



PESTICIDES IN ZIMBABWE

Toxicity and Health Implications

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Chapter 3

Pesticides and occupational safety and health in Zimbabwe.

Rodwell C. Chitemerere

Summary

Introduction

Health effects of some pesticides

Accidents involving pesticides

Preventative programmes

Statutory Instrument 313 of 1981

Statutory Instrument 315 of 1981

Statutory Instrument 262 of 1984

Statutory Instrument 205 of 1985

Law enforcement

Health and safety promotional programmes

Conclusion

References

Chapter 4

Epidemiology of the health impact of pesticide use in Zimbabwe.

Rene Loewenson and Charles F. B. Nhachi

Summary

Introduction

Workers' assessment of occupational exposure to pesticides

Other factors

Indirect health effects of pesticide use

Conclusions

Acknowledgements

References

Chapter 5

Acute pesticide poisoning in Zimbabwe: Government

Analyst Laboratory records

David B. Nhari

Chapter 6

Organophosphate exposure in pesticide manufacturing
factories in Zimbabwe

Reginald B. Z. Matchaba

Chapter 7

Organophosphate poisoning in urban Zimbabwe.

Ossy M. J. Kasilo and Charles F. B. Nhachi

Acute Pesticide Poisoning: Government Analyst Laboratory Records

David B. Nhari

Summary

Examination and analysis of records from the (Zimbabwe) Government Analyst Laboratory show that there has been 1 294 cases of positive, acute pesticides poisoning from 1960 to 1990. Of these, 40 per cent were suicide cases, 24 per cent foul play and 36 per cent accidental. The pesticides involved in the highest number of cases are arsenic formulations during the period 1960–1969, endosulphan (1970–1979), dioxathion (1980–1984) and endosulphan (1985–1989 and 1990). Cases were recorded from the provinces, with Manicaland having the highest proportion (13 per cent of cases) and Masvingo the lowest (4 per cent of cases).

Among other tasks, the Government Analyst Laboratory which falls under the Health Support Services Branch of the Ministry of Health analyses many varied samples and specimens to provide medico-legal data in Sudden Death Dockets for the Zimbabwe Republic Police when poisoning is the suspected cause of death. The decision on what cases are submitted for analysis is made by the Investigating Officer of the Zimbabwe Republic Police aided by the professional opinion of the Government Medical Officer performing the post-mortem. Viscera, the suspected poison, when available, and any other substance(s) and containers found and suspected to have been used are submitted for analysis with a brief report of the circumstances on Form 36. A report is written after the analysis. When a poison is detected, an affidavit is written and submitted for use as evidence if so required.

Many diverse cases have been analysed over the years. They can be roughly classified into those involving:

- (a) agrochemical poisoning (pesticides and herbicides);
- (b) chemicals other than those listed in (a);
- (c) drugs; and
- (d) traditional medicines (*muti*).

Agrochemicals can further be classified as:

- (i) organophosphorous compounds (OP),
- (ii) carbamate compounds (C),

- (iii) organochlorine compounds (OC), or
- (iv) other, that is, compounds and formulations which do not fall under (i), (ii) or (iii) (WHO, 1992).

This chapter discusses specific cases of acute poisoning which occurred in Zimbabwe between 1960 and 1990 and are attributed to agrochemicals. Data is presented in five-year periods covering the cases analysed, the circumstances of incidents, the pesticides involved and distribution according to provinces. Records for 1990 are presented separately.

The records in files and entry books were examined and information extracted year by year for each of the following periods; 1960–1964, 1965–1969, 1970–1974, 1975–1979, 1980–1984, 1985–1989 and 1990. The data included the following; number of cases submitted, number of pesticides-positive cases, type of incidents (foul play, accident or suicide), pesticides detected and number of cases in each province and major city.

This information is presented to show trends, if any, in acute pesticide poisoning over the years. From 1960 to 1990, there were 12 616 cases of sudden death submitted to the Government Analyst Laboratory by various police centres for analysis. Of these, 1 294 (10,3 per cent) were found to be positive for agrochemical poisoning. A breakdown of these cases according to five-year periods is given in Table 1.

