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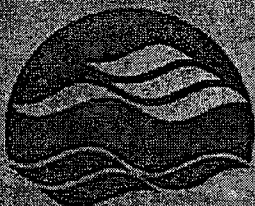


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NATIONAL WATER  
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**TOWARDS A RESEARCH STRATEGY ON THE  
ASSESSMENT OF HUMAN AND AGRICULTURAL  
PHARMACEUTICALS AND THERAPUTIC  
PRODUCTS IN THE CANADIAN ENVIRONMENT**

**Mark R. Servos and Elizabeth Innes**

**NWRI Contribution No. 01-054**

***Towards a Research Strategy on the Assessment of Human and  
Agricultural Pharmaceuticals and Therapeutic Products in the  
Canadian Environment***

Proceedings of a Meeting Hosted by the  
National Water Research Institute, Environment Canada  
Holiday Inn Plaza La Chaudière, Hull, Québec  
August 15<sup>th</sup>, 2001

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NWRI Report 01-054  
October 4, 2001

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## **Management Perspective**

Pharmaceuticals and therapeutic products in the environment is an important emerging international issue with potential implications for Canadians and the Canadian environment. The use of these substances by humans and in agriculture results in their environmental release in effluents or surface runoff. Several of these chemicals have been widely detected in surface waters at concentrations that may cause adverse effects in ecosystems and there are concerns over their possible presence in drinking water supplies. There is very little information available globally and only preliminary data on the exposure of these chemicals in the Canadian environment. The potential for ecological and human health effects is also very poorly understood. They usually enter the environment as mixtures with the potential for complex interactions. The wide variety of potential pharmaceuticals and therapeutic products, as well as potential modes of action, makes the environmental assessment of this group particularly problematic. Current approaches are unlikely to be adequate to protect ecosystem and human health. These substances are expected to have significant effects at very low concentrations, especially during critical stages of develop. The lack of data and knowledge for these compounds will make it difficult to conduct environmental assessments or develop scientifically defensible regulations to meet the requirements of CEPA 1999. This report is the proceedings of a multidepartmental meeting held on August 15<sup>th</sup>, 2001, which scoped the research needs of the federal departments with regard to this issue. The major knowledge gaps, and needs, as well as a recommended path forward are presented based on the conclusions of the meeting participants.

## **Sommaire à l'intention de la direction**

Depuis quelque temps, la présence de produits pharmaceutiques et thérapeutiques dans l'environnement suscite des inquiétudes dans le monde entier, et cet état de choses pourrait aussi avoir des incidences sur l'état de l'environnement et sur la santé publique au Canada. L'utilisation de ces substances par les humains et en agriculture est à l'origine de rejets dans l'environnement par les effluents ou par le ruissellement. On a détecté plusieurs de ces substances chimiques dans les eaux de surface, à des concentrations pouvant avoir des effets néfastes sur les écosystèmes, et on craint qu'elles ne soient présentes dans les approvisionnements en eau de boisson.

On ne dispose que de très peu d'informations à l'échelle mondiale et l'on n'a que des données préliminaires sur l'exposition à ces substances chimiques dans l'environnement canadien. De plus, on ne comprend pas très bien leurs effets possibles sur l'environnement et sur la santé humaine. Ces agents pénètrent habituellement dans l'environnement à l'état de mélanges qui peuvent avoir des interactions complexes. La grande diversité des produits pharmaceutiques et thérapeutiques, ainsi que de leurs modes d'action possibles, rendent difficile d'effectuer une évaluation environnementale pour ce groupe, qui risque de poser un grand nombre de problèmes. Et il est peu probable que les approches actuelles soient adéquates pour protéger les écosystèmes et la santé humaine. On croit que ces substances peuvent avoir des effets significatifs à de très faibles concentrations, surtout pendant les stades critiques du développement. Le manque de données et de connaissances sur ces composés rendra difficile de mener des évaluations environnementales ou d'élaborer des règlements sur une base scientifique, conformément aux exigences de la LCPE de 1999. Ce rapport fait état d'une réunion multilatérale tenue le 15 août 2001 pour définir les besoins en recherches de plusieurs ministères du gouvernement fédéral. On y présente les principales lacunes de données, ainsi que les besoins notés et les mesures recommandées, selon les conclusions des participants.

## Foreword

The issue of human and agricultural pharmaceuticals and therapeutic products in the environment is a rapidly emerging issue worldwide. The European Union has recently proposed new approaches for assessing the impact of both human and veterinary drugs in the environment. There will undoubtedly be growing public awareness and concern regarding the possible effects these trace bioactive compounds are having both upon human health and the health of Canadian ecosystems. Moreover, it is likely that Canada will be expected to harmonize policy and a regulatory approach with that of our trading partners.

Unfortunately there is very little information available to assess the risk of these chemicals, especially in Canada. This is confounded further by the vast array of substances. Each substance could potentially have a variety of effects. Furthermore, detection of these substances is often difficult using traditional methods. The need to gain a better understanding of the scope and of the significance of the presence of trace amounts of pharmaceuticals, personal care products, etc., on the Canadian environment has been made even more urgent because of requirements under CEPA 1999 which involve an assessment of the potential of these compounds to harm the Canadian environment.

The National Water Research Institute of Environment Canada hosted a federal multi-departmental meeting on this issue on August 15, 2001. The objectives of this meeting were to:

- Identify the major implications for regulation and policy (*i.e.*, CEPA, FDA, *etc.*);
- Identify the science needs to allow scientifically sound environmental assessments; and
- Determine a collaborative path forward to address the issue.

This meeting included federal scientists, regulators and policy makers directly involved with the issue. The structure of the meeting involved a number of formal and informal presentations and discussions on the science and regulatory needs and allowed for considerable interaction and exchange of ideas. The intention of this meeting was not to conduct a comprehensive review of research needs and knowledge gaps, but rather to identify the major issues and to develop a plan to create a sound scientific knowledge base. It is anticipated that the results of this meeting will become the basis for the establishment of a cooperative and collaborative science program focused on the policy and regulatory needs of federal Departments. The conclusions and recommendations of the breakout groups and general discussion are summarized in this report and a suggested path forward based on the results of the meeting is identified.

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## Introduction

A large number of drugs and related products have been detected recently in the environment (Daughton and Ternes 1999; Halling-Sorensen et al. 1998; Giger 2000; Sedlak et al. 2000). Human wastes (sewage) may contain a vast array of pharmaceuticals such as antibiotics, blood lipid regulators, analgesics, anti-inflammatory, and beta-blockers, as well as cosmetics and related products such as fragrances (musks), skin care products, disinfectants and antiseptics (Table 1). Current livestock and aquaculture production practices in Canada include the use of a wide variety of pharmaceuticals to enhance animal health and food production including anti-microbials (antibiotics), growth enhancers and feed supplements. These substances, and their metabolites, enter the environment primarily from the release of human and animal waste through discharge of effluents or runoff from fields treated with manures or biosolids (sludges). There are only limited data available for the distribution of a select number of these substances in Canadian municipal effluents or environments (Metcalf et al. 2001; Ternes et al. 1999). Although there are limited data, this issue has been identified as a potential threat to water quality in Canada (Servos et al. 2001b). The need to address this issue effectively has also taken on an added urgency by the requirement for products regulated under the Food and Drugs Act to comply with CEPA's new substance regulations until such time as regulations appropriate for the different substances can be developed.

Traditionally, pharmaceuticals, therapeutic products and personal care products have not been viewed as environmental pollutants. However, the potential for these substances to cause a variety of physiological responses at very low concentrations in non-target species has raised concerns for possible impacts on the Canadian environment. The direct (effluent) or indirect (agricultural runoff) release of these substances into aquatic environments may result in wide exposure of biota, including humans. Although, these substances are usually found in very low concentrations in the environment, continuous low dose exposure to these complex mixtures, especially during sensitive life stages may have significant effects. The ecological impact of long-term exposure to large mixtures of biological active chemicals is unknown. Many of these chemicals are designed to target specific biological functions at very low doses, and may be very persistent in treatment systems and the environment. Chemicals found in sewage and manure, such as natural and synthetic estrogens, are known to have biological consequences at extremely low exposures (Servos et al. 2001a; Burnison et al. 2001). Many drugs can alter the normal function of the endocrine systems and other systems of animals. Exposure of biota to even low doses during critical or sensitive life stages may have profound effects on development and reproduction of several generations. Impacts on endocrine function have been identified as an important issue and research on endocrine disrupting substances is a requirement under CEPA 1999 (Servos et al. 2001a). Preliminary risk assessments conducted on selected pharmaceuticals and therapeutic products in Denmark and the United Kingdom have indicated that there is a risk to the environment from the current exposure to several of these substances (Stuer-Lauridsen et al. 2000; CSTEE European Commission 2001). These assessments used traditional endpoints and when other



