1980-01-01


Committee on the Assessment of Human Health Effects of Great Lakes Water Quality

Great Lakes Science Advisory Board

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1980 Annual Report

Committee on the
Assessment of Human Health Effects of
Great Lakes Water Quality
The 1980 Progress Report of the International Joint Commission’s Committee on the Assessment of Human Health Effects of Great Lakes Water Quality was prepared for both the Water Quality Board and for the Science Advisory Board.

Highlights from the activities of the Committee from its previous reporting date, July 1979, to the present, are reported here.

1980 Annual Report

Committee on the
Assessment of Human Health Effects of
Great Lakes Water Quality

presented to the
Great Lakes Water Quality Board
and to the
Great Lakes Science Advisory Board
Preface

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The 1980 periodic report of the Interagency Joint Commission's Committee
on Scientific Assessment of Human Health Effects of Direct Lunar Nuclear
Explosions for the National Aeronautics Board.

Highlights from the Activities of the Committee from 1979 to 1980.
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Membership and Terms of Reference

for the IJC Committee on the Assessment of Human Health Effects of Great Lakes Water Quality
Introduction

The Committee on the Assessment of Human Health Effects of Great Lakes Water Quality presents a summary of its activities during 1979-80 in this report to the Water Quality Board and to the Science Advisory Board.

High priority was given to the health hazard evaluation of the chemicals identified in the Great Lakes Ecosystem, but time was taken to investigate such other areas of concern as viruses in the Great Lakes, the development of compatible cancer registries within the Great Lakes Basin and levels of contaminants in fish.

The last section of this report outlines future activities of the Committee which will reflect the ecosystem approach adopted by the Boards. Particular emphasis will be placed on the conduct of epidemiological studies and the development of data bases for such studies (morbidity and mortality data, as well as cancer registries). As more information is developed on human exposure to chemicals found in the Great Lakes Basin, hazard assessments will be made on the priority chemicals listed in this report.
Introduction

The Committee on the Assessment of Human Health Effects of Great Lakes Water Quality presents a summary of its activities during 1970-80 to the Report to the Great Lakes Board and to the Science Advisory Board.

High priority was given to the West Lake Eradication, and funds were allocated to investigate methods of control of the organism. The task was assigned to Colorado as a model for the Great Lakes. The development of the comprehensive cancer registries within the Great Lakes Basin and their role in cancer control activities is included in this report.

The last section of this report outlines future activities of the Committee, which will reflect the continuing efforts and the progress of the Board.

As more information is developed on human exposure to contaminants found in the Great Lakes Basin, greater emphasis will be placed on the priority given to these factors in this report.
I. Viruses

VIRUSES - Sources and Significance of Viruses in the Water Environment

Background

Sewage is the source of most of the viruses of human enteric origin that occur in surface waters. In the temperate areas of North America, these viruses are recoverable in quantities of 100 to 1,000 plaque-forming units (PFU) per litre from almost all domestic sewage. Ten to one hundred times higher counts are reported from other parts of the world (1). Because of the current limitations of available isolation methods, the true concentrations of viruses in sewage could be one or two orders of magnitude greater than those currently reported.

Most viruses of enteric origin predominate in populations during the warmer months of the year and consequently are found in sewage in largest numbers during the warmer season. Hepatitis A virus, rotaviruses (neither easily detected in waters because of lack of simple isolation methods) and adenoviruses, however, are primarily cold weather infectors. Specific enteric viruses, therefore, occur in sewage predominantly during certain seasons. Because of the methodology constraints and because the cell systems used to detect these viruses are usually more sensitive to many of the warm weather agents than to adenoviruses, general surveys for enteric viruses would normally show much greater numbers present during the warmer months than during the colder months. Where continuous, all season, live-virus polio vaccination programs are routinely undertaken, seasonal patterns for the total numbers of viruses recovered from sewage are obliterated.

All domestic sewage, however, is likely to contain some human enteric viruses throughout the year.

Although efficient secondary treatment and terminal disinfection remove substantial numbers of viruses from sewage, some viruses survive. This is so
because virus aggregates and viruses within particulate matter, possibly fecal, may survive chlorination whereas free, monodisperse viruses are more readily destroyed. Moreover, because the chloramines that form during the terminal disinfection of sewage with chlorine destroy indicator bacteria much more rapidly than they destroy viruses, it is possible to reduce fecal coliform levels to 200-400 colony-forming units per 100 mL or less and still have detectable numbers of viruses in the effluent. Furthermore, viruses survive better in the water environment than do fecal coliforms. Thus, viruses have been detected in recreational waters and at the water intakes of water treatment plants at times when fecal coliforms were not detected in standard tests (2).

Treatment of public water supplies that use Great Lakes water will generally include flocculation-precipitation and disinfection, which reduce the health risk from viruses.

No virus is likely to get through a good water treatment system, except when a plant or one of its components breaks down. Concern regarding the possibility of viral (and bacterial) transmission via particulate material is reflected in the drinking water objectives of the various controlling agencies. These specify that the finished water turbidity should not exceed 1 nephelometric turbidity unit (NTU). In Ontario, the turbidity parameter has become a health rather than an aesthetic consideration.

Transmission of Viruses Through Drinking Water

In the Great Lakes, the combined effects of wastewater treatment, dilution and dieoff in the lake water and water treatment result in the virtual elimination of virus from drinking water, yet there is no guarantee of absolute protection of the population from this source. Current detection methods so far have failed to demonstrate the presence of viruses in single, 400 litre, samples of finished potable water in the Great Lakes Basin. The efficiency of the detection methods is in doubt. As methods are improved, occasional positive findings are a definite possibility. Isolated findings elsewhere in the U.S. and in Canada have been challenged or are under investigation.
Viruses which enter a community through a water supply may not necessarily cause overt epidemics. It has long been known that certain viruses, in the smallest numbers detectable in cell culture systems, can produce infection in man.