Table 1: Cases of acute pesticide poisoning

Year	No of Cases	No of PP*	Per cent of PP**
1960–64	774	131	10
1965–69	1 453	83	6
1970–74	2 577	123	10
1975–79	3 319	146	11
1980–84	2 100	253	20
1985–89	1 978	486	38
1990	415	72	6
(1960–1990)	12 616	1 294	10,3%

*PP: Pesticide - positive

** As a percentage of total number of cases

NB: Per cent data is quoted to the nearest decimal point.

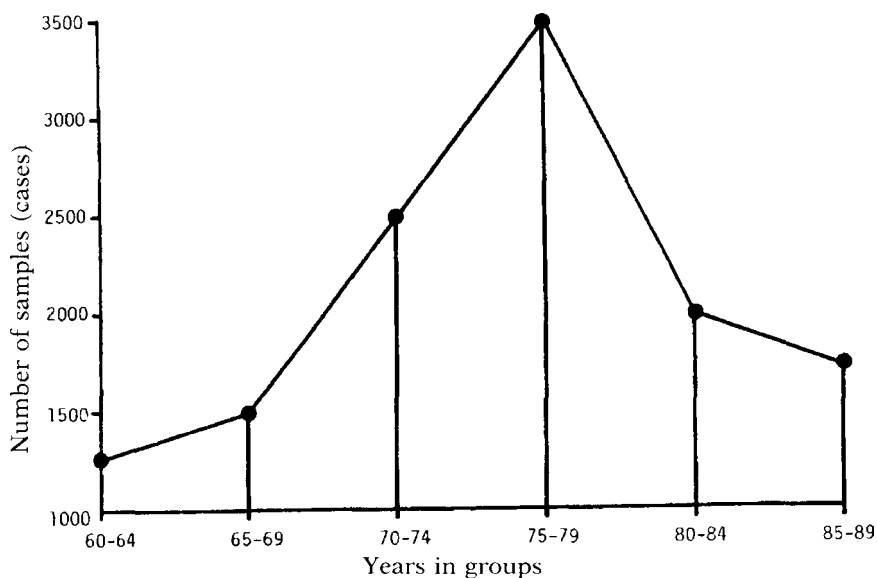


Figure 1: Number of samples versus time

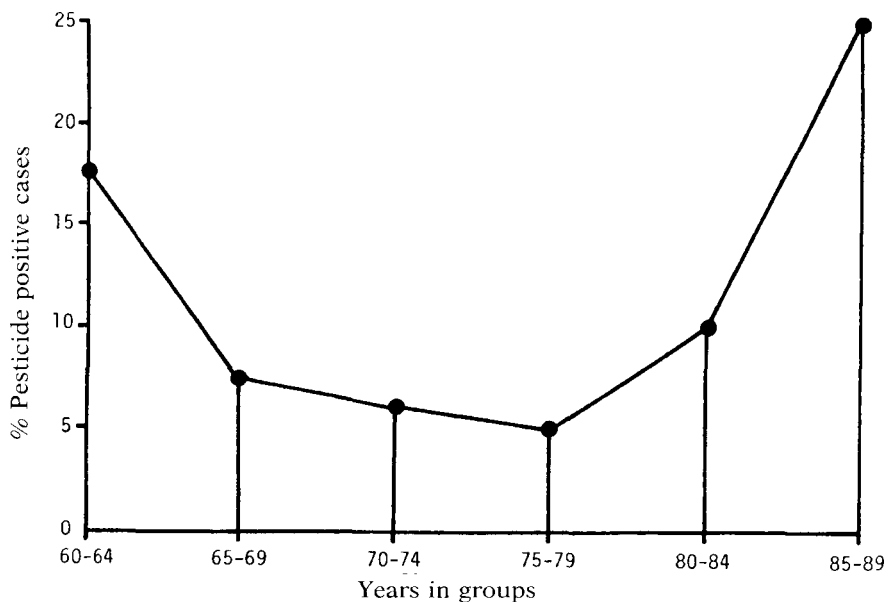


Figure 2: Percentage pesticide-positive cases versus time

Table 2: Examples of classification of incidents

Circumstances of poisoning	Description of information extracted
1. <i>Foul Play:</i>	<i>Mberengwa SDD/89</i> "..... the deceased died after she drank some traditional brew (Mahewu) given to her by a neighbour"
2. <i>Accidental:</i>	<i>Matebeleland SDD/89</i> The deceased took Diazol poison orally. The deceased thought it was a cough mixture. (Analysis results – Diazon detected) <i>Masvingo SDD/90</i> "..... six people died after consuming sadza they had prepared for lunch. During the previous night they had sprayed their hut with some insecticide to kill bed bugs" (Analysis result – Endosulphan detected)
3. <i>Suicide:</i>	<i>Parirenyatwa SDD/90</i> "..... the deceased bought two bottles at a local store and bade farewell to his friends saying he was going to drink Rogor. That was the last time he was seen alive" (Analysis result – Dimethoate detected)