**Table 1. Examples of pharmaceuticals, therapeutic products and personal care products that may enter the environment.**

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**Pharmaceuticals and Therapeutic Products**

Synthetic Hormones

*e.g. synthetic estrogen (17 $\alpha$ -ethynylestradiol); androgen hormone inhibitors (finasteride); thyroxine analogs*

Antibiotics

*e.g. penicillins, erythromycin, tetracycline*

Blood Lipid Regulators

*e.g. fibrates e.g., clofibrate (clofibric acid)*

Analgesics/Non-steroidal Anti-Inflammatory

*e.g. ibuprofen, acetylsalicylic acid, diclofenac*

Beta-Blockers

*e.g. metoprolol, propranolol*

Antidepressants

*e.g. fluoxetine (Prozac)*

Antiepileptics

*e.g. carbamazepine*

Antineoplastics (hospitals)

*e.g. oxazaphosphorines, ifosfamide*

Impotency

*e.g. sildenafil citrate (Viagra)*

Tranquilizers

*e.g. diazepam*

Retinoids

*e.g. tretinoin, isotretinoin (derivatives of vitamin A)*

Diagnostic Contrast Media (hospitals)

*e.g. diatrizoate, iopromide*

**Personal Care Products**

Fragrances (musks)

*e.g. musk ketone, musk xylene, nitro musk*

Preservatives

*e.g. alkyl-p-hydroxybenzoates*

Disinfectants/Antiseptics

*e.g. Triclosan (2,4,4'-trichloro-2'-hydroxydiphenyl ether)*

Sunscreen Agents

*e.g. methylbenzylidene camphor*

Nutraceuticals/Herbal Remedies

*e.g. wide array of natural substances*

Food Products

*e.g. caffeine*

**Other Products**

Wide array of other drug classes

Biologics

Veterinary pesticides and therapeutics

Illicit drugs

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endpoints such as endocrine disruption are included under a weight of evidence approach, as required by CEPA 1999, the level of concern may be heightened. However, conducting risk assessments using non-traditional endpoints like endocrine disruption presents a variety of scientific challenges (Servos et al. 2001c).

In addition to the direct effects of drugs, the heavy use of antimicrobial drugs may result in the development of antibiotic resistant microbes. Antibiotic resistance is created when bacteria transfer genes to other, unrelated bacteria, including known pathogens. Given a low level but continuous concentration of a vast array of antibiotics in the environment, bacteria which are genetically disposed to be resistant a given group of antibiotics can pass this resistance on to other bacteria through gene transfer. Ultimately this will allow for the proliferation of antibiotic resistant bacteria. Antibiotic resistance can be potentially transferred via the environment to either human or environmental pathogens. The European Union has prohibited the non-therapeutic use of antimicrobial products that are important in humans, in animals and livestock production, as a precaution to avoid the potential development of antimicrobial resistance. Antimicrobial resistance would restrict the future therapeutic benefits of these compounds both in animals and humans. Currently concern has arisen as several antibiotics have been found in soils and surface waters around the globe.

The array of pharmaceuticals in use for both humans and animals will continue to diversify and grow with changing use patterns in human populations and animal production facilities. Rapid developments in the pharmaceutical industry will also continue to add quickly to the vast number of chemicals entering the environment. Many of these chemicals, especially drugs, may to be engineered to be increasingly persistent in the body, specific and biologically active. This will make future assessment and monitoring of these chemicals very difficult, as analytical and testing methods for the environment may not be available.

The sources of contamination, the distribution of substances, their fate and the exposure of biota to this wide range of substances are not currently well documented in Canada. The ecological and human health consequences of exposure to these substances, metabolites or products (e.g., anti-microbial resistance) needs to be determined to allow for scientifically sound risk assessments and the development of appropriate risk management strategies.

## **The Food and Drug Act and Canadian Environmental Protection Act**

When the Canadian Environmental Protection Act (CEPA) 1999 was promulgated in the spring of 2000, it formalized the requirements for exemption from environmental assessments under CEPA 1988. Under CEPA 1999, it became the responsibility of the Governor-in-Council to determine whether or not the regulations and legislative authorities administered by another Department were equivalent to those of CEPA, to warrant exemption from CEPA's environmental assessment requirements. Accordingly, Departments were given two years to "list" their legislation and regulations under Schedules 2 and 4 of CEPA 1999. Schedule 2 was intended for chemicals and polymers and Schedule 4 was intended for products of biotechnology.

Due to fundamental questions regarding both the ability of the Food and Drugs Act to meet the policy intent of CEPA and the robustness of the Food and Drugs Act (1953) to successfully administer and enforce environmental assessment regulations, together with the enormity of the task of developing regulations for the substances for which the Food and Drugs Act is responsible, e.g. cosmetics, natural health products, medical devices, pharmaceuticals, disinfectants and sanitizers, the Food & Drugs Act was not listed in either Schedule 2 or Schedule 4. Accordingly, "new" substances regulated under the Food and Drugs Act will default to the New Substance Notification, (NSN) Regulations of CEPA.

It is acknowledged that the NSN regulations were developed with commercial chemicals in mind, and are therefore not entirely suitable for the regulation of Food & Drugs Act products. But there are significant difficulties associated with the development of appropriate regulations and associated risk management techniques and methodologies for the products of the Food and Drugs Act. These difficulties stem in part from a fundamental lack of understanding of the extent and significance of the release of these substances into the environment.

It is expected that the development of appropriate risk management of pharmaceuticals in the environment will be built upon three foundations:

- The first will be co-operation between federal, provincial and municipal governments since all have an important role to play in the development of an appropriate risk management strategy.
- Another will be the development of an effective bridge between science and policy. While much has been written about the difficulty of the marriage between science and government policy, effective management of this issue regarding the impact of pharmaceuticals upon ecosystems, will require policy and regulations to be sufficiently flexible in order to be able to evolve with increased scientific understanding. There is a substantial opportunity here to develop processes that will effectively link scientific initiatives and the resulting understanding of the problem with risk management strategies of governments.
- The third will be the recognition of the overlap of concern with this issue amongst federal departments including, Environment Canada, Health Canada, Agriculture and Agri-Food Canada and the Department of Fisheries and Oceans. Over and above the opportunity to develop an effective risk management strategy for pharmaceuticals in the environment, this initiative represents the occasion to develop strong lines of communication between the interested departments.

Other jurisdictions including the European Community and the United States have taken steps to implement environmental assessments of human and veterinary pharmaceuticals and therapeutic products and have recently provided guidance for industry (Scientific Committee on Toxicity, Ecotoxicology and the Environment, European Commission. 2001; Committee for Veterinary Medicinal Products 1998; U.S. Department of Health and Human Services 1998; 1999). International cooperation and harmonization may become critically important.

## Meeting Participants

Participants from several departments (Table 2) attended the meeting and contributed to the following recommendations. As stated previously, the objective was not to conduct a detailed assessment of the gaps in our scientific understanding of the issue but rather to 1) identify the major issues and 2) to identify a path forward for scientific collaboration to address the issue.

**Table 2. Departmental representatives that attended or contributed to the success of the meeting.**

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<b>Agriculture and Agri-Food Canada</b>	<b>Fisheries and Oceans Canada</b>
S.K. Ho	Andrée Chevrier
Ed Topp	<b>Health Canada</b>
Carlos Monreal	Elizabeth Nielsen
Garry Hewston	Elizabeth Innes
<b>Canadian Food Inspection Agency</b>	Ivan Ross Vrana
Linda Webster	Joseph Given
Ruben Gandia	Andrew Beck
<b>Environment Canada</b>	Luc Bourbonniere
Mark Servos	Anthony Ridgway
John Carey	Michael Wade
Jim Maguire	Helen MacDonald-Piquard
Rodney McInnis	Hugo Hamel
Scott Brown	Kim Ostapyk
Don Bennie	Corin G Roversseavx
Jim Louter	Luisa Carter-Phillips
Philippa Cureton	France Lemieux
Andy Atkinson	
Nigel Skipper	
Jonathan Tigner	
Donald Andersen	
Peter Seto	
Laird Shutt	

---

## Identification of the Major Issues

There is very little known about the sources, fate, exposure and effects of pharmaceuticals and therapeutic products on the environment. In Canada there are only preliminary data available on the presence of these chemicals in sewage effluents and this work is restricted to a limited number of substances and metabolites. The potential for substances from intensive farming practices to impact soils and runoff into adjacent aquatic environments is also poorly studied, although there is some limited information on antibiotics. The large diversity in properties of these chemicals and a poor understanding of their fate and persistence in treatment or holding systems, as well as the environment makes it very difficult to predict environmental exposure. Moreover, the wide variety of potential modes of action make it very difficult to predict the effects on non-target organisms. This is confounded by the potential for complex mixture interactions.

It is known that many pharmaceuticals may have biological effects, especially effects on endocrine function at concentrations found in effluents in Canada. Development of regulations, assessment of risk and development of risk management options for existing and new substances in this group will be difficult and severely hampered by our lack of information and knowledge. Research is necessary to increase our understanding of the exposure, effects and environmental risk so that the uncertainty associated with assessments is reduced and both assessments and new regulations are based on sound scientific understanding of the issue.

The following major knowledge gaps were identified by the participants. They are organized according to themes, but not prioritized.

### Exposure

1. The assessment of exposure must include a broad range of pharmaceuticals and therapeutic products that have the potential to enter the Canadian environment. This includes substances used both in humans and agriculture.
2. There is a need to have a better understanding of the use patterns, sales, prescriptions, production, imports, etc., as a way to predict potential entry into the environment. Survey and information gathering tools under CEPA may be used to gather information on use and production.
3. Analytical method development for a wide variety of substances, (e.g. metabolites including conjugates, and matrices including effluent, sludge, sediment, etc.) is urgently needed.
4. An evaluation of the major mode of entry is required (e.g. sewage effluents, production facilities, intensive agriculture, waste disposal).
5. Factors controlling fate, persistence and metabolism in the Canadian environment require identification.
6. Evaluation of the importance of geographic, climatic and ecosystem differences on the fate, exposure and potential effects needs to be done.
7. Need to identify active and potentially active forms (e.g. bioavailability).

### **Hazard**

8. Determination of the potential effects and their modes of action in non-target species.
9. Determination of the potential for environmental transfer of microbial resistance.
10. Determining the extent of deleterious effects on non-target species in the Canadian environment.
11. Link observed biological responses to effects at higher levels of organization, including impacts on individuals, populations and ecosystems.
12. Determination of dose-response relationships.
13. Interactions with drugs with similar modes of action.
14. Interactions with other chemicals, (e.g. heavy metals, nutrients).

### **Risk Assessment/Development of Regulations**

15. Development and validation of indicators or exposure and effects.
  - Development and validation of appropriate assessment endpoints.
  - Development and validations of appropriate approaches/methods for assessing existing substances, new substances and the environment.
  - Development and validation of tiered testing approaches.
16. Define the risk of these substances relative to other toxic substances in similar environments (e.g. sewage effluents, manures).
17. Development and validation of approaches to assess the risk of complex mixtures.
18. Development of testing approaches for new classes of substances or modes of action, etc. as new products are developed.
19. Methods to quantify the uncertainty.
20. Develop multimedia models of fate and behaviour in sources and the environment to support assessments and risk management.
21. Establish a monitoring program for surface, ground and drinking waters.

### **Risk Management**

22. An understanding of the fate and distribution of substances in sewage treatment systems, including inflow, final effluents and biosolids.
23. An understanding of the fate and distribution of substances in manures and agricultural fields.
24. Determination of the factors affecting effective removal; comparison of treatment designs and facilities.
25. Development of possible risk management strategies and alternatives.
26. Development and validation of best management practices.
27. Development of effective monitoring programs.

## **A Path Forward**

Based on the discussions that occurred a number of immediate and long-term actions and activities were identified or recommended. There is an immediate need to collect and summarize the information that exists to:

- Review the current state of knowledge on pharmaceuticals and therapeutic products in the Canadian environment and their potential effects.
- Place this data in the context of studies, initiatives and data that are available in other jurisdictions, particularly the EU and US; based on the available information, the major knowledge gaps should be identified and prioritized.
- Place the issue within the context of broader issues of toxic chemicals in these effluents and environments.

More specifically, the effluent dominated receiving waters and environments most at risk in Canada should be identified. In order to scope the potential extent of the issue a survey of the presence of these substances in a variety of effluents, manures and environments should be undertaken to assess the potential exposure. Representative sewage treatment systems and farm operations should be studied in more detail and incorporate a broad spectrum of pharmaceuticals and therapeutic products. These studies should define the temporal and spatial distribution of these potential contaminants. STPs with different treatment systems and sewer sheds should be included in the studies to define the potential variability. A variety of farm operations should be examined to determine the potential exposure from these sites.

Ultimately, a federal and national strategy should be developed that includes a research program to fill these knowledge gaps and supports risk assessments as well as the development and implementation of new regulation and appropriate risk management strategies.

A multi-departmental working group should be established. This group should facilitate communication amongst government departments and other interested parties, complete a review of the state of science in Canada and provide a forum for the integration of science, regulation development and policy.

One of the recommendations made was to hold a multidisciplinary, multi-stakeholder scientific workshop. This would include representation from various federal government departments, industry, academia, other levels of government including municipalities, non-government organizations, and interested parties. The goal of the meeting would be to review the state of the science, knowledge gaps and needs for risk assessments, regulatory and policy development. This would also serve as an opportunity to establish research collaborations and programs. The workshop should include invited experts from other jurisdiction (e.g. EU and US) and include scientists from various levels of government, universities, industry and non-government agencies with a target of 40-50 participants. This would be contingent on securing adequate funding to host and organize the meeting.

A major challenge that may restrict progress on addressing this issue will be identification and securing of adequate funding to complete the required tasks. There is currently only sporadic undirected research funding associated with this issue. However, a focused integrated research and regulatory program needs to be developed and funded.



Unlike other issues, this area has very little reliable data available on which to develop or defend regulatory assessments or actions. Current research programs and research funding initiatives such as the Toxic Substances Research Initiative (TSRI) will contribute to our knowledge but will be inadequate to address the breadth and depth of this complex issue. It is highly recommended that a strong research program should be associated with any funding requests (e.g. Memorandum to Cabinet - MC) for the implementation or development of risk assessment and risk management of Food and Drug Act substances to meet the requirements under CEPA. This should include examination of existing as well as new substances and approaches to assess and manage their risk. It is unlikely that current approaches will be sufficient or appropriate for this group of substance which are dramatically different in their environment behaviour, fate and effects from substance assessed under other programs.

Possible funding avenues identified:

- Toxic Substances Research Initiative;
- Departmental A-base and special initiatives (e.g. Priority Ecosystem Initiatives);
- National Science & Engineering Research Council (NSERC);
- Water and Wastewater Associations, e.g. WERF;
- Deputy Ministers Emerging Issues Fund (Implementation of CEPA); and
- Potential MC on Environmental Assessment Regulations for F&DA.

The inclusion of a strong research component with the proposed MC was unanimously endorsed by the groups.

This issue is not unique to Canada. It is therefore critical that Canada cooperate with other jurisdictions to address this emerging issue. It is likely that a number of key meetings, workshops and collaborations will be initiated in the immediate future that will be directly relevant to Canada. Canadian scientists should be encouraged to actively participate in these activities. Current programs such as the Canada-Germany Memorandum of Understanding (MOU) may prove to be particularly useful and should be encouraged.

### **Development of a Federal Strategy**

A federal strategy is urgently needed to coordinate and facilitate research, communication and regulation/policy development on this issue in Canada. The development of a national strategy should also be encouraged. Components of the federal strategy should include:

- A review of the state of science;
- A coordinated multidisciplinary research program;
- Integration of science with the development of regulation and policy;
- Discussion with provinces, territories and municipalities;
- A communication program.

## **Actions Recommended**

A multi-departmental working group should be established to follow-up on the recommendations of the meeting. The group should examine issues related to therapeutic products including pharmaceuticals, personal care products and related products arising from both human and agricultural uses. This proposed working group, the "Interdepartmental Working Group on Environmental Assessment and Management of Therapeutic Products", should have several objectives, including:

- To complete a critical review of the science gaps from a Canadian perspective;
- To coordinate and facilitate scientific collaboration and communications among federal departments related to risk assessment/ management and development of regulations related to therapeutic products in the environment;
- To develop an effective link between the science, regulation and policy development on the issue.

The working group should be co-chaired by Environment Canada and Health Canada and have representation from Agriculture and Agri-Food Canada and Fisheries and Oceans Canada. A secretariat should be established to facilitate the activities and communication. The group will need adequate funding to implement these objectives.

Based on the conclusions and recommendations of the participants the following actions should be initiated immediately:

- Distribution of the Proceedings of the August 15<sup>th</sup>, 2001 Meeting;
- Establish a communications network among interested groups (e.g. e-mail distribution list, etc.);
- Facilitate a multi-departmental, multi-stakeholder scientific workshop to review the current state of the science, identify knowledge gaps from a Canadian perspective for scientific assessment/management and the development of scientifically defensible regulations and risk management strategies;
- Development of a focused research program and funding to acquire the necessary knowledge to do scientifically sound assessments of existing and new FDA substances;
- Development and funding of a research program to support the development and implementation of new regulations on the environmental assessment and management of FDA substances;
- Encourage the support and participation of Canadian scientists in international activities on the issue.

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## Acknowledgements

The efforts of the many people who volunteered their time to attend this meeting and contribute to the outcome was greatly appreciated. Elizabeth Innes, Ivan Ross Vrana and S.K. Ho played an important role in planning and organizing this meeting. Ivan Ross Vrana also reviewed the document and his comments greatly enhanced the final product. The presentations by John Carey, Mark Servos, Ed Topp, Jim Louter/Nigel Skipper and Elizabeth Innes were extremely beneficial and appreciated. The advice and support of Scott Brown and Jim Maguire was greatly appreciated. Rod McInnis contributed enormously to the organization, including providing technical and logistical support. The National Water Research Institute, Aquatic Ecosystem Protection Research Branch provided financial and infrastructure support for the meeting and report.

## Appendix 1

Meeting Agenda: Towards a Research Strategy on the Assessment of Human and Agricultural Pharmaceuticals and Therapeutic Products in the Canadian Environment, Holiday Inn Plaza La Chaudière, Hull, August 15, 2001.

### Agenda

**Program Chair:** Mark Servos

- 8:30 Coffee
- 9:00 **Welcome**  
*John Carey, Executive Director, National Water Research Institute, Environment Canada*
- 9:10 **Introductions**
- 9:20 **Overview of the State of the Science on Human and Agricultural Pharmaceuticals and Therapeutic Products in the Canadian Environment**  
*Mark Servos, National Water Research Institute, Environment Canada*
- 9:50 **Implications of Antibiotics and Antibiotic Resistance in the Environment Related to Agricultural Practices**  
*Ed Topp Agriculture and Agri-Food Canada*
- 10:00 **CEPA and Implications for Pharmaceuticals and Therapeutic Products**  
*Jim Louter/Nigel Skipper, Commercial Chemicals Evaluation Branch, Environment Canada*
- 10:30 Coffee
- 10:45 **FDA and Implications for Pharmaceuticals and Therapeutic Products in the Environment**  
*Elizabeth Innes, Therapeutic Products Directorate, Health Canada*
- 11:15 **General Discussion** (*facilitated by Mark Servos*)
- 12:15 Lunch
- 12:45 **Identifying the Tasks**
- 1:00 **Break Out Session I**  
- Identifying the major issues
- 1:45 **Group Reports and Discussion**
- 2:15 **Break Out Session II**  
- Establishing the path forward
- 2:30 Coffee (in the Break Out Rooms)
- 3:00 **Group Reports and Discussion**
- 3:30 **General Conclusions**
- 4:00 **Wrap-up**

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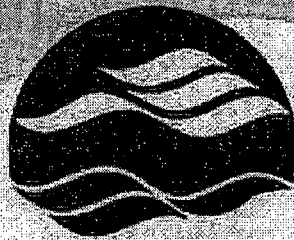
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