of health programmes, their insufficiency or even their absence.

The Expanded Programme for Immunization (EPI) aimed at eradicating measles, diphtheria, tetanus, whooping-cough, poliomyelitis and tuberculosis contributed to reducing mortality caused by measles and whooping cough during the accelerated phase of the programme. On the other hand, the impact on tetanus and tuberculosis was less obvious. In the latter case, in addition to preventive action, curative action should be taken into account for evaluation purposes. The efforts of the Maternal and Child Health Department have been encouraged by a drop in the number of deaths caused by diarrhoeal illnesses, malnutrition and acute respiratory diseases.

The temporary insufficiency of a programme can also translate into a negative effect, as in the fight against the plague. In the same way, the absence of a programme can result in an epidemic, as was the case with the malaria epidemic of 1985-1988.

Data providing indicators for the monitoring of programmes, act as a gauge for the whole of the capital, but also at the level of the *arrondissement* and the neighbourhood. One example was that of maternal health.

Given the results, the objective is now to go back over the series until 1980, and especially to perpetuate it by including it within a set of indicators. But also to extend the experience to centres in the other Provinces and to test the same approach in rural sectors.

A strategy based on the complementarity of both approaches, periodic snapshots of the national level and chronological series, has proved to be more adapted to needs. Indeed, the Demographic Health Surveys (DHS) - single-round surveys, representative at a national level - have provided, since 1975 almost all of the data on mortality. However, for a given year, the number of countries chosen is limited, and whichever country is studied, at the national level few reference points in time are available. Here again, this concerns only child mortality (and maternal mortality in some surveys) without causes of death.

More information about the health status of developing countries requires the implementation of a permanent system for the registration of births and deaths. Many African capitals already have such systems. It is true that such a registration system cannot provide a representative picture of the country. But this shortcoming is compensated by substantial advantages: it concerns all age groups and includes cause of death. The data are quickly available: with a monthly registration input one may even refer to real-time availability. The cost of exploiting such data is extremely low, compared to that of a survey.

It may be wondered why such data are not used systematically since they represent a reliable source of information. It is true that for a long time the prevailing dogma was that of preferring national statistics, even if they are unreliable or only partly reliable, to chronological series that were reliable but limited to part of the country. In other words preference was given to an international centralized vision to the detriment of the country's own needs.

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Annex

CODES FOR CAUSES OF DEATH

N° of the heading	Cause of death	Code
1.	Diarrhoea	009
2.	Other infectious intestinal diseases	001->008
3.	Tuberculosis	010->018
4.	Plague	020
5.	Diphtheria	032
6.	Whooping cough	033
7.	Tetanus	037
8.	Poliomyelitis	045
9.	Measles	055
10.	Viral hepatitis	070
11.	Malaria	084
12.	Other infectious and parasitic diseases	021->139
13.	Tumours	140->239
14.	Endocrine and diabetic diseases	240->259
15.	Malnutrition	260->269
16.	Diseases of the metabolism	270->279
17.	Diseases of the blood	280->289
18.	Mental disorders, including alcoholism	290->319
19.	Diseases of the nervous system	320->379
20.	Ear infections, including otitis	380->389
21.	Hypertensive diseases	401->409
22.	Ischemic heart diseases	410->414
23.	Cardiac insufficiency	428
24.	Cerebral vascular diseases	430->438
25.	Other diseases of the circulatory system	390->459
26.	Pneumonia, bronchial pneumonia and flu, or acute respiratory infections (ARI)	480->487
27.	Other diseases of the respiratory system	460->519
28.	Diseases of the digestive system	520->579
29.	Diseases of the genital and urinary organs	580->629
30.	Pregnancies ending in abortion	630->639
31.	Complications linked to pregnancy	640->648
32.	Complications during labour	650->669
33.	Complications following labour	670->679
34.	Diseases of the skin, of the muscles	680->739
35.	Prematurity, insufficient weight at birth	765
36.	Hypoxia	768
37:	Neonatal tetanus	771.3
38.	Congenital and perinatal diseases	740->779
39.	Senility	797
40.	Other indeterminate diseases	780->799
41.	Traumas	800->999