MEDITERRANEAN ACTION PLAN
MED POL

UNITED NATIONS ENVIRONMENT PROGRAMME

WORLD HEALTH ORGANIZATION

EPIDEMIOLOGICAL STUDIES RELATED TO ENVIRONMENTAL QUALITY CRITERIA FOR BATHING WATERS, SHELLFISH-GROWING WATERS AND EDIBLE MARINE ORGANISMS (ACTIVITY D)

ETUDES EPIDEMIOLOGIQUES RELATIVES AUX CRITERES DE LA QUALITE DE L'ENVIRONNEMENT POUR LES EAUX SERVANT A LA BAIGNADE, A LA CULTURE DE COQUILLAGES ET A L'ELEVAGE D'AUTRES ORGANISMES MARINS COMESTIBLES (ACTIVITE D)

FINAL REPORT ON PROJECT ON RELATIONSHIP BETWEEN MICROBIAL QUALITY OF COASTAL SEAWATER AND ROTAVIRUS-INDUCED GASTROENTERITIS AMONG BATHERS (1986-88)

RAPPORT FINAL SUR LE PROJET SUR LA RELATION ENTRE LA QUALITE MICROBIENNE DES EAUX MARINES COTIERES ET LA GASTRO-ENTERITE PROVOQUEE PAR LE ROTAVIRUS ENTRE LES BAIGNEURS (1986-88)

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This volume is the forty sixth issue of the Mediterranean Action Plan Technical Report Series.

This Series will collect and disseminate selected scientific reports obtained through the implementation of the various MAP components: Pollution Monitoring and Research Programme (MED POL), Blue Plan, Priority Actions Programme, Specially Protected Areas and Regional Marine Pollution Emergency Response Centre.

Ce volume constitue le quarante sixième numéro de la série des Rapports techniques du Plan d'action pour la Méditerranée.

Cette série permettra de rassembler et de diffuser certains des rapports scientifiques établis dans le cadre de la mise en oeuvre des diverses composantes du PAM: Programme de surveillance continue et de recherche en matière de pollution (MED POL), Plan Bleu, Programme d'actions prioritaires, Aires spécialement protégées et Centre régional pour l'intervention d'urgence contre la pollution marine accidentelle.

GENERAL INTRODUCTION

The United Nations Environment Programme (UNEP) convened an Intergovernmental Meeting on the Protection of the Mediterranean (Barcelona), 28 January - 4 February 1975), which was attended by representatives of 16 States bordering on the Mediterranean Sea. The meeting discussed the various measures necessary for the prevention and control of pollution of the Mediterranean Sea, and concluded by adopting an Action Plan consisting of three substantive components:

- Integrated planning of the development and management of the resources of the Mediterranean Basin (management component);

- Co-ordinated programme for research, monitoring and exchange of information and assessment of the state of pollution and of protection measures (assessment component);

- Framework convention and related protocols with their technical annexes for the protection of the Mediterranean environment (legal component).

All components of the Action Plan are interdependent and provide a framework for comprehensive action to promote both the protection and the continued development of the Mediterranean ecoregion. No component is an end in itself. The Action Plan is intended to assist the Mediterranean Governments in formulating their national policies related to the continuous development and protection of the Mediterranean area and to improve their ability to identify various options for alternative patterns of development and to make choices and appropriate allocations of resources.

MED POL - Phase I (1976-1980)

The Co-ordinated Mediterranean Research and Monitoring Programme (MED POL) was approved as the assessment (scientific/technical component of the Action Plan.

The general objectives of its pilot phase (MED POL -Phase I), which evolved through a series of expert and intergovernmental meetings, were:

- to formulate and carry out a co-ordinated pollution monitoring and research programme taking into account the goals of the Mediterranean Action Plan and the capabilities of the Mediterranean research centres to participate in it;

- to assist national research centres in developing their capabilities to participate in the programme;

- to analyse the sources, amounts, levels, pathways, trends and effects of pollutants relevant to the Mediterranean Sea;

- to provide the scientific/technical information needed by the Governments of the Mediterranean States and the EEC for the negotiation and implementation of the Convention for the Protection of the Mediterranean Sea against Pollution and its related protocols;

- to build up consistent time-series of data on the sources, pathways, levels and effects of pollutants in the Mediterranean Sea and thus to contribute to the scientific knowledge of the Mediterranean Sea.

MED POL - Phase I was implemented in the period from 1975 to 1980. The large number of national research centres designated by their Governments to participate in MED POL (83 research centres) from 15 Mediterranean States and the EEC), the diversity of the programme and its geographic coverage, the impressive number of Mediterranean scientists and technicians (about 200) and the number of co-operating agencies and supporting organizations involved in it, qualifies MED POL as certainly one of the largest and most complex co-operative scientific programmes with a specific and well-defined aim ever undertaken in the Mediterranean Basin.

MED POL - Phase II (1981-1990)

The Intergovernmental Review Meeting of Mediterranean Coastal States and First Meeting of the Contracting Parties to the Convention for the Protection of the Mediterranean Sea against Pollution, and its related protocols (Geneva, 5-10 February 1989), having examined the status of MED POL - Phase I, recommended that during the 1979/80 biennium a Long-term pollution monitoring and research programme should be formulated.

Based on the recommendations made at various expert and intergovernmental meetings, a draft Long-term (1981-1990) Programme for pollution monitoring and Research in the Mediterranean (MED POL-Phase II) was formulated by the Secretariat of the Barcelona Convention (UNEP), in co-operation with the United Nations Agencies which were responsible for the technical implementation of MED POL-Phase I, and it was formally approved by the Second Meeting of the Contracting Parties of the Mediterranean Sea against pollution and its related protocols and Intergovernmental Review Meeting of Mediterranean Coastal States of the Action Plan held in Cannes, 2-7 March 1981.

The general long-term objectives of MED POL-Phase II were to further the goals of the Barcelona Convention by assisting the Parties to prevent, abate and combat pollution of the Mediterranean Sea area and to protect and enhance the marine environment of the area. The specific objectives were designed to provide, on a continuous basis, the Parties to the Barcelona Convention and its related protocols with:

- information required for the implementation of the Convention and the protocols;

- indicators and evaluation of the effectiveness of the pollution prevention measures taken under the Convention and the protocols;

- scientific information which may lead to eventual revisions and amendments of the relevant provisions of the Convention and the protocols and for the formulation of additional protocols;

- information which could be used in formulating environmentally sound national, bilateral and multilateral management decisions essential for the continuous socio-economic development of the Mediterranean region on a sustainable basis;

- periodic assessment of the state of pollution of the Mediterranean Sea.

