The Dow Chemical Company - Flawed Science

Volume 2
Mortality of Midland Plant Workers II

The effects of dioxin exposure on human health have been studied for almost fifty years. The Dow Chemical Company is a recognized leader in the various issues associated with dioxin exposure to chemical workers. Occasionally, even Dow, with all its resources and expertise, can make a mistake – a defect that brings into question the validity of a single study or, perhaps, even the validity of several dioxin studies.

Until any defects are corrected or found to be inconsequential, the relevant study must be considered "flawed science". It is a tribute to the company that the majority of its studies are sound science and any flawed science is only "occasional."

Volume 1 focused on mistakes that the company may have made in three (3) mortality studies of Midland plant employees exposed to pesticide plant dioxins.

DioxinSpin found apparent discrepancies between the three studies in the following areas:

(1) Total number of employees exposed to pesticide dioxins
(2) Total number of employees that worked in each dioxin-pesticide plants
(3) Number of employees exposed to varying intensities of TCDD

Unfortunately, these discrepancies could not be resolved by an examination of the studies and additional information and explanation will be needed from the company.

Volume 2 will focus on "oversights" that the company may made in reporting the updated mortality experience of the dioxin exposed plant employees discussed in Volume 1.

The most recent mortality studies of Dow's dioxin-pesticide plant workers are Ramlow (1997)[1] and Bodner (2002)[2]. Ramlow (1997) examined worker mortality from 1940 to **1994** and Bodner (2002) from 1940 to **1995**. No explanation was given as to why Bodner (2002) only expanded the time period by one year. The Ramlow study provided much more detail, while the Bodner study provided a more concise summary.

Normally as the study period is expanded, the number of "expected deaths" will increase. As the age of the cohort increases, with each additional year, more of the cohort may die and the total number of expected deaths will increase.

[1] Ramlow, JM, *et al,* Ten-Year Update of a Cohort Mortality Study of Workers with Potential Exposure to Higher Chlorinated Dioxins, 11/13/97

[2] Bodner KM, Cancer risk for chemical workers exposed to 2,3,7,8-tetrachlorodibenzo-p-dioxin, Occup Environ Med 2003: **60**:672-675

However, the most recent Bodner (2002) study actually reported a decrease in the number of expected deaths even though more years were covered. This finding is very unusual since both the Ramlow and the Bodner studies reported the same number of total deaths (655).

This abnormality in the number of "expected deaths" is shown on Table A.

Table A

The Dow Chemical Company : Midland Plant
Expected Deaths

	Ramlow 1997	Bodner 2002
Time period	**1940-1994**	**1940-1995**
Number of employees	2,187	2,187
Deaths, All Causes		
Expected number	740.3	**721.1**
Exp. deaths per 1000 men	338.5	**329.7**
Deaths, All Cancers		
Expected number	171	**170.4**
Exp. deaths per 1000 men	78.2	**77.9**

As can be seen from the Table, there is an unusual reduction in the number of expected deaths from All Causes and All Cancers in the Bodner study even though the study period had been expanded by one year. While the differences in Deaths, All Cancers is less than 0.5%, the differences in Deaths, All Causes is almost 3%. It is possible that the studies may have used slightly different programs to extract US National Population data. It is not known if this discrepancy in the Bodner (2002) study is significant.

The Bodner study did compare its results with three (3) other earlier mortality studies of the same cohort. Without the Ramlow study as a comparison, the number of expected deaths and the expected deaths per 1000 employees in the Bodner study would have appeared to be normal. The Bodner study did not reference the prior Ramlow study and no explanation for the decrease in expected deaths was required.

A reporting "oversight" was noticed in the mortality of employees not diagnosed with chloracne.

The Ramlow study reported a decrease in the mortality of the 245 Dow employees that had been ever diagnosed with "definite" or "probable" chloracne. However, the Ramlow study failed to recognize that the larger (1,942 workers) group of "non-chloracne" employees had a much higher overall mortality and that the mortality for All Cancers for the larger group of employees was elevated for workers with both 0 and 25 years of latency. This information is shown in Table B.

Table B
The Dow Chemical Company : Midland Plant
Worker Mortality : With and Without Chloracne

	WITH CHLORACNE						WITHOUT CHLORANCE					
	0 Yrs Latency			25 Yrs Latency			0 Yrs Latency			25 Yrs Latency		
	obs.	exp.	smr	obs.	exp.	smr	obs.	exp.	smr	obs.	exp.	smr
Deaths, All Causes	51	86.5	59	36	53.1	68	604	653.8	92	334	371.1	90
Deaths, All Cancers	10	20.3	49	9	13.3	68	158	150.7	**105**	96	94.4	**102**
Expected mortality												
No. Employees	245						1942					
All Causes, exp. deaths/1000		353.1	**(Older)**					336.7	**(Younger)**			
All Causes, actual deaths/1000		208.2						311				

Ramlow, JM, et al, Ten-Year Update of a Cohort Mortality Study of Workers with Potential Exposure to Higher Chlorinated Dioxins.

The Ramlow study did not provide any actual information on the "Without Chloracne" sub-cohort. The information shown in Table B is based on the calculated differences between the entire cohort and the "With Chloracne" employees. It is not known if the elevated moralities from All Cancers for the non-chloroacne workers are "statistically significant".

The number of "Expected Deaths per 1000 Employees" can be used as a rough approximation of the age of a cohort. Table B shows that the "Without Chloracne" sub-cohort is slightly younger than the "With Chloracne" group (All Causes, exp. deaths/1000, 336.7 vs. 353.1).

However, even though the "Without Chloracne" sub-cohort is younger, its actual All Causes mortality is almost 50 percent greater (All Causes deaths/1000: 311 vs. 208.2) than the "With Chloracne" mortality experience.

A prior Dow study, Bond (1987)[3] reported that, for 1940 to 1982, employees without chloracne experienced a 15% increase in mortality from All Causes and a 56% increase in mortality, All Cancers compared to the with chloracne employees. The Ramlow (1997) study indicated that, with an additional 12 years, the difference between the without chloracne and the with chloracne groups had increased to a 56% increase over mortality, All Causes and a 114% increase in mortality, All Cancers.

It is highly unusual that the authors did not notice this extremely large increase with time.

It may be entirely possible that chloracne is a visible manifestation of the human body's increased biological defense mechanisms against dioxin. Those workers with chloracne may have neutralized the health effects of dioxin exposure to a greater degree than those employees without chloracne. The data shown in Table B confirms that non-

[3] Bond GG, Evaluation of Mortality Patterns Among Workers With Chloracne, Chemosphere, Vol 16, No. 8/9, pp 2117-2121 (1987)

chloracne workers have much higher death rates (All Causes, All Cancers) than do workers that were diagnosed with chloracne.

As mentioned in Volume 1, the Ramlow (1997) study is not available on the company's web site. The company did not respond to DioxinSpin's request for a copy of the study. Eventually, a confidential source provided a copy of the study. Readers desiring a copy should contact Dow and request a copy. A Freedom of Information Act request to the MDCH or the DEQ will also be effective.

Midland plant employees have, in general, a lower overall mortality than do the corresponding average US citizens. However, the lower mortality is not "statistically significant". A Dow mortality study, Ott (1987)[4], made this observation, "The SMR for all causes of death was 93. Thus, fewer deaths occurred than expected... but the difference was not statistically significant (95% confidence limits, 84 to 104). This finding of lower mortality... probably reflects both initial [employment] selection and the ongoing [health insurance] benefits of employment."

The Ramlow study provides a great deal more information than does the Bodner (2002) study. The additional information allows for a greater understanding of the health effects associated with TCDD exposure.

The Ramlow study compared the mortality of Midland plant workers exposed to TCDD against two different expected death data bases: (1) the US National average data base and (2) the expected death rates of Michigan Division employees that were not exposed to dioxins.

The comparison of the TCDD employees when compared against the US National average demonstrates lower overall mortality and lower mortality from all cancers. The elevation seen in Cancer of the Stomach, Cancer of the Prostate and Lymphatic-Hematolietic Cancers may be statistically significant.

However, the Ramlow study failed to point-out and comment on the higher mortality of the TCDD exposed workers when compared to the general population of Division employees that were not exposed to pesticide plant TCDD.

Table C shows a comparison of TCDD exposed workers with Michigan Division expected mortality and US National average mortality. The Table clearly shows that, in comparison to the non-TCDD Division employees, the TCDD exposed workers have a higher All Causes mortality and a higher All Cancer mortality.

In addition, there may be a statistically significant elevation in seven (7) out of the ten specific cancer and disease categories for which Ramlow (1997) provided data.

It is not known if the poor mortality experience is the result of TCDD exposure or the result of an anomaly in the Michigan Division data base. Additional information and explanation will be needed from the company.

[4] Ott MG, *et al*, Cohort Mortality Study of Chemical Workers With Potential Exposure to the Higher Chlorinated Dioxins, Jour Occ Med Vol 29, No 5, May 1987

Table C
The Dow Chemical Company : Midland Plant
Mortality of TCDD Exposed Workers (b)

		MICHIGAN DIVISION (a)		US NATIONAL AVERAGE	
Cause of Death	Number of Deaths	Expected Deaths	SMR	Expected Deaths	SMR
All Causes	655	637.1	**102.8**	734.5	89.2
All Cancers	168	161.9	**103.8**	170.2	98.7
Cancer, digestive organs and peritoneum	42	38.7	**108.5**	43.3	97.0
Cancer, stomach	10	5.7	**169.5**	6.7	**149.3**
Cancer, large intestine	16	14	**114.3**	15.4	**103.9**
Cancer, lung	48	56.1	85.6	59.8	80.3
Cancer, prostate	20	12.5	**160.0**	12	**167.7**
Cancer, lymphatic & hematoietic	21	15.8	**132.9**	16.4	**128.1**
Diseases, circulatory system	318	312.2	**101.9**	352.5	90.2
Nonmalignant respiratory diseases	34	41.8	81.3	50.3	67.6
Digestive diseases	24	23.2	**103.5**	31.9	75.2
Cirrosis of liver	11	11.4	96.5	17.9	61.45

(a) Internal Dow database, all Michigan Division employees not exposed to pesticide plant dioxins

(b) Ramlow (1997)

These potential oversights on the part of Dow's Epidemiology Department are extraordinary and not in keeping with the precision that has been shown in the past.

Dow's epidemiology studies of dioxin exposed workers are consistently of high quality. Occasionally, errors and oversights can be made and may not be apparent until reviewed in detail. DioxinSpin is very confident that The Dow Chemical Company is dedicated to presenting the most accurate, sound science information needed by all the interested parties in order to resolve the various issues associated with dioxin contamination in the Midland plant, in the city of Midland and in the Saginaw Valley.

A copy of this analysis will be sent to the company for review and, hopefully, comment. Any response that the company would care to make will be posted on the DioxinSpin web site.

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