Table 3: Types of incidents

Period	Foul Play (%)	Accidental (%)	Suicide (%)
1960–64	—	—	—
1965–70	24	36	41
1970–74	21	43	36
1975–79	32	37	31
1980–84	12	38	50
1985–89	23	28	49
1965–89	23	36	41

Most of the pesticides encountered are used in the control of pests and diseases in farming – both pastoral and crop production. Some are also used for the control of domestic pests. Table 4 lists the pesticides encountered from 1960 to 1990.

Table 4: Pesticides encountered from 1960-90

Pesticide Period	60-64	65-69	70-74	75-79	80-84	85-89	90
Aldicarb (C)						X	
Aldrin (OC)	X	X	X			X	
Arsenic Compounds (AS)	X	X	X	X			
Atrazine (TZN)						X	X
Bromophos Ethyl (OP)				X	X	X	X
Carbaryl (C)			X	X	X	X	X
Carbofuran (C)						X	
Chlordan (OC)						X	X
Chlorpyrifos (OP)						X	
Cyanides (CN)	X	X	X	X			
Dementon-F-5-methyl (metasystox) (OP)						X	X
Diazinon (OP)		X	X	X	X	X	X
Dicrotophos (OP)				X	X	X	
Dieldrin (OC)	X	X	X	X		X	
Dimethoate (OP)		X	X	X	X	X	X
Dioxathion (OP)		X	X	X	X	X	X
Endosulphan (OC)		X	X	X	X	X	X
Endrin (OC)	X	X					
Ethyl Dibromide (EDB)	X	X	X				
Fenitrothion (OP)			X	X	X		X
Gamma Benzene (GB)	X	X	X			X	X
Malathion (OP)	X	X	X	X		X	X
Monocrotophos (OP)			X	X		X	X
Parathion (OP)	X	X	X	X	X	X	X
Parathion-methyl (OP)						X	X
Phosdrin-(mevinphos) (OP)						X	
Telodrin (OC)						X	
Toxaphene (TP)	X	X	X	X			
Triazophos (OP)						X	
Warfarin (ACOA)						X	

Source: WHO, 1992.

Table 5: Pesticides contributing to most deaths

Period	Pesticide	Number	Percentage
1960-64	Arsenates (AS)	81	62
	Cyanides (CN)	61	12
	Parathion (OP)	13	10
	Dieldrin (OC)	8	6
	Others	13	10
1965-69	Arsenates (AS)	37	45
	Cyanides (CN)	7	8
	Parathion (OP)	6	7
	Dieldrin (OC)	5	6
	Toxaphene (TP)	5	6
	Diazinon (OP)	5	6
	Others	18	23
1970-74	Endosulphan (OP)	26	21
	Arsenates (AS)	20	17
	Dimethoate (OP)	12	0
	Dioxathion (OP)	12	10
	Others	53	42
1975-79	Endosulphan (OP)	31	21
	Dimethoate (OP)	27	18
	Dioxathion (OP)	14	10
	Dicrotophos (OP)	14	10
	Others	60	41
1980-84	Dioxathion (OP)	55	22
	Endosulphan (OP)	54	21
	Dimethoate (OP)	53	21
	Chlorfenvinphos (OP)	27	11
	Others	64	25
1985-89	Endosulphan (OP)	209	43
	Dimethoate (OP)	103	21
	Dioxathion (OP)	45	9
	Aldrin (OC)	19	4
	Diazinon (OP)	20	4
	Others	90	19

Table 7: Provinces with the highest and lowest number of cases

Period	Province	Percentage
1960-64	(H) Mashonaland East	19
	(L) Matebeleland South	5
1965-69	(H) Masvingo	17
	(L) Midlands	8
	(L) Matebeleland South	8
1970-74	(H) Mashonaland Central	21
	(L) Masvingo	2
1975-79	(H) Mashonaland West	24
	(L) Masvingo	1
1980-84	(H) Mashonaland East	15
	(L) Matebeleland South	4
	(L) Matebeleland North	4
1985-89	(H) Manicaland	14
	(L) Masvingo	1
1960-89	(H) Manicaland	13
	(L) Masvingo	4

NB: Thirty cases were recorded in major towns and cities during the period 1960-89.