The monitoring of, and research on, pollutants affecting the Mediterranean marine environment reflects primarily the immediate and long-term requirements of the Barcelona Convention and its protocols, but also takes into account factors needed for the understanding of the relationship between the socio-economic development of the region and the pollution of the Mediterranean Sea.

As in MED POL-Phase I, the overall co-ordination and guidance for MED POL-Phase II is provided by UNEP as the secretariat of the Mediterranean Action Plan (MAP). Co-operating specialized United Nations Agencies (FAO, UNESCO, WHO, WMO, IAEA, IOC) are responsible for the technical implementation and day-to-day co-ordination of the work of national centres participating in monitoring and research.

The first eight volumes of the MAP Technical Reports Series present the collection of final reports of the principal investigators who participated in the relevant pilot projects (MED POL I - MED POL VIII). The ninth volume of the MAP Technical Reports Series is the final report on the implementation of MED POL-Phase I, prepared, primarily, on the basis of individual final reports of the principal investigators with the co-operation of relevant United Nations Agencies (FAO, UNESCO, WHO, WMO, IAEA, IOC).

From the tenth volume onwards, the MAP Technical Report Series contains final reports on research projects, assessment documents, and other reports on activities performed within the framework of MED POL-Phase II, as well as documentation originating from other components of the Mediterranean Action Plan.

This forty-sixth volume of the MAP Technical Reports Series contains the final report of the second research project to be completed within the framework of MED POL Phase II in Activity D - "Epidemiological studies related to environmental quality criteria for bathing waters, shellfish-growing waters and edible marine organisms (Activity D)". Final reports on other projects will appear in future issues of the series.

INTRODUCTION GENERALE

Le Programme des Nations Unies pour l'environnement (PNUE) a convoqué une réunion intergouvernementale sur la protection de la Méditerranée (Barcelone, 28 janvier - 4 février 1975) à laquelle ont pris part des représentants de 16 Etats riverains de la mer Méditerranée. La réunion a examiné les diverses mesures nécessaires à la prévention et à la lutte antipollution en mer Méditerranée, et elle s'est conclue sur l'adoption d'un Plan d'action comportant trois éléments fondamentaux:

- Planification intégrée du développement et de la gestion des ressources du bassin méditerranéen (élément "gestion");

- Programme coordonné de surveillance continue, de recherche, d'échange de renseignements et d'évaluation de l'état de la pollution et des mesures de protection (élément "évaluation");

- Convention cadre et protocoles y relatifs avec leurs annexes techniques pour la protection du milieu méditerranéen (élément juridique).

Tous les éléments du Plan d'action étaient interdépendants et fournissaient le cadre d'une action d'ensemble en vue de promouvoir, tant la protection que le développement continus de l'écorégion méditerranéenne. Aucun élément ne constituait une fin à lui seul. Le Plan d'action était destiné à aider les gouvernements méditerranéens à formuler leurs politiques nationales en matière de développement continu et de protection de zone de la Méditerranée et à accroître leur faculté d'identifier les diverses options s'offrant pour les schémas de développement, d'arrêter leurs choix et d'y affecter les ressources appropriées.

MED POL - Phase I (1976-1980)

Le programme coordonné de sruveillance continue et de recherche en matière de pollution de la Méditerranée (MED POL) a été approuvé au titre de l'élément "évaluation" (scientifique/technique) du Plan d'action.

Sa phase pilote (MED POL-Phase I) avait les objectifs généraux ci-dessous, élaborés au cours d'une série de réunions d'experts et de réunions intergouvernementales:

- formuler et exécuter un programme coordonné de surveillance continue et de recherche en matière de pollution en tenant compte des buts du Plan d'action pour la Méditerranée et de l'aptitude des centres de recherche méditerranéens à y participer;

- aider les centres de recherche nationaux à se rendre plus aptes à cette participation;

- étudier les sources, l'étendue, le degré, les parcours, les tendances et les effets des polluants affectant la mer Méditerranée;

- fournir l'information scientifique et technique nécessaire aux gouvernements des pays méditerranéens et à la Communauté économique européenne pour négocier et mettre en oeuvre la Convention pour la protection de la mer Méditerranée contre la pollution et les protocoles y relatifs;

- constituer des séries chronologiques cohérentes de données sur les sources, les cheminements, les degrés et les effets des polluants de la mer Méditerranée et contribuer par là à la connaissance scientifique de cette mer.

La Phase I du MED POL a été mise en oeuvre au cours de la période 1975-1980. Le grand nombre de centres de recherche nationaux désignés par leurs gouvernements pour participer au MED POL (83 centres de recherche de 15 Etats méditerranéens et de la CEE), la diversité du programme et sa couverture géographique, l'effectif impressionnant de scientifiques et techniciens méditerranéens (environ 200) ainsi que la quantité d'organismes coopérants et d'organisations d'appui qui y étaient engagés permettent sans conteste de caractériser le MED POL comme l'un des programmes de coopération scientifique les plus vastes et les plus complexes, comportant un *objectif spécifique et bien défini, qui ait jamais été entrepris dans le bassin méditerranéen.*

MED POL-Phase II (1981-1990)

La réunion intergouvernementale des Etats riverains de la Méditerranée chargés d'évaluer l'état d'avancement du Plan d'action et première réunion des Parties contractantes à la Convention pour la protection de la mer Méditerranée contre la pollution et aux protocoles y relatifs (Genève, 5-10 février 1979), ayant examiné la situation de la Phase I du MED POL, a recommandé que, durant la période biennale 1979-80, soit formulé un programme à long terme de surveillance continue et de recherche en matière de pollution.

Sur la base des recommandations énoncées lors des diverses réunions d'experts et réunions intergouvernementales, un projet de programme à long terme (1981-1990) de surveillance continue et de recherche en matière de pollution (MED POL - Phase II) a été formulé par le secrétariat de la Convention de Barcelone (PNUE), en coopération avec les organismes des Nations Unies chargés de l'exécution technique de MED POL - Phase I, et il a été officiellement approuvé lors de la deuxième réunion des Parties contractantes à la Convention pour la protection de la mer Méditerranée contre la pollution et aux protocoles y relatifs et réunion intergouvernementale des Etats riverains de la mer Méditerranée chargée d'évaluer l'état d'avancement du Plan d'action, qui s'est tenue à Cannes du 2 au 7 mars 1981.