It has been argued that a few viruses may seed a community that contains large numbers of susceptibles and that direct contact with these index infections may bring about large numbers of new infections and perhaps disease. This thesis has been challenged (3) and there are currently no epidemiological data indicating that this kind of transmission is occurring and there has been no known outbreak of virus disease where drinking water met current biological standards (3)(3a)(3b)(3c).

This may be explained in part by the insensitivity of the epidemiological techniques employed. On the other hand we cannot ignore that one detected virus particle per 400 litres of drinking water corresponds to an exposure of only 1 virus infectious unit per year per person (at 1 litre consumption of uncooked water per day), or possibly 10 to 100, given the limited adequacy of present detection methods. By contrast, one cough or sneeze produces about 90 tissue culture infectious doses (TCID₅₀) (4). Each gram of feces of an infected person typically contains 100 to 1,000 TCID₅₀ and sometimes much more (10⁴.⁵-10⁵.⁵) (5) and these viruses are transmitted in aerosol form in flush toilets (6) and also by smear infection, since the majority of the population does not wash its hands after using the toilet.

In any community at any time a certain percentage of the population, particularly children, carries inapparent infections. During non-epidemic periods, enteroviruses were isolated from 2.6% of the healthy children of upper socio-economic levels and from 11.4% of the children of lower levels (7). This suggests that person-to-person spread or transmission of viruses through contaminated surfaces in public places and conveyances, schools, offices and homes at least in our area, outweighs that from the inadvertent reuse of municipal wastewater by the public water systems. The water route of transmission also involves certain delays, in the case of surface water in the order of one or several weeks, between the discharge of an infectious agent in
one location and its appearance in another and the patterns of spread of epidemics in large watersheds of the U.S. and Canada so far have not suggested that the primary spread occurs via the public water systems.

In view of these findings and considerations it cannot be proven and indeed it is doubtful that public water supplies drawing Great Lakes water at present contribute to the incidence of viruses in the populations they serve, except possibly when malfunctions occur.

Routine monitoring of drinking water would not appear to be practical or necessary at this time, since viruses would only be expected to be present during improper plant operation, which normally can be detected by monitoring other parameters at the plant. These determinations include types and concentrations of disinfectant and time of exposure, turbidity or other measurements of particulate matter and bacteriological examinations. Additionally, there is no currently acceptable standard method for virus isolation from any type of water and the controlling agencies have therefore not proposed a virus standard for potable water.

The Multiple Barrier Concept

The multiple barrier concept, where the disinfection of sewage and the full treatment and disinfection of surface water supplies are both regarded as necessary to prevent the spread of waterborne disease, is generally accepted by controlling agencies in the Great Lakes Basin. Microbiological standards are imposed on sewage effluents being discharged to areas of human use from the U.S. Great Lakes states and are currently under consideration by Ontario.

In many situations, however, neither conventional sewage treatment nor dilution and removal in the receiving water nor water treatment by itself, provides a reduction in virus concentrations of $10^6$ or $10^7$ which, on the basis of present methods and experience, apparently produces drinking water of acceptable quality. It seems that in many instances two, if not all three mechanisms are required to lower virus concentrations to the level now commonly observed and as a result, multiple barrier protection does not really
exist - a disquieting thought considering the reality of raw sewage bypasses at wastewater treatment plants. Moreover, proposed reductions in the use of chlorine for the disinfection of wastewater effluent (8) and possible treatment process modification and failures in connection with energy conservation measures must be evaluated carefully and steps must be taken to assure continued adequate virus removal.

The virus exposure of the public in public water supplies constitutes an involuntary risk and a very conservative position must be taken in defining an acceptable level of risk from that source.

**Sludges**

As more and more secondary sewage treatment plants come on stream, greater quantities of sewage sludges are generated. The viruses that are removed by primary, secondary and by most tertiary treatment processes end up in the sludges. After digestion (which does not destroy all of the viruses present) these sludges are often discharged to the land where they may become a threat to ground waters or to food crops.

However, in the Great Lakes Basin the disposal of such sludges is governed by guidelines, developed as a result of research studies, which have been drawn up to prevent the development of a public health hazard as a result of the practice. In Ontario, sludge cannot be used on land where crops for human consumption are grown and the type of terrain to be used for disposal and its distance from ground and surface water sources, respectively, are strictly specified. Research in this area is also intense in the U.S. and guidelines for the land application of sewage sludge are being developed under the leadership of the U.S. Food and Drug Administration and the Environmental Protection Agency.

**Aerosols**

Since viruses are present in sewage, sewage effluents and in sludges, aerosols produced from such materials at treatment plants and at discharge
sites, especially if discharges are achieved by spray, may constitute hazards to persons downwind of disposal sites. Numerous papers at a recent symposium (9), however, indicated that there was no evidence of disease transmission by aerosols and no hazard attributable to them could be substantiated with the techniques presently available.

Water and Sewage Plant Operation

There should be continuing emphasis placed on the need to upgrade the training of plant operators at both water and sewage plants; the requirements for the optimal functioning of these plants at all times should be stressed.

Research Needs

In the Autumn of 1978, a World Health Organization (WHO), Scientific Group on "Human Viruses in Water, Wastewater and Soil" met in Geneva, appraised the importance of viruses in a water environment on a world-wide scale and prepared recommendations. The following of those recommendations would appear to be relevant to the Great Lakes Basin and are endorsed by this Committee.

(1) Develop and standardize a sensitive method or methods (if necessary) for recovering small numbers of enteric viruses from waters, secondary effluents, tertiary effluents and renovated waters used for potable and recreational purposes.

This recommendation is currently being followed in the United States (Federal) and in Ontario (Provincial), where studies to develop, compare and attempt to standardize isolation methods for viruses in raw and potable waters are currently under way.

As improved methods become available, research efforts to recover viruses from drinking waters produced from highly polluted raw waters, should be encouraged as should studies on the dissemination and survival of viruses in the natural environment.
(2) Develop more reliable bacterial indicator systems for viruses in the water environment. Additional epidemiological studies should be conducted, to determine the relationship of water quality (number of viruses and indicator bacteria in the water) and the occurrence of disease in persons exposed to recreational waters into which sewage effluents are discharged.

A study funded by Health and Welfare Canada, has been designed to address these aspects at selected bathing-beaches in Ontario. The U.S. EPA presently supports epidemiologic studies at freshwater beaches.

(3) Determine the rates at which selected gastrointestinal viruses, in particular hepatitis A and rotaviruses, are destroyed by water disinfectants and the degree to which embodiment in particulates (such as fecal material) affects the disinfection process.

References


2. Health hazard ranking of Appendix E compounds

Introduction

As outlined in last year's report, a health hazard evaluation entails evaluation of available data on toxicity as well as exposure. Information on exposure may be developed from monitoring data, along with use patterns, amounts utilized in the Great Lakes Basin, the physical-chemical properties of the chemical and its environmental fate. Toxicity data may be obtained from predictive experiments in laboratory animals or from studies on humans exposed industrially or environmentally.

While investigating the available information on the parameter needed to assess man's exposure to the 381 compounds listed in Appendix E (1) and developing a procedure to utilize such data in deriving an accurate human exposure index, the Committee evaluated the available toxicological information on these chemicals. The criteria for carrying out a toxicity evaluation for the categories of acute toxicity, chronic adverse effects, carcinogenicity, mutagenicity, neurotoxicity and reproductive effects, were outlined in last year's report (2).

Results of the Committee's Evaluation

Utilizing minor, non-substantive changes in the scoring system for mutagenicity and reproductive effects, the Committee, with the assistance of data on chronic effects prepared under contract, made a preliminary assessment of those chemicals having insufficient toxicological data for any sort of toxicity evaluation, as well as those chemicals exhibiting a high level of acute toxicity in man or animals or causing chronic effects in man and/or animals. Only 89 chemicals listed in Appendix E had sufficient acute or chronic toxicity data to make a meaningful toxicity evaluation. For the remaining 292 chemicals identified in the Great Lakes Basin ecosystem, there were insufficient toxicological data to make any sort of toxicity evaluation.
The 18 chemicals listed in Table I were acutely toxic, but insufficient chronic toxicity data were available for further assessment. The chemicals of most concern are the 33 known to cause chronic effects in man (Table II). Those chemicals listed in Appendix E which were found to cause chronic effects in experimental animals only are listed in Table III.

**Estimating Exposure**

During our toxicity evaluations, it became apparent that insufficient data were available to adequately assess man's exposure to these chemicals. Thus, a health hazard evaluation is not possible at this time, nor can such evaluations be carried out until data become available on man's total daily exposure to these chemicals and/or data on the potential for exposure can be obtained. Where adequate monitoring data are not available, information on the amounts produced, used or stored in the Great Lakes Basin can, in concert with persistence data, give a reasonable estimate of man's possible exposure to a specific chemical.

**Future Activities**

Work is proceeding in these areas. Also, the physical-chemical properties of the chemicals in Tables I - III will be examined to determine which chemicals have a low probability of being found in significant quantities within the Great Lakes Basin ecosystem. Thus, it is hoped to present a more refined hazard evaluation of the chemicals in Table II and III in next year's report. Where possible, health hazard evaluations will also be carried out for any chemical identified within the Great Lakes Basin ecosystem which is brought to the attention of the Health Effects Committee. A list of references supporting such assessment will be prepared at that time.

**Recommendations**

Meanwhile, the Committee urges that appropriate agencies carry out more measurements to ascertain the extent of contamination by those chemicals listed in Tables II and III. Also, chronic toxicity data must be accumulated.
on those chemicals in Table I if it is found that such materials are widely utilized in the Great Lakes Basin. A similar recommendation should be made regarding those chemicals listed in Appendix E for which insufficient toxicity data were available, but which are widely utilized in the Great Lakes Basin. It is also proposed that the Health Effects Committee review the draft Great Lakes International Surveillance Plan to ensure that it will provide information directly applicable to assessing exposure data to humans.

### TABLE I

**APPENDIX E CHEMICALS FOR WHICH ONLY ACUTE TOXICITY DATA ARE AVAILABLE**

<table>
<thead>
<tr>
<th>COMPOUND NUMBER*</th>
<th>CHEMICAL COMPOUND</th>
<th>ORAL LD$_{50}$ $(&lt;5 \text{ mg/kg})$</th>
<th>ORAL LD$_{50}$ $(5-50 \text{ mg/kg})$</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Acetone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Benzyl alcohol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>Borneol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>Bromochloroethane</td>
<td></td>
<td></td>
</tr>
<tr>
<td>44</td>
<td>Camphor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>Carbofuran</td>
<td>Carbofuran</td>
<td></td>
</tr>
<tr>
<td>51</td>
<td>Diazinon</td>
<td>Diazinon</td>
<td></td>
</tr>
<tr>
<td>78</td>
<td>bis-2-Chloroethane</td>
<td></td>
<td></td>
</tr>
<tr>
<td>115</td>
<td>Diisobutyl phthalate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>121</td>
<td>N,N-Dimethyl aniline</td>
<td></td>
<td></td>
</tr>
<tr>
<td>141</td>
<td>Endosulfan $(\alpha,\beta)$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>144</td>
<td>Ethion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>157</td>
<td>Guaiacol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>231</td>
<td>Monochlorophenol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>233</td>
<td>Naphthalene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>317</td>
<td>Trichlorotrifluoroethane</td>
<td></td>
<td></td>
</tr>
<tr>
<td>322</td>
<td>Triphenyl phosphate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>333</td>
<td>Vanadium</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Chemical numbers are those used in the Great Lakes Water Quality Board Report, Appendix E, July 1978.
<table>
<thead>
<tr>
<th>COMPOUND NUMBER*</th>
<th>CHEMICAL**</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Aniline</td>
</tr>
<tr>
<td>46</td>
<td>Carbon disulphide</td>
</tr>
<tr>
<td>57</td>
<td>Chloropropene</td>
</tr>
<tr>
<td>96</td>
<td>1,2-Dichloroethane</td>
</tr>
<tr>
<td>103</td>
<td>2,4(Dichlorophenoxy) acetic acid</td>
</tr>
<tr>
<td>130</td>
<td>Dioxane</td>
</tr>
<tr>
<td>147</td>
<td>Ethyl Benzene</td>
</tr>
<tr>
<td>155</td>
<td>Formaldehyde</td>
</tr>
<tr>
<td>181</td>
<td>Leptophos</td>
</tr>
<tr>
<td>293</td>
<td>Tetrachloroethane</td>
</tr>
<tr>
<td>327</td>
<td>Vinyl chloride</td>
</tr>
<tr>
<td>330</td>
<td>Cobalt</td>
</tr>
<tr>
<td>334</td>
<td>Benzene</td>
</tr>
<tr>
<td>335</td>
<td>Dichlorobenzenes</td>
</tr>
<tr>
<td>339</td>
<td>Hexachlorobenzene</td>
</tr>
<tr>
<td>341</td>
<td>Chlorinated Naphthalenes</td>
</tr>
<tr>
<td>344</td>
<td>Trichlorophenols (2,4,5- and 2,4,6-)+</td>
</tr>
<tr>
<td>345</td>
<td>Pentachlorophenol+</td>
</tr>
<tr>
<td>347</td>
<td>Carbon tetrachloride</td>
</tr>
<tr>
<td>348</td>
<td>Chloroform</td>
</tr>
<tr>
<td>350</td>
<td>Tetrachloroethylene</td>
</tr>
<tr>
<td>353</td>
<td>Toluene</td>
</tr>
<tr>
<td>355</td>
<td>2,3,7,8-Tetrachlorodibenzo-p-dioxin</td>
</tr>
<tr>
<td>358</td>
<td>Polybrominated biphenyls</td>
</tr>
<tr>
<td>360</td>
<td>Nickel++</td>
</tr>
<tr>
<td>362</td>
<td>Chromium++</td>
</tr>
<tr>
<td>373</td>
<td>Polychlorinated biphenyls</td>
</tr>
<tr>
<td>374</td>
<td>Kepone</td>
</tr>
<tr>
<td>376</td>
<td>Arsenic++</td>
</tr>
<tr>
<td>377</td>
<td>Cadmium++</td>
</tr>
<tr>
<td>378</td>
<td>Lead</td>
</tr>
<tr>
<td>379</td>
<td>Mercury</td>
</tr>
<tr>
<td>379</td>
<td>Methyl Mercury</td>
</tr>
</tbody>
</table>

* Chemical numbers are those used in the Great Lakes Water Quality Board Report, Appendix E, July 1978.

** Chronic effects in humans have resulted from relatively long periods of exposure to high levels of these chemicals in the general environment or from occupational exposures. The human health hazard from low environmental levels must be ascertained.

† In addition to the chronic toxicity in man of the parent chemical, there is concern over the human health hazard of contaminants such as dioxins associated with the production of these chemicals.

++ Only specific compounds of these elements have been shown to cause chronic toxic effects in man.
### TABLE III

**APPENDIX E CHEMICALS KNOWN TO CAUSE CHRONIC ADVERSE EFFECTS IN EXPERIMENTAL ANIMALS ONLY**

<table>
<thead>
<tr>
<th>COMPOUND NUMBER*</th>
<th>CHEMICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Anthracene</td>
</tr>
<tr>
<td>23</td>
<td>Benzo(a)pyrene</td>
</tr>
<tr>
<td>33</td>
<td>Butadiene, 1,3</td>
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<tr>
<td>47</td>
<td>2-Chloroaniline</td>
</tr>
<tr>
<td>65</td>
<td>Chrysene</td>
</tr>
<tr>
<td>79</td>
<td>Diazobenzene</td>
</tr>
<tr>
<td>80</td>
<td>Dibenz (a,h)-Anthracene</td>
</tr>
<tr>
<td>85</td>
<td>1,2-Dibromoethane</td>
</tr>
<tr>
<td>88</td>
<td>2,2-Dichlorobenzidene</td>
</tr>
<tr>
<td>91</td>
<td>Dichlorobutadienes</td>
</tr>
<tr>
<td>163</td>
<td>Hexachlorobutene</td>
</tr>
<tr>
<td>164</td>
<td>Hexachloroethane</td>
</tr>
<tr>
<td>183</td>
<td>Limonene</td>
</tr>
<tr>
<td>185</td>
<td>Malathion</td>
</tr>
<tr>
<td>212</td>
<td>Methyl methacrylate</td>
</tr>
<tr>
<td>245</td>
<td>Oxychlordane</td>
</tr>
<tr>
<td>267</td>
<td>Photomirex</td>
</tr>
<tr>
<td>274</td>
<td>Safrole</td>
</tr>
<tr>
<td>275</td>
<td>Salicylic acid</td>
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<tr>
<td>277</td>
<td>Silvex</td>
</tr>
<tr>
<td>281</td>
<td>Styrene</td>
</tr>
<tr>
<td>302</td>
<td>Tetrahydrofuran</td>
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<tr>
<td>312</td>
<td>Trichloroethylene</td>
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<td>315</td>
<td>(2,4,5-Triphenoxy)acetic acid</td>
</tr>
<tr>
<td>326</td>
<td>Vinyl bromide</td>
</tr>
<tr>
<td>328</td>
<td>Xylenes</td>
</tr>
<tr>
<td>331</td>
<td>Silver</td>
</tr>
<tr>
<td>352</td>
<td>Hexachlorobutadiene</td>
</tr>
<tr>
<td>356</td>
<td>α-(Hexachlorocyclohexane)</td>
</tr>
<tr>
<td>359</td>
<td>Chlorinated terphenyls</td>
</tr>
<tr>
<td>363</td>
<td>Aldrin</td>
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<tr>
<td>364</td>
<td>Chlordane</td>
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<tr>
<td>365</td>
<td>Dieldrin</td>
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<tr>
<td>366</td>
<td>DDT and metabolites</td>
</tr>
<tr>
<td>367</td>
<td>Endrin</td>
</tr>
<tr>
<td>370</td>
<td>Lindane</td>
</tr>
<tr>
<td>372</td>
<td>Toxaphene</td>
</tr>
<tr>
<td>375</td>
<td>Mirex</td>
</tr>
</tbody>
</table>

* Chemical numbers are those used in the Great Lakes Water Quality Board Report, Appendix E, July 1978.
References


3. Levels of contaminants in Great Lakes fish

Background

In a personal communication to the IJC Health Effects Committee, Dr. Edward Horn, Division of Fish and Wildlife, New York State Department of Environmental Conservation, presented the Abstract of the paper "Trends in Levels of Several Known Chemical Contaminants in Fish from New York State Waters", by Roger W. Armstrong and Ronald J. Sloan.

It should be noted that a parallel fish surveillance study undertaken by the Ontario Ministry of the Environment in Lake Ontario has yielded similar results, indicating a significant decline of organochlorine residual contaminants (PCBs, DDT and mirex) in the species studied.

The Abstract of the New York State study and the data from Ontario are both reproduced in Chapter 5 of the Great Lakes Water Quality Board's Report to the International Joint Commission, November, 1980.

Recommendation

The Committee recommends that additional fish surveillance studies be carried out in order to closely monitor decontamination trends in Great Lakes fish so as to assess "real time" exposures of man as well as to assess the effectiveness of contaminant control strategies.
References


In a report on communication to the Joint Technical Group on Water Quality Board of the Great Lakes, Division of Fish and Wildlife, New York State Department of Conservation, Environmental Conservation, New York State, Great Lakes Water Quality Board and to the Great Lakes Water Quality Board, July 1978.

It is a standard practice to work with the environmental community to outline the potential effects of contaminants in the Great Lakes. A study was conducted by the Great Lakes Water Quality Board to evaluate the potential effects of contaminants in the Great Lakes.

The purpose of this study is to identify potential effects of contaminants in the Great Lakes. A study was conducted by the Great Lakes Water Quality Board to evaluate the potential effects of contaminants in the Great Lakes.

The Committee recommends that additional field evaluations be carried out in order to confirm the findings described in this report. These recommendations are based on the need to assess the effectiveness of contaminant control measures.
4. Cancer registries and related governmental activities

1. Proposed Joint Activities of Great Lakes Cancer Registries

Background: The Committee, at its Sixth Meeting, resolved to contact representatives of the Cancer Registries within the jurisdictions bordering on the Great Lakes with a view to fostering intercomparisons of methodology and the exchange of relevant material. As a first step in this process representatives from Michigan, New York, and Ontario were invited to describe their existing or proposed Cancer Registries during the Eighth Committee Meeting, where it was agreed that:
- the Committee would continue to facilitate meetings of representatives of existing and proposed Cancer Registries in the Great Lakes Basin to ensure compatibility;
- under the aegis of the Committee, a cancer morbidity and mortality survey would begin of contiguous counties surrounding Lake Ontario, i.e., in New York State and in Ontario; and
- the Ontario Cancer Treatment and Research Foundation would continue to maintain a liaison with the Committee.

Existing and Proposed Cancer Registry Systems in Michigan, New York, and Ontario


This report is abstracted here in some detail primarily in order to illustrate current thoughts on the subject of Cancer Registries and to identify their requirements.

Introduction: The Governor's Task Force on Michigan Cancer Data submitted its report and recommendations in June 1978. It was stated that a lack of comprehensive cancer incidence data in Michigan presents an obstacle to quantifying the relationship between high risk environmental factors and the distribution and causes of...
cancer. To meet this need, it was recommended that the Michigan Department of Public Health fund, develop and maintain a Cancer Incidence Reporting System to obtain data on cancer incidence in the state and provide for a Departmental analytical unit capable of identifying causative and risk factors involved. On the basis of this information, state wide programs could be implemented which would be designed to reduce the risk of cancer incurred by Michigan residents.

General Description

1. Information Systems:
   - Cancer Registries - these record incidence and mortality data together with diagnosis and histories of cancer patients.
     i) "Hospital Based Registries" - data are recorded for all cancer patients (In Michigan).
     ii) "Central" - cover a larger area, ie. counties, multiple-hospitals or states (In Michigan).
   - Cancer Reporting Systems - these record only the incidence or occurrence of cancer, ie. no diagnostic treatment or patient survival data (None in Michigan).

2. Data Collection and Use:
   i) Hospital Registries - the levels of data obtained are determined internally, often complying with the accreditation requirements for hospital cancer programs established by the American College of Surgeons (ACS). Few hospital registries have computerized data collection and retrieval systems and data utilization is mainly internal, eg. for cancer assessment and patient management effectiveness; patient education effort targeting; long term medical audits and the evaluation of treatment effectiveness.
   ii) Central Registries - for larger populations, consist of the following types:
     • a consortium of hospital registries formed to consolidate data collection and retrieval activities;
     • a sampling of cancer cases in a county, region or state; and
     • a register for all cancer incidence in a specified area.
An annual follow-up of patients in addition to incidence, diagnostic and treatment data, is recorded in each of the those types of Central Registry described above.

3. Data Analysis

This includes:

- incidence trends;
- morbidity and mortality rates;
- age, sex, site;
- race and ethnic background;
- stage of disease at diagnosis;
- assessment of the effects of stage of the disease at diagnosis; and
- treatment and survival experience.

Analysis of Central Registry data is more frequent owing to the availability of staff and facilities.

Existing Facilities in Michigan (1978)

Two Central Registries are functioning in the state, viz:
- the Michigan Cancer Foundation (MCF) Registry; and
- the Kent County Central Cancer Registry.

Both facilities maintain registers on approximately 60% of Michigan's cancer patients, the MCF being the major cancer data collector in the state with 50% of the annual incidence recorded as a detailed abstract of 72 items per patient obtained from medical records, radiotherapy, pathology and out-patient records. Additional, supplementary, information is found in death certificates and allows detection of hitherto unreported cancer cases.

Substantial information is made available to participating institutions and to the National Cancer Institute to fulfill SEER program requirements.

Comment on American College of Surgeons' Guidelines for Cancer Registries

The ACS has played a significant role in the development of Cancer
Registries since 1956 through its Commission on Cancer. One criterion for ACS approval of an institutional cancer program is a functioning Cancer Registry conducting a lifetime follow-up of all (ie. 90% or more) cancer patients and periodic reporting to hospital staff.

Governor's Task Force Recommendations (1978)

These may be summarized as follows:

- "that a state-wide Cancer Incidence Reporting System be established in the State Department of Public Health";
- "that a Cancer Epidemiology Study Unit be established in the State Department of Public Health"; and
- "that an independent Cancer Research Advisory Committee be convened at the earliest stages of the implementation process".

B. New York (established)
The New York State Department of Health has a Cancer Incidence Reporting System.

Data  By law, a malignant neoplasm report record with 23 items must be completed and submitted to the Department on every cancer patient diagnosed or treated. A computerized data storage and retrieval system is used.

Data Sources  These are primarily hospital medical records and tumour registries and secondarily, departments of pathology.

Data Utilization  Annual reports are published on cancer incidence and mortality, with information on cancer incidence by county. Epidemiological studies are also undertaken by the Department of Health.

C. Ontario (established)
The Ontario Cancer Treatment and Research Foundation's Division of Epidemiology and Statistics maintains a "passive" cancer reporting system for the entire province, utilizing data voluntarily submitted by multiple sources. In addition, a sub-registry consists of cancer
patients treated at the Foundation's clinics throughout the province, this being an actively followed group of patients representing about one-half of all cancer cases in Ontario. The 1957 Cancer Act mandates the Foundation's responsibility to collect cancer information, to retain this confidential information and to utilize the information for clinical and epidemiological research.

**Data**
A computerized data storage and retrieval system is used. Computerized medical record linkage techniques are used to match different source records to create newly diagnosed cases of cancer. The technique uses linking weights of statistical probabilities for each variable comparison (name, date of birth, OHIP number, etc.) because a unique, personal, identifying number does not exist in Ontario. The following sources of data are utilized for the Ontario Cancer Registry: every Ontario hospital discharge record with a mention of cancer among the diagnoses; every Ontario death certificate which mentions cancer; all new patient registrations from the Foundation's sponsored biopsy and chemotherapy drug programs; pathology department reports with mention of cancer (haematology labs to be added soon); information from regional or local tumour registries; and reports of Ontario cancer cases diagnosed in any other of the 10 Canadian provinces.

**Data Files**
A brief description of major data files is given below:

- cancer incidence 1969 - 1971 and the years 1964 - 1968 and 1972 - 1977 are currently being created which will bring the total to 325,000 cases for the 14 year period;
- cancer mortality 1950 - 1979, about 390,000 deaths;
- treatment centre patients 1960 - 1980, about 273,000 patients;
- census data 1951 - 1976, population data by county, sex and age; and
- patient activity 1969 - 1980, about 1.5 million records on each Regional Treatment Centre patient visit including information on treatments and follow-up.
Data Coding  The Foundation has been using each revision of the TNM staging classifications since their inception. Site of disease follows the ICD revisions and in 1979 the Foundation used the ICDO coding system in addition to the ICD9 when the codes differ. Strict coding procedures are followed and assessed by the use of an ongoing quality control mechanism.

Data Utilization  The Division of Epidemiology and Statistics uses the data for many different cancer research projects and assists other researchers. A major service function exists by utilizing the data for enquiries by government, medical institutions, researchers, international agencies, news media and the public. In addition to an annual report, supplements and a monograph series on cancer topics are being planned. Each year selected cancer sites undergo a medical audit and one of the functions is to generate detailed survival analyses on patients followed at the treatment centres (recent sites were 10,000 cervix cases, 25,000 breast cases, 2,000 larynx cases and 3,000 testis cases). The Division operates a research unit at the University of Toronto which performs many epidemiologic studies and special investigations requested by the Ontario Ministry of Health. Also, submissions of data are made to Statistics Canada for inclusion in the National Cancer Incidence Reporting System and to the World Health Organization for the international publication 'Cancer Incidence in Five Continents'.

RECOMMENDATION

A Proposed Workshop for Great Lakes Basin Cancer Registry Intercomparisons, 1981

As a further step in the process of implementing the Committee's agreed intent to ensure compatibility of data collection and handling methodologies of Cancer Registries in the Great Lakes Basin, a Workshop on the compatibility of Great Lakes Basin Cancer Registries Intercomparisons has been proposed for 1981 to be held under the auspices of the
Committee. This activity would be a necessary prelude to the proposed cancer morbidity and mortality survey of the counties bordering on Lake Ontario, also agreed to by the Committee. Further details for both the Workshop and the study have yet to be developed by the Committee.

Introduction

In this Chapter, proposed future activities of the Committee are outlined. These activities are in accord with the stipulations of the 1978 Great Lakes Water Quality Agreement and will address the adequacy of the Water Quality Objectives, both chemical and microbiological, for the protection of human health. A further account of these activities will be provided in the 1984 Biennial Report of the Committee.

1. Viruses and Other Microbiological Indicators

The Committee will continue to closely examine advances in the field of viruses and other microbiological indicators in order to advise the Boards of significant developments likely to affect human health through the current usage of Great Lakes waters for recreation and drinking purposes and to advise the Boards generally on the scientific basis for adopting aquatic ecosystem objectives.

2. Human Health Hazard Assessment of Great Lakes Basin Ecosystem Contaminants

A. Hazard Ranking of Appendix F Compounds

The Committee is continuing its examination of the hazards of contaminants to humans identified in the Great Lakes. Additional studies will be undertaken by the Committee during the coming year, including an evaluation of the exposure to a contaminant to provide an estimate of the hazard posed to human health.

Recommendations

1. "That a more detailed examination be made of man's exposure to chemicals presently identified in the Great Lakes and shown to induce chronic toxicity in humans."
Data Utilization. The Division of Epidemiology and Statistics uses the data for many different cancer research projects and assists other researchers. A major service function exists by utilizing the data for queries by government, medical institutions, researchers, international agencies, news media and the public. In addition to an annual report, questionnaires and a monograph dealing on cancer topics are being produced. Each year selected cancer sites undergo a medical audit and one of the functions is to generate detailed survival analyses on patients enrolled at the eight cancer centres (recent sites were 10,000 cervix cases, 25,000 breast cases, 8,000 liver cases and 3,000 testis cases). The Division operates a research unit at the University of Toronto which performs many epidemiologic studies and special investigations requested by the Ontario Ministry of Health. Also, submissions of data are made to Statistics Canada for inclusion in the National Cancer Incidence Reporting System and to the World Health Organization for the International publication 'Cancer Incidence in Five Continents'.
5. Health perspectives

Introduction

In this Chapter, proposed future activities of the Committee are outlined. These activities are in accord with the stipulations of the 1978 Great Lakes Water Quality Agreement and will assess the adequacy of the Water Quality Objectives, both chemical and microbiological, for the protection of human health. A further account of these activities will be provided in the 1981 Biennial Report of the Committee.

1. Viruses and Other Microbiological Indicators

The Committee will continue to closely examine advances in the field of viruses and other microbiological indicators in order to advise the Boards of significant developments likely to affect human health through the current usage of Great Lakes waters for recreation and drinking purposes and to advise the Boards generally on the scientific basis for adopting aquatic ecosystem objectives.

2. Human Health Hazard Assessment of Great Lakes Basin Ecosystem Contaminants

A. Hazard Ranking of Appendix E Compounds

The Committee is continuing its examination of the hazards of contaminants to humans identified in the Great Lakes. Additional studies will be undertaken by the Committee during the coming year, including an evaluation of the exposure to a contaminant to provide an estimate of the hazard posed to human health.

RECOMMENDATIONS

1. That a more detailed examination be made of man's exposure to chemicals presently identified in the Great Lakes and known to induce chronic toxicity in humans.
2. For many chemical contaminants identified in the Great Lakes with potential human health effects, an inadequate toxicological data base exists. It is therefore urged that the Governments be advised that additional toxicological studies on these chemicals be undertaken to permit assessment of their hazard to human health.

B. Air Component

The Committee proposes studying the air component of the ecosystem as an integral part of its examination of health hazards posed by the Great Lakes Basin Ecosystem. This activity would entail further study of the health effects associated with existing and proposed energy technologies and the long range air transportation of contaminants.

C. Epidemiological Studies of Great Lakes Basin Residents

In recent years, the Science Advisory Board has urged that residents of the Great Lakes Basin be singled out for epidemiological studies.

The Committee has responded to the Board's leadership by contacting representatives from Great Lakes Basin Cancer Registries and by recommending that an IJC workshop be held in 1981 on "The Compatibility of Great Lakes Basin Cancer Registries"; see Chapter 4, above. Such a workshop would foster the uniformity of data recording and encourage the exchange of information among the Cancer Registries of the region.

The Committee has further recommended that an international, transboundary, cancer morbidity and mortality survey be made of the counties bordering on Lake Ontario; involving primarily the Ontario and New York Cancer Registries under the aegis of the Committee. Additional details will be developed by the Committee.

During the coming year, the Committee will discuss the adequacy of epidemiological techniques and identify major areas of concern regarding the design of epidemiological studies in human populations found in the Great
Lakes Basin. It is proposed that a workshop be held on "Epidemiological Methodologies and their Role" in order to develop guidelines for epidemiological studies. The Committee has yet to discuss the advisability of holding a workshop on this topic.

In taking these steps, the Committee has begun to explore the serious problem of latency in disease, where a period of up to 20-40 years is not uncommon before chronic symptoms appear. The long term health perspective on this important topic will be further developed by the Committee in its 1981 Biennial Report.
2. For many chemical contaminants identified in the Great Lakes with potential human health effects, no long-term toxicological studies have been conducted. Therefore, the Committee has decided that additional toxicological studies on these chemicals are necessary to provide a more definitive assessment of their effects on human health.

3. Air Compositions

Many air pollutants, such as those emitted by power plants and industries, can have significant impacts on the environment and human health. The Committee recommends further research on the impact of air compositions on the Great Lakes Basin Ecosystem. This will help in understanding the potential effects associated with various pollutants and their impact on the flora and fauna of the region.

C. Epidemiological Studies of Great Lakes Basin Residents

In recent years, the Scientific Advisory Board has argued that residents of the Great Lakes Basin be studied for epidemiological studies. The Committee has responded to the Board's leadership by contacting representatives from Great Lakes Basin Cancer Registries and by recommending that a workshop be held in 1981 on "The Compatibility of Great Lakes Basin Cancer Registries." The workshop would foster the uniformity of data standards and encourage the exchange of information among the Cancer Registries in the region.

The workshop has been proposed to include representatives from each State, Province boundary, and other federal agencies within the Great Lakes Basin. The workshop would aim to harmonize the Ontario and New York Cancer Registries under the aegis of the Committee. Additional details will be developed by the Committee.

During the coming year, the Committee will address the adequacy of epidemiological techniques and identify major areas of concern regarding the design of epidemiological studies in human populations found in the Great Lakes Basin.
6. Recommendations

1. Hazard Ranking of Appendix E Compounds

1. That a more detailed examination be made of man's exposure to chemicals presently identified in the Great Lakes and known to induce chronic toxicity in humans.

2. The Committee recommends that additional fish surveillance studies be carried out in order to closely monitor decontamination trends occurring in Great Lakes fish so as to assess "real time" exposures of man as well as to assess the effectiveness of contaminant control strategies.

3. For many chemical contaminants identified in the Great Lakes with potential human health effects, an inadequate toxicological data base exists. It is therefore urged that the Governments be advised that additional toxicological studies on the chemicals be undertaken to permit assessment of their hazard to human health.


As a further step in the process of implementing the Committee's agreed intent to ensure compatibility of data collection and handling methodologies of Cancer Registries in the Great Lakes Basin, a Workshop on the Compatibility of Great Lakes Basin Cancer Registries has been proposed for 1981 to be held under the auspices of the Committee. This activity would be a necessary prelude to the proposed cancer morbidity and mortality survey of the counties bordering on Lake Ontario, also agreed to by the Committee. Further details for both the Workshop and the study have yet to be developed by the Committee.
3. **A Workshop on the Interaction of Toxic Chemicals of Concern in the Great Lakes Ecosystem**

Models are currently under development to evaluate the toxicity of exposure to mixtures and verification of the models is necessary for predicting the combined effects of the compounds present. Based on acute toxicity data for the individual chemicals, prediction of their joint action has been possible but is presently limited to handling two or three interacting compounds at one time.

The workshop is intended to review the current state of knowledge concerning these predictive models, the nature of their data requirements, and the limitations of their application. In addition, the results of this activity will complement the Water Quality Board's list of chemicals found in the Great Lakes ecosystem and will aid in the process of identifying and quantifying potential toxicological effects of interactions.

Although recommended by the Committee in its July, 1979, report, this workshop will probably be held at some future date when appropriate to the needs of the developing state-of-the-art.
Membership List and Terms of Reference

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ASSESSMENT OF HUMAN HEALTH EFFECTS OF GREAT LAKES WATER QUALITY

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ASSESSMENT OF HUMAN HEALTH EFFECTS OF GREAT LAKES WATER QUALITY  

(Continued)

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TERMS OF REFERENCE  
for the  
JOINT SCIENCE ADVISORY BOARD/WATER QUALITY BOARD  
IJC COMMITTEE ON THE ASSESSMENT OF HUMAN HEALTH EFFECTS

The Committee will take the following under its purview:

1. assess the risk to health posed by contaminants in the Great Lakes ecosystem;

2. review action levels and guidelines for selected substances;

3. provide to the International Joint Commission through its Boards, interpretation and consultation on health matters;

4. maintain awareness of current advances and knowledge as they relate to human health aspects of the Great Lakes ecosystem.