The classification of the cases into "Foul Play", "Accidental" or "Suicide" deduced from the information obtained from P36 forms (see Table 2). However, some statements are not as clear as should be. For most foul play and accidental cases, the agrochemicals are ingested through drink or food but in suicide cases the chemicals are taken directly or mixed with water.

Foul play cases have generally been fewer than either accidental or suicide case, with the exception of the 1970-74 and 1975-79 periods where foul play was slightly higher than suicide cases. Overall, suicides are the highest, between 65 and 89, followed by accidental poisoning, and with foul play being lowest. Foul play and suicide cases are a result of pesticides being used by persons who know very well that pesticides are toxic. To reduce or control these requires making access to pesticides by the public difficult. However, for the cases of accidents both education and safety measures are necessary. For

Abbreviation used in Tables 3 and 4

OP	=	Organophosphates
C	=	Carbamates
OC	=	Organochlorines
AS	=	Arsenic compounds
TZN	=	Atrazine
CN	=	Cyanide
EDB	=	Ethyl dibromide
GB	=	Gamma Benzene
Anti-Coag	=	Anticoagulant pesticide
TP	=	Toxaphene

Table 6: Distribution of organophosphorous, organochlorine and other pesticides

Period	Organophosphorous	Organochlorine	Other
	No.	No.	No.
1960-64	16	13	102
1965-69	17	18	47
1970-74	48	40	35
1975-79	93	42	11
1980-84	187	55	11
1985-89	221	239	26
1990	44	22	6
1960-90	626	429	239

Cases of pesticide poisoning are found in all provinces with most incidences occurring in the major cities in all the periods. This, however, is not the true picture. Some of the cases may have occurred in the rural areas, but end up being counted with the urban cases because of the unavailability of post-mortem facilities in rural areas as mentioned earlier. Table 7 lists the provinces with the highest and the lowest percentage of cases in each period.

The number of cases submitted increases to a high of 3 319 in the 1975-1979 and then decreases to 1 978 in 1985-89 period. The increase (1975-1979) coincides with the time when the liberation war was at its highest. However, from the percentage, the pesticide-positive cases were very low compared to the other periods. This suggests that sudden deaths reported were mainly from other types of poisons rather than agrochemicals. This may be due to the fact that agricultural activity was affected by the war thus reducing somewhat the availability and distribution of agrochemicals.

Table 7: Provinces with the highest and lowest number of cases

Period		Province	Percentage
1960-64	(H)	Mashonaland East	19
	(L)	Matebeleland South	5
1965-69	(H)	Masvingo	17
	(L)	Midlands	8
	(L)	Matebeleland South	8
1970-74	(H)	Mashonaland Central	21
	(L)	Masvingo	2
1975-79	(H)	Mashonaland West	24
	(L)	Masvingo	1
1980-84	(H)	Mashonaland East	15
	(L)	Matebeleland South	4
	(L)	Matebeleland North	4
1985-89	(H)	Manicaland	14
	(L)	Masvingo	1
1960-89	(H)	Manicaland	13
	(L)	Masvingo	4

NB: Thirty cases were recorded in major towns and cities during the period 1960-89.

The classification of the cases into "Foul Play", "Accidental" or "Suicide" is deduced from the information obtained from P36 forms (see Table 2). However, some statements are not as clear as should be. For most foul play and accidental cases, the agrochemicals are ingested through drink or food but in suicide cases the chemicals are taken directly or mixed with water.

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the above data it seems necessary to educate the public on the toxicity and necessary safety precautions for storage, use and general handling with definite restrictive measures to ensure that only licensed, qualified persons have access to pesticides.

Arsenic compounds and cyanides accounted for 74 per cent of all positive cases of pesticide poisoning in the 1960–64 period and 53 per cent in the 1965–69 period with arsenic compounds alone responsible for 63 per cent in 1960–69 and 17 per cent in 1970–74 (see Table 3). From 1960 to 1969 cattle dip tank solutions were almost exclusively formulations of arsenic compounds. However, by 1975 arsenic compounds were replaced as the leading available livestock pesticide involved in acute poisoning cases by other formulations. Apparently, there seems to have been few pesticides available for use in the control of plant pests before the 1970–74 period and of these, the major ones noted are parathion, dieldrin, toxaphene and diazinon, with aldrin, endrin, malathion also appearing. Arsenic formulations were replaced by such pesticides as dioxathion, chlorfenvinophos, dicotophos singly or in combination. Most probably, this was mainly because of livestock deaths resulting from grazing on arsenic-contaminated grass in the proximity of dip tanks. As more pesticides became available for control of crop pests and diseases as well as household pests, the once leading role of livestock pesticides in poisoning decreased (see Table 3). In the 1975–79 period, arsenics and cyanides were replaced by endosulphan (Tables 3 and 4) in the control of cotton, tea, coffee, tobacco and other crop pests, dimethoate — an all-purpose pesticide commonly known by its trade name — Rogor and dioxathion — a dip tank solution — almost completely disappeared from thence on.

Endosulphan which appeared in 1965 (Tables 3 and 4) has since then become the single pesticide responsible for more incidents than any other, perhaps because it is a broad-spectrum pesticide used for controlling many agricultural insect pests. It is of interest to note that the involvement of dieldrin and toxaphene was reduced drastically from 1970 onwards when their use was banned. However, it appears large stocks of these pesticides are still available as cases of poisoning from them continue to appear.

From 1960 to 1969, pesticides available were mainly for the control of livestock pests and the province with the highest number of poisoning (Mashonaland East) and the next highest (Matebeleland North and Masvingo) are all very active in livestock production. These three provinces accounted for 34 per cent of the poisoning cases during those two periods that is higher than the major cities. The next ten years (1970–79) saw more pesticides made available for both livestock and plants and, likewise, cases of pesticide poisoning increased in the areas involved in raising crops such as tea, coffee (Manicaland) and maize and cotton (Midlands and Mashonaland Central). As a result, the provinces which are mainly pastoral (Matebeleland South and North and Masvingo) had relatively fewer cases.

There is a definite relationship between the availability of agrochemicals and number of pesticide poisoning cases. Mashonaland East, Central and West produce most of the maize, tobacco, cotton and livestock. Not surprising, they accounted for 30 per cent of all the cases of pesticide poisoning (1960–89) roughly equalling that of the major cities for the same period.

However, Manicaland, the province with specialised agriculture, that is, production of coffee and tea and their need for intensive pest and disease control, is the province with the highest number of cases out of the eight individual provinces, followed closely by Mashonaland Central, Mashonaland East, and Mashonaland Western, each with 10 per cent. The other four provinces contributed as follows: Midlands, 7 per cent (cotton); Matebeleland North, 6 per cent (livestock); Matebeleland South, 5 per cent (livestock) and, finally, Masvingo, 4 per cent (livestock).

The number of 'other' was higher than the total of OPs and OCs for the periods 1960–64 and 1965–69. Seventy-six and 58 per cent were recorded during these periods respectively (see Table 5). From then on the OPs and OCs took over the lead, accounting for over 90 per cent of all acute pesticide poisoning incidents from the 1975–79 period to 1990. The high number of 'other' in the first three periods was due to the arsenic and cyanide formulations which were used in dip tank solutions for livestock pest control. When these were disbanded, the incidents due to OPs and OCs increased. In the "other" group, besides the arsenic formulations and cyanides which ceased to be used as pesticides in the 1960s, are such pesticides as carbaryl, carbofuran, ethyl dibromide, gamma benzene and atrazine (a herbicide) which have been involved in most of the periods but contributing a very small percentage. As mentioned earlier, the organophosphorous and organochlorines are now the major agrochemicals accounting for the largest number of deaths.

For the 1960–64 and 1965–69 periods, the OPs and OCs are not that far apart (see Table 5). In the 1970–74 and 1975–79 periods, organophosphorous pesticides took the lead and continued in the 1980–84 to lead by as much as 73 per cent compared to 22 per cent. In 1985–89, the reversal is due to the astronomical increase in the endosulphan (organochlorine) cases. Alone, endosulphan was responsible for 343 cases in 1960–90 which is higher than any other individual pesticide. In fact, from 1969–90, the only organochlorine pesticide accounting for over 50 per cent of all organochlorine cases is endosulphan. The number of organophosphorous pesticides making the total contribution in all these periods is far higher. The highest OP contribution (1960–90) is dimethoate with 208 cases, followed by dioxathion (128 cases). Parathion (87 cases), chlorfenvinphos (51 cases) and diazinon (50 cases) are other major OPs contributing while parathion appears in all the periods.

The number of suspected poisoning cases submitted fluctuate from about 35–45 a month giving roughly about 420–450 cases a year. It is difficult to project what the number of cases will be in future since this depends on the attitude of the population, availability of toxic substances, future pest and

disease control technologies and enforcement of control measures by the Hazardous Substances and Articles Board (Ministry of Health and the Ministry of Labour) and other interested organisations and parties. However, these results are similar to those obtained in other similar studies (Hettiarachchi and Kodituwaaku, 1989; Tan, 1987 and Jerayathnam, 1985).

However, that there will be some foul play studies and suicide cases resulting from pesticide poisoning is certain for as long as pesticides are available (Casey and Vale, 1994). If the control measures are tightened, those intending to kill others or themselves may be forced to use other means such as the use of therapeutic drugs which is apparently on the increase. For example, in 1990, chloroquine was responsible for 30 per cent of all positive cases (Kasilo, 1992). The number of accidental cases can be reduced somewhat by improved education, storage and handling.

The agrochemicals available for domestic and agricultural use are gradually increasing and will continue to do so unless new methods of controlling pests which do not involve the use of chemicals are found. More organophosphorous compounds are used in formulations than organochlorine and others. This trend will continue in the immediate future and consequently deaths due to organophosphorous compounds will continue to predominate. Similarly, the provincial distribution of cases will not change very much for as long as the same agricultural activities continue. Changes may occur if new sources of water supply become available in such provinces as Masvingo, Matebeleland North and South, which will mean introduction of new crops which, in turn, will need additional and/or different pesticides which may also be abused and lead to acute poisoning cases.

The best approach to reduce the number of sudden death cases must involve all parties concerned with the supply, storage, use and control of pesticides. A coordinated effort of all parties involved in educating the public on the toxicity and handling of agrochemicals should yield positive results. The policing of those charged with distribution in keeping with the requirements of the laws themselves should be reviewed and updated to further restrict the availability of pesticides to those who are likely to abuse them. The best situation would be developing methods of pest control which are harmless to people and to get rid of all toxic agrochemicals.

Since the data presented in this chapter is only from the records of the Government Analyst Laboratory, that is, information from the submitted documents and analysis reports, there are obvious limitations. Not all cases are reported to the police, and the information on the reported cases is not always complete and may thus be unreliable. Furthermore, in cases where the deceased had received some treatment, detection of the toxic substance is difficult. It is important therefore not to take the data as representing all cases of acute poisoning in Zimbabwe, but rather as giving some insight as to the problems associated with use and availability of pesticides to the public.

References

- Casey, P.B. and Vale, J.A. (1994) Deaths from pesticide poisoning in England and Wales, 1945–1989. *Human and Exp. Toxicol.* **13**:95–101.
- Hettiarachchi, J. and Kodituwaakku, G.C. (1989) Pattern of poisoning in rural Sri Lanka. *Int. J. Epidemiol.* **18**(ii):418–422.
- Jerayathnam, J. (1985) Pesticide and occupational health in developing countries. *Scand. Work and Environ. Health* **11**:229–234.
- Kasilo, O.M.J. (1992) Chloroquine therapeutics, pharmacology and toxicology and misconceptions. University of Zimbabwe, Department of Pharmacy – Drug Toxicol. *Inf. Serv. Bull.* **25**.
- Tan, C.T. (1987) Suicidal poisoning deaths in Singapore 1975–1984. *Ann. Acad. Med Singapore* **16**:300–302.
- World Health Organisation (1992) The WHO recommended classification of pesticides by hazard and guidelines to classification 1992–1993. WHO/International Programme on Chemical Safety (IPCS)/92.14.



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