L'objectif général à long terme de la Phase II du MED POL était de concourir à la réalisation des objectifs de la Convention de Barcelone en aidant les parties contractantes à prévenir, réduire et combattre la pollution dans la zone de la mer Méditerranée ainsi qu'à protéger et améliorer le milieu marin dans cette zone. Les objectifs particuliers étaient de fournir constamment aux Parties contractantes à la Convention de Barcelone et aux Protocoles y relatifs:

- les renseignements dont elles avaient besoin pour appliquer la Convention et les protocoles;

- des indications et une évaluation de l'efficacité des mesures prises pour prévenir la pollution en application de la Convention et des protocoles;

- des renseignements scientifiques qui pourraient servir à réviser et modifier les dispositions pertinentes de la Convention et des protocoles et à rédiger des protocoles additionnels;

- des informations qui pourraient servir à formuler sur les plans national, bilatéral et multilatéral, les décisions de gestion, respectueuses de l'environnement, qui seraient indispensables à la poursuite du développement socio-économique de la région méditerranéenne;

- une évaluation périodique de l'état de pollution de la mer Méditerranée.

La surveillance continue des polluants affectant le milieu marin de la Méditerranée ainsi que la recherche menée à leur sujet répondent en premier lieu aux prescriptions immédiates et à long terme de la Convention de Barcelone et des protocoles y relatifs, mais elles tiennent également compte des facteurs requis pour la compréhension des relations existant entre le développement socio-économique de la région et la pollution de la mer Méditerranée.

Comme lors de la Phase I du MED POL, la coordination et la direction générales de la Phase II étaient assurées par le PNUE, par l'intermédiaire du secrétariat du Plan d'action pour la Méditerranée (PAM). Les organismes spécialisés coopérants des Nations Unies (FAO, UNESCO, OMS, OMM, AIEA, COI) étaient chargés de l'exécution technique et de la coordination quotidienne des travaux des centres de recherche nationaux participant au programme de surveillance continue et de recherche.

Les huit premiers volumes de la Série des rapports techniques du PAM rassemblent les rapports finaux de chercheurs responsables qui ont participé aux projets pilotes correspondants (MED POL I -MED POL VIII). Le neuvième volume de cette même Série se compose du rapport final sur la mise en oeuvre de la Phase I du programme MED POL, établi essentiellement sur la base des rapports finaux individuels des chercheurs responsables avec la coopération des organismes compétents des Nations Unies (FAO, UNESCO, OMS, OMM, AIEA, COI).

A partir du dixième volume, la Série des rapports techniques du PAM, comprend des rapports finals sur les projets de "recherche", des documents d'évaluation et d'autres rapports d'activités effectués dans le cadre de MED POL-Phase II, ainsi que de la documentation prise dans d'autres domaines du Plan d'action pour la Méditerranée.

Ce quarante sixième volume de la Série des rapports techniques du PAM comprend le rapport final sur le deuxième projet de recherche à mener à terme dans le cadre de la Phase II du MED POL, dans l'Activité D - Etudes epidémiologiques relatives aux critères de la qualité de l'environnement pour les eaux servant à la baignade, à la culture de coquillages et à l'élevage d'autres organismes marins comestibles (Activité D). Les rapports finals sur d'autres projets figureront dans les prochaines publications de la série.

THE RELATIONSHIP BETWEEN MICROBIAL QUALITY OF COASTAL SEAWATER AND ROTAVIRUS-INDUCED GASTROENTERITIS AMONG BATHERS IN MEDITERRANEAN ISRAELI BEACHES

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ABSTRACT

A prospective epidemiological study was conducted on four Mediterranean beaches in Israel during the summer of 1986 (three in the Tel-Aviv area: Gordon, Sheraton Religious and Sheraton; and one 15 km south: Rishon Lezion). This was done in order to study the swimming-associated morbidity associated with water quality as measured by the concentrations of bacterial indicators. The second objective was to examine the feasibility of extending the project to establish the aetiology of the swimming-associated gastroenteritis, observed in the earlier phases of the overall programme.

A total of 233 families comprising 784 persons were interviewed for this study. Interviews were conducted on working days: Sundays and Mondays. Gordon, Sheraton, and Sheraton Religious beaches have horizontal surf breakers which markedly restrict water exchange. Twenty three percent (23%) of the study population were 0-4 years-old. A total of 42 seawater samples were tested for bacterial indicator concentrations, faecal coliforms and enterococci, on the days interviews were conducted. The faecal coliform and enterococcus densities in the water were significantly higher ($p<0.05$) at Sheraton Religious (GM, 105 and 81 CFU/100 ml, respectively) than at Rishon Lezion (GM, 10 and 14 CFU/100 ml, respectively).

No significant difference in the incidence of swimming-associated enteric symptoms was found between Sheraton Religious and Rishon Lezion both for all ages and for the 0 to 4-year-old age group.

The response of the study population to blood donation was poor. Forty (4.9%) donated at least one blood sample. Of them only 24 (2.9%) donated both acute and convalescent blood samples. All blood sera were positive for rotaviruses in both samples, and no seroconversion was detected.

The morbidity results of this study were similar to those found for the summer of 1984, which was also performed at the same beaches on days other than Saturday.

From all studies conducted, the following can be concluded:

1) The results of the prospective, follow-up epidemiological study conducted at three Israeli coastal beaches in 1983 showed that enteric, respiratory and ear symptomatology were higher among swimmers than non-swimmers, especially for young children. Both the enterococcus levels and the swimming-associated rates for enteric and respiratory symptoms at one of the beaches (Gordon) were at least twice those at another beach (Rishon Lezion). The higher swimming-associated symptom rates of Gordon beach were largely attributable to individuals who swam on Saturdays, which are non-working days in Israel, as opposed to Fridays and Sundays. The absence of extrinsic sources of pollution, the restricted water exchange due to horizontal surf breakers, the greater bather density on Saturdays, and the higher indicator levels on Saturdays (including *S. aureus* as well as enterococci and *E. coli*) suggest (contamination from the bathers themselves as the explanation for swimming-associated illness at Gordon Beach) (see Appendix 7, manuscript to be submitted for publication). The epidemiological data clearly show an increased risk of swimming-associated illness on Saturdays.

However, the increased risk is hardly predictable from the indicator levels in the water and it would be unreasonable to apply the standards to such situations.

2) The analysis of the data obtained from prospective epidemiological studies conducted on bathing beaches in Israel in 1983 and 1986 indicates that:

a) the swimming-associated rates for total and highly credible enteric and respiratory symptoms were markedly higher during high bather effect (HBE) days (Saturdays at Gordon and Sunday at Sheraton Religious Beach) than low bather effect days (all other days at the study beaches other than HBE)

b) the illness-indicator points obtained from the Israeli studies fall between the regression lines from the United States and Egyptian studies. Because of the confounding effect of contamination by the bathers themselves, it was not possible to select the most appropriate criterion among those available from studies in other countries. Additional, more extensive, studies are needed to establish an appropriate criterion for Israel. (See Appendix 7, manuscript accepted for publication and presentation to the Israel Society for Ecology an Environmental Quality Sciences at the Fourth International Conference for Environmental Quality and Ecosystem Stability, Jerusalem, June 1989).

There are five conclusions that can be drawn from the studies conducted in 1983, 1984 and 1986. There are:

1. The bathers themselves can be an important source of the agents responsible for swimming-associated illness at marine beaches under conditions of heavy beach usage and poor water exchange.

2. In beaches of poor water exchange (due to surf breakers) new and low microbial standard indicator should be applied than in open beaches of high water exchange (no surf breakers).

3. None of the criteria developed in other countries are particularly appropriate for the discharger-user conditions in Israel. New studies are needed to establish an appropriate criterion for Israel.

4. An urgent need remains for the conduct of such studies with tourists from one country (preferable one with a high degree of environmental sanitation) swimming at beaches in another country (preferable one in which environmental sanitation is less developed).

5. Establishing aetiology in the course of prospective bathing beach epidemiological studies will be extremely difficult unless heroic and costly measures are used to obtain the cooperation of the participants.

1. INTRODUCTION

Several epidemiological studies have been performed in order to investigate the relationship between the microbial quality of coastal seawater and morbidity among bathers. Shuval (1986), in his review of the literature on the morbidity associated with bathing water pollution, summarizes some 100 studies for the period 1909-1985.

The level of faecal pollution of bathing seawaters, measured by the concentrations of bacterial indicators, has been found to be positively correlated with the incidence of enteric disease among swimmers (Cabelli *et al.*, 1979, 1983; Foulon *et al.*, 1983; Fattal et *al.*, 1986). This association was also found in fresh water (Seyfried *et al.*, 1985a,b). In many of the above studies, an excess of various diseases was found among swimmers over non-swimmers, regardless of the microbial quality of the water.

The best-planned study according to epidemiological criteria was performed by Cabelli (1983). In this study a direct, linear relationship between swimming-associated gastrointestinal illness and the quality of the bathing water was found. Enterococci were found to be the best indicator of all bacteria examined as their levels in the water correlated the best with the rates of swimming-associated gastroenteritis.

A "mini" prospective epidemiological study was conducted on three Mediterranean beaches in 1983-1984 by Fattal & Shuval (1986). The objective of the study was to examine the findings from previous studies that swimming in sewage polluted waters carries with it a measurable risk of infectious disease and that this risk is correlated with the levels of at least one fecal indicator in the bathing water. In this study the risk of enteric symptomatology was found to be significantly higher among swimmers than among non-swimmers for the most polluted (Gordon) beach (but not for the least polluted (Rishon Lezion) beach) for the 0- to 4-year old age group and all ages.

There was a significant excess in the rates of enteric symptoms (vomiting, abdominal pain, nausea, and diarrhoea) in the 0- to 4-year-old age group among swimmers relative to non-swimmers when the densities of *E. coli , Enterococcus and Staphylococcus* in seawater were "high", but not when they were "low". Trial days were divided into those with "high" or "low" bacterial densities prior to and independently of the morbidity analysis. Statistically significant Pearson correlations were found between the incidence of swimming-associated enteric symptoms rates and enterococci and staphylococci densities in seawater (r=0.45 and r=0.50, respectively). A significant excess was also found for respiratory symptoms (heavy cough, cold, throat infection) and skin infections among swimmers as compared with non-swimmers, in the 0- to 4-year-old age group, but this excess was not associated with the bacterial densities in seawater. No excess of enteric and respiratory symptoms and skin infections was detected for other age groups. No excess of ear infections or highly credible enteric symptoms was detected in any age group.

Research conducted to date has not included serological studies of the swimmers in order to unequivocally discover disease indicators. This study was performed to determine the relationship between the concentrations of the defined bacterial indicator organisms (i.e. faecal coliforms, enterococci and staphylococci) and defined symptoms of respiratory and enteric disease among swimmers and non-swimmers exposed at bathing beaches with different levels of water contamination and to study the aetiological agent of gastroenteritis among the study population by testing for the presence of antibodies to Norwalk-like viruses and the human rotaviruses.

The epidemiological investigation conducted by the USEPA in the United States clearly established that the most prevalent disease among swimmers is acute gastroenteritis, most probably of viral aetiology (Norwalk-like viruses or the human rotaviruses), and the risk can be predicted by measuring enterococcal densities in the bathing water (Cabelli, 1983). Because of differences in the immune status of the swimmer population to the specific agent, rates can vary from one country to another, depending on general sanitary conditions which influence transmission of this disease via other routes. A review of literature on rotavirus is included as a part of the introduction.

1.1 Rotaviruses and Children's Diarrhoea

Walsh and Warren (1979) have estimated that 3 to 5 billion cases of diarrhoea occured in Asia, Africa and Latin America during the year 1978 resulting in 5 to 10 million deaths. Another estimate which reviewed data from several longitudinal studies in children revealed that 4.6 million diarrhoea deaths and 744 million to 1 billion episodes of diarrhoea occured in children less than 5 years of age in the same regions excluding China (Snyder, Merson, 1982).

Since its discovery 12 years ago, rotavirus has been recognized as the single most common aetiologic agent of gastroenteritis in infants, requiring hospitalization in developed and developing countries alike. Development of a vaccine against rotavirus might diminish the high infant mortality rates due to diarrhoeal illness in developing countries as well as the high endemicity observed in both developed and developing countries. Much current research in the field is directed to the development of such a vaccine. Despite the wealth of knowledge accumulated in recent years on the virus itself, our knowledge of the natural history of rotavirus infection is still incomplete.

Several important gaps exist in our understanding of rotavirus infection. These were initially motivated by the difficulties in cultivating the virus from human stools, a problem that has been now partially solved (Sata et al, 1981). Another limit to studying rotavirus has been the lack of a simple animal model to examine the immune response. It is likely that relevant information will be obtained from vaccine trials being carried out in humans in several locations. One further obstacle to the better undertanding of rotavirus infections and the designing of strategies for immunization derives from the existing differences in the epidemiology of the infection in developed countries where the disease occurs almost exclusively in the winter, in comparison with the endemic pattern in developing countries where high rates of rotavirus illness are observed throughout the year.

Knowledge gained from studies in developed areas, where most of the research is currently performed, cannot be generally applied to the worldwide situation. There is a strong need for community-based longitudinal studies (as opposed to hospital-based studies) of rotavirus infections over a period of time, especially in developing countries.

1.2 Immunity Against Rotavirus Infections

The role of the human immune system in protecting against rotavirus infection is poorly understood. Information obtained from animal studies is difficult to transfer to humans because of the marked differences in the local immune system in different species; besides, there are major differences in the period of susceptibility to rotavirus illness in humans as compared to most animal species; essentially, infection with rotavirus during the neonatal period is frequently asymptomatic in humans, whereas in most animals the neonatal period is the most critical time of vulnerability to rotavirus illness.

Experiments in calves and lambs carried out to elucidate the relative role of mucosal vs systemic immunity have demonstrated that rotavirus illness may occur in the presence of circulating rotavirus antibody whereas rotavirus antibody in the lumen of the small intestine was protective. Oral administration of gamma-globulin which contained rotavirus antibody to low birth weight newborn children has been shown to delay and diminish the symptoms of rotavirus infection. These observations taken together imply that the presence of antibody in the intestinal lumen is necessary to afford protection against rotavirus.

It has also been shown that the presence of serum rotavirus antibodies in infants and children is not necessarily associated with protection against infection or illness. It is likely that serum antibodies are only a reflection of the levels of local antibodies, the effectors of immunity, and that their levels in blood may be sustained even after local antibody has disappeared.

Several longitudinal studies have confirmed the fact that infection with rotavirus does not necessarily confer protection. Subclinical infections are commonly observed in adult contacts of infants with rotavirus gastroenteritis. Symptomatic reflections are also known to occur, although their frequency has not been extensively studied. It is not known, however, whether reinfections with illness in children are the result of shortened duration of the immune response to the initial infection or of susceptibility to other rotavirus serotypes different from the one causing the initial illness.

In a study by Bishop et al. (1983), 44 babies who shed rotavirus during the neonatal period were followed up for 3 years along with 37 control children. The children who had been infected during the neonatal period had a rate of reinfections (as assessed by serology) similar to that of the non-infected group; however, the neonatally infected children had lower rates of diarrhoea and significantly less severe symptoms when reinfection occurred. This study suggests that protection against rotavirus disease may be conferred by early administration of vaccines and that a single vaccine strain may be useful against different circulating strains.

The effects of breast-feeding in the prevention of rotavirus infection are not clear at this time. Banatvala et al. (1978) have demonstrated that the rate of neonatal rotavirus infections was significantly lower in babies who were breast-fed; similarly the number of rotavirus particles in the stools was lower in breast-fed babies. Prospective studies by Gurwith et al. (1981) have not demonstrated a significant protective role of breast-feeding against rotavirus illness. Further studies are necessary to clarify this important question.

1.3 Epidemiology of Rotavirus Infections

The importance of rotaviruses as the major aetiologic agents of gastroenteritis in children under 2 years of age has been documented in numerous cross-sectional studies carried out in more than 30 countries. In most of these studies rotaviruses have been associated with 20 to 60% of the cases of diarrhoea requiring hospital admission; often the virus has been associated with the most severe cases of dehydration. No information is available from any study on the actual contribution of rotavirus to the high infant mortality rates observed in developing areas. Severe rotavirus illness also occurs in developed countries; however, prompt medical attention prevents mortality. It would seem, however, that in developing countries, due to the precarious medical attention existing in remote areas, a good proportion of the rotavirus cases would be fatal.

Not many prospective studies have been carried out to assess the actual incidence of rotavirus illness at the community level. One study in Washington, D.C. estimated that 1 in 272 infants under 1 year of age and 1 in 451 children 1 to 2 years of age would be hospitalized with rotavirus diarrhoea during a 1-year period (Rodriguez et al, 1980). Another study in Michigan (Koopman et al., 1984) estimated that children experience 0.15 episode of rotavirus diarrhoea during the first year of life and 0.05 episode during the second year; 11% of those children required hospitalization. These figures contrast with longitudinal studies carried out in Bangladesh and Guatemala in which estimates of 0.5 and 0.8 episodes, respectively, of rotavirus diarrhoea per child per year were calculated during the first 2 years of life (Black et al, 1982; Mata et al., 1983).

In general, the incidence of rotavirus diarrhoea when studied longitudinally at the community level represents only a small fraction (2 to 10%) of all the cases of diarrhoea, but it is clear from each one of the studies mentioned that dehydration occured more frequently with rotavirus diarrhoea than the diarrhoea due to other agents.

In areas with temperate climates rotavirus diarrhoea occurs in seasonal peaks corresponding to the cooler months of the year. In tropical areas, where most of the developing countries are located, rotavirus diarrhoea occurs throughout the year, with some occasional epidemic outbreaks. This seasonal distribution may be responsible in part for some differences encountered in other epidemiologic factors such as the modes of transmission, the rate of reinfections and the age of occurrence of the disease.

The age distribution of rotavirus diarrhoea in developing countries differs somewhat from that observed in developed regions. Most studies from areas with temperate climates reveal a peak incidence of rotavirus illness in children 6 months to 2 years of age. In developing countries a good proportion of the rotavirus cases occur in children under 6 months of age. This discrepancy many depend on a earlier exposure of children in developing areas to contaminated sources as well as overcrowded home environments. It could also be related to the seasonal variations observed in developed countries where the cyclic character of the disease would spare many young susceptible children for at least one season.

1.4 Clinical Features

The typical clinical picture of a child with rotavirus gastroenteritis is for all practical purposes indistinguishable from those diarrhoeas of other aetiology. In general, children with rotavirus gastroenteritis present with fever, vomiting and dehydration more commonly than children with diarrhoea due to other agents. In most severe cases the illness has an abrupt start and the child is usually taken to the hospital within the first 36 hours after onset of symptoms. In many cases, the resolution of the illness is rather benign since the patients can be rehydrated within the first hours after admission. The average hospital stay is 4 days; however, up to 20% of the patients require 7 days or more of hospitalization.

In immunodeficient children and children or adults receiving immunosuppressive therapy, the infection with rotavirus imposes additional threats ranging from the establishment of a chronic or prolonged diarrhoea to severe cases associated with fatality (Yolken et al., 1982).

Thus, the clinical spectrum of rotavirus infection is rather broad, from subclinical infections (their extent has not been studied extensively in infants) to serious cases of dehydration leading to death. Although a series of syndromes have been associated with rotavirus diarrhoea including intus-susception, Reyes syndrome, sudden death, necrotizing enterocolitis, etc., a direct cause-effect relationship has not been established.

2. RESEARCH OBJECTIVES

The primary objectives of this study were:

1. to study the bathers' morbidity as related to seawater pollution as measured by the concentrations of bacterial indicators.

2. to study the aetiological agent of swimming-associated gastroenteritis (human rotaviruses and possibly be Norwalk-like viruses).

3. comparison of this study with other studies performed in Israel and other countries.

3. MATERIALS AND METHODS

The design of this "mini" epidemiological prospective study, conducted in Israel was similar to that of Fattal et al 1986. It followed the recommendations for prospective epidemiological-microbiological studies of Health Criteria and Epidemiological Studies Related to Coastal Water Pollution (WHO/UNEP 1977).

3.1 Study season and beaches

Studies were conducted during the bathing season (July-October) of 1986. Research was conducted on normal working days of the week (Sundays, Mondays and Tuesdays), and not on week-ends. In Israel, Sunday is an ordinary working day.

Four beaches were chosen for the study: Gordon, Sheraton, Sheraton Religious (for religious reasons men and women bathe at this beach on separate days) and Rishon Lezion (see Figure 1 for the map), studied previously by Fattal and Shuval (1986). Sheraton Religious beach was the only one on which men and women bath separately. The first three beaches were chosen because of their proximity (5 km from the source of raw sewage damping in Tel-Aviv) and the relative pollution of their water in terms of bacterial content. The Rishon Lezion beach (15 km south of raw sewage damping in Tel-Aviv) on the other hand, is considered relatively clean since it is not near any outfall sewers. All beaches were officially approved for bathing by the Israeli Ministry of Health.

3.2 Environmental data

Seawater and air temperature, seawater pH and flag color (indicator of the permitted bathing) were recorded on each beach. The data on wind direction and wave height were obtained from the Meteorological Service, Beit Dagon (see Fattal and Shuval, 1986 for the recording forms of environmental data).

3.3 Bacteriological tests

Water samples were taken for bacteriological tests twice a day (once in the morning and once in the afternoon) during the day of the beach interview at points along the beach, where bathers swim. The samples were kept on ice, transported to the laboratory, and tested within 6 hours of sampling in order to avoid changes in bacterial counts (see Appendix 1 for recording of bacterial tests). A total of 42 samples of seawater (21 days of sampling) were collected.

The following bacteriological tests were conducted: bacterial counts were according to reference methods indicated below in Table 1 (for details see Fattal and Shuval, 1986):

Table 1
Microbiological methods used in this study

Bacterial indicators	Symbol	Reference
1. Faecal coliforms	FC	WHO, 1982, Reference Method N.3
2. Enterococci	Ent	Levin *et al.*, 1975

3.4 Participants in the study

Potential participants were divided into two groups:

1. recruited by interview at the beach, where an effort was made to recruit only families which:

a) included at least one child below the age of 10 years present on the beach, and
b) had an access to a telephone.

The mother was usually chosen as the interviewee.

2. families that agreed to participate in the study and to donate two blood samples. These families were taken to the beach by the project staff.

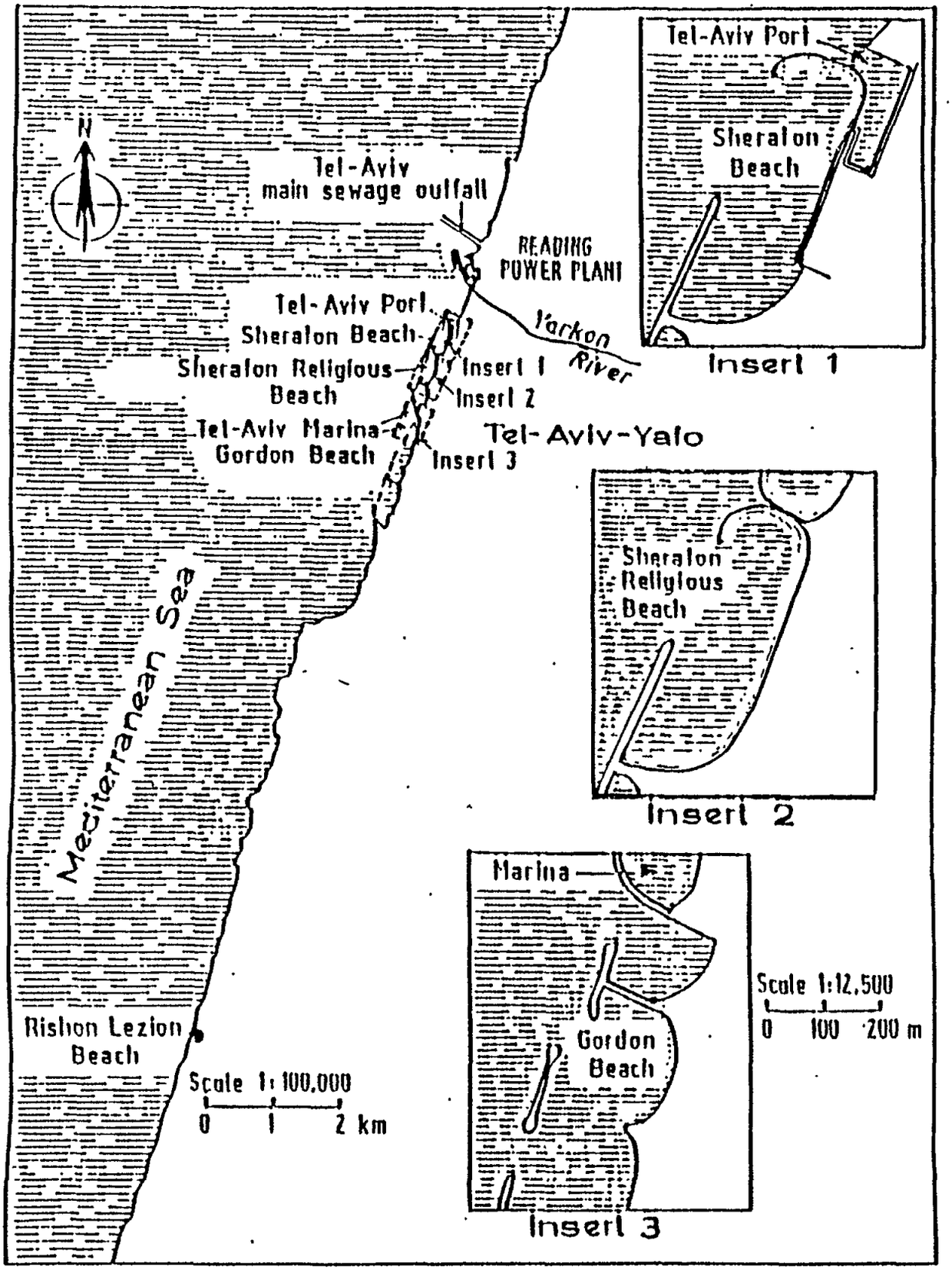

Figure 1: The Study Beaches

A total of 233 families were interviewed during the bathing season. Of these families, a total of 226, comprising 784 individuals, was reached for the telephone interview, of which 40 individuals donated at least one blood sample. Twenty four (24) individuals donated double blood samples and 16 single blood samples.

3.5 Definition of bathers and swimmers

A "bather" was defined in this study as any person present at the bathing beach, regardless of swimming status. A "swimmer" was defined as a bather whose face/head had been immersed in the water or who had swallowed seawater (i.e. answered "yes" to question 1 of the 6 questions below). All bathers answering "no" to the question 1 were defined as non-swimmers.

On the beach the bathers were asked:

- whether he/she entered the water and immersed the face in the water and/or swallowed the water.
- whether the head but not the face was splashed by the waves.
- sat on the shore but did not immerse the face in the water (mostly for children).
- whether he/she entered the water up to shoulder level, but did not immerse the head in the water.
- whether he/she entered the water up to hip level, but did not immerse the head in the water.
- did not enter the water.

3.6 Morbidity symptoms

The following morbidity symptoms were studied:

Enteric (Gastrointestinal): vomiting, diarrhoea, abdominal, pain, nausea.
Respiratory: severe cough, running nose, pain in chest, sore throat.
General: skin sores, sunburn, red eyes or eyes inflammation, fever (38°C and over).

Enteric and respiratory symptoms were considered highly credible if fever was recorded together with any symptom included within the group (enteric or morbidity) or/and a person was absent from work/school/kindergarten, and/or visited a nurse or physician, and/or had lab tests performed for any of these symptoms.

3.7 Questionnaires

Two questionnaires were prepared: one to be conducted on the beach and another for the follow-up by telephone some 3-5 days after the beach interview.

The questionnaires on the beach (see Appendix 2) with an explanatory letter (see Appendix 3) on the research were administered to families of bathers. Families already interviewed during the same bathing season were not reinterviewed. Families of bathers without telephones were not interviewed, but their addresses were recorded on the special recording form. Only families who had not been at the beach/swimming pool for a week prior to the beach interview were included. The number of refusals were also recorded. The interviewer was given precise instructions for collecting data, involving categorization of swimmers and non-swimmers.

The beach questionnaire included information on the demographic data (age, socio-economic status, etc.) and swimming status of bathers during the day of the beach interview and for the week prior to the beach interview. The beach questionnaire also included questions as to whether bathers visited any beach or suffered from any morbidity symptoms mentioned above during the week prior to the beach interview.

The telephone interview collected the information on the morbidity symptoms of the bathers interviewed on the beach (for telephone questionnaire, see Appendix 4). It was conducted

about 3 days following the beach interview. If the family was not reached after the first telephone call, one more telephone call was performed.

3.8 Blood samples

About 300 blood samples were planned to be drawn from the study population. Two blood samples were to be taken from each person, one within three days after the telephone interview, and the second within one month. Since the response for blood donation among the study population interviewed on the beach was very low, it was decided to include in the study any person who volunteered to go bathing on one of the four study beaches and to donate two blood samples. However as the response from volunteers was low, it was decided that the project would cover costs of transport to the beach and back to those families who agreed to donate two blood samples. Families resident in Jerusalem were also taken by the project staff by car to the blood donation center. Four centers for blood donation were selected, using the facilities in private commercial laboratories (in Jerusalem, Tel-Aviv city and Tel-Aviv area: Petach-Tikva and Bnei-Braq).

Forty (40) individuals donated blood samples. Out of these, 24 donated double blood samples and 16 single blood sample (the first one only).

3.9 Analysis of blood Sera

Paired sera samples were tested for antibodies to rotaviruses by enzyme-linked immunosorbent assay (ELISA) (Champsaur *et al.*, 1984), and if it is possible will be tested also for Norwalk-like virus antibodies by radioimmunoassay (RIA) (Greenberg *et al.*, 1978).

3.9.1 ELISA procedure

Behring rotavirus enzygnost plates (Cat 05UZ 02/03, batch 406716) were used. Each well was pre-coated with rabbit anti-Simian-rotavirus antibodies. Alternate columns or microtitier plates were reacted with SA-11 antigen (Simian rotavirus) or control antigen (inoculated MA-104 cell extract) both diluted 1:160 in PBS-Tween containing 0.01 M EDTA. Plates were incubated at 37°C for 1 h and then kept overnight at 4° C.

Serial dilutions of sera (1:40, 1:80, 1:160, 1:320) were added to each SA-11 and control antigen-reacted wells. Plates were incubated for 1 h at 37° C. Behring anti-human IgG -alkaline phosphatase conjugate (Cat OSDH 04/05, batch 410945 A) diluted 1:80 was added and the plates incubated at 37° C for 1 h. P-Nitrophenul phosphate (1 mg/ml) in diethanol amine buffer was then added and plates incubated 30 min at 37° C. The reaction was stopped with 2N NaOH.

3.10 Coding of data for the computer analysis

All the data was coded directly into an IBM PC computer using DBASEIII, and then transferred to a PR1ME computer.

3.11 Statistical analysis of data

Incidence rates and relative risks were computed. The standard errors of incidence rates were calculated as follows:

If the rate of symptom in a groups is r, and N is the total population in this group, then the standard error (SE)= $r(100-r)/N$.

The significance of differences between the incidence rates were defined as follows:

If SE is the standard error, and R is the morbidity symptom incidence rate, then the significance of differences between the incidence rates of groups i and j will be:

$$Z = (R_i - R_j) / \sqrt{(SE_i)^2 + (SE_j)^2}$$

The P values of Z are extracted from the table of cumulative normal distribution.

SPSS (Statistical Package for Social Sciences) and FORTRAN were used for calculation of morbidity symptom incidence rates per 100 persons, swimmers and non-swimmers, for each beach and all beaches cumulatively, according to the various bacterial concentrations found in the seawater.

4. RESULTS

4.1 Meteorological and sea conditions

During the study period, data on meteorological and sea conditions were collected for each sampling, including wave heights,wind direction, water pH and water temperature. A total of 42 (21 double) water samples were tested for all beaches (6 at Gordon, 8 at Sheraton Religious, 2 at Sheraton and 5 at Rishon Lezion). The months of sampling were from August to October for Gordon, from August to September for Sheraton Religious and Rishon Lezion, and on July for Sheraton. The wind direction was west or north-west.

Table 2 presents some environmental parameters for the beaches studied. Water temperature ranged between 25°C and 31°C (mean water temperature was 29.6°C) pH values ranged between 6.4 and 7.1 for all beaches studied. Bathing was usually permitted or restricted on each sampling day though on one sampling day for Gordon, Sheraton and Rishon Lezion it was forbidden. Most of the sampling days were Sunday and Monday, though each beach was also sampled once on Tuesday. No samples were taken on weekends, i.e. Saturdays (in Israel Sunday is a regular working day).

Table 2
Water and environmental parameters by beaches

		Gordon	Sheraton Religious	Sheraton	Rishon Lezion
Temperature of water oC	#	12	16	4	10
	Mean	28.9	30.2	28.5	29.7
	SD (+/-)	2.0	0.9	0.6	0.8
	Range	25*-31	29-31	28-29	29-31
pH	Mean	6.4	6.5	7.1	6.4
	SD(+/-)	0	0.3	0.6	0.1
Months		August-October*	August September	July	August-September
Day of Week	Sunday	4	6	0	8
	Monday	6	8	2	0
	Tuesday	2	2	2	2
Number of sampling days		6	8	2	5

* One sampling day was in October
SD standard deviation

4.2 Seawater bacteriological quality

Table 3 presents median, range, geometric mean and standard deviation in (CFU/100ml), the number of samples, and the frequency distribution for faecal coliform (FC) and enterococcal (Ent) densities by beaches. From these tables it can be seen that Rishon Lezion beach, located 15 km south of the Tel-Aviv sewage outfall, showed the lowest densities of each of the bacterial indicators tested, when compared to the three other beaches, which are situated within 5 km to the Tel-Aviv sewage outfall. Sheraton Religious beach showed the highest median and geometric mean counts for all three bacterial indicators.

The frequency distributions for FC and Ent show a higher percentage of 101-1000 CFU/100 ml for Gordon, Sheraton and Sheraton religious beaches, as compared with Rishon Lezion beach, for all bacteria. The differences between the densities of each of the bacterial indicators between the study beaches were found to be significant ($P<0.01$). All the bacterial concentrations found on the study beaches fall within UNEP/WHO standards of water quality for bathing beaches.

Table 3

Densities of bacterial indicators (median, range, geometric mean (GM), and frequency distribution) CFU/100ml) by beaches

Bact. indic.	Parameter	Gordon	Sheraton Religious	Sheraton	Rishon Lezion
FC	Median	31	116	24	20
	Range	5-69	13-652	18-29	0-36
	GM	24.4	104.7	22.8	9.5
	Upper SD	65.9	41.6	31.9	12.3
	Lower SD	9.0	26.0	16.3	4.7
	#	6	8	2	5
	Frequency distribution				
	0-10	2	1	0	3
	11-100	9	9	4	6
	101-1000	1	6	0	1
ENT	Median	25	56	22	14
	Range	14-51	4-150	6-38	2-44
	GM	25.9	80.9	15.1	13.8
	Upper SD	44.0	50.2	55.5	58.0
	Lower SD	15.2	13.0	4.1	3.3
	#	6	7	2	5
	Frequency distribution				
	1-10	2	1	2	4
	11-100	9	13	1	5
	101-1000	1	2	1	1

FC - faecal coliforms
Ent - enterococci
GM - geometric mean
SD - standard deviation of geometric means

Table 4 shows the bacterial indicator densities in seawater defined as "high", "medium" and "low" for the purpose of morbidity analysis of bathers. The cut of bacterial counts were done regardless to morbidity rate. It can be seen from this table that the GM at low level is about one log smaller than that in high levels of bacterial indicator densities.

Table 4

Densities of bacterial indicators (median, range, and geometric mean (GM)) (CFU/100ml) for all beaches for low, median and high levels

Level		FC	ENT
Low	Median	13	6
	Range	0-20	2-17
	GM	3	7
	#	7	7
Median	Median	36	38
	Range	26-90	23-44
	GM	38	34
	#	9	7
High	Median	191	65
	Range	104-652	51-150
	GM	248	71
	#	5	6

FC - faecal coliforms
Ent - enterococci
GM - geometric mean

4.2.1 Correlation between bacterial indicators

Table 5 shows the Pearson correlation coefficients, with their significance levels, between geometric means of bacterial indicator concentrations for all beaches together. The correlation coefficient between FC and Ent was 0.78 and it was significant at $P<0.0001$.

Table 5

Pearson correlation coefficients between three bacterial indicators

		FC
ENT	r	0.78
	#	21
	p*	0.0001

4.3 Demography

Out of 236 families addressed on the beach 233 (99%) agreed to participate in the study.

Out of 233 families (814 individuals) interviewed on the beach (the first part of the questionnaire was filled), 266 (97%) families were actually reached by telephone for the health interview. However the demography analysis presented below is based on 233 families, including 784 individuals.

Table 6 shows the distribution of the study population by age groups and beaches. It can be seen that 23% of all bathers belonged to the 0-4 year-age group; 26% to the 5-9-year-old and 36% to the 18+ age group. The 18+ age group was the lowest (29%) and the 0-9-age group the highest (56%) at the Sheraton Religious beach as compared with other beaches.

The distribution of the study population by bathing beaches was as follows: 27% of the population were interviewed at Gordon beach, 40% at Sheraton Religious, 13% at Sheraton and 20% at Rishon Lezion.

Table 6

The distribution of all bathers interviewed on the beach
by age groups and beaches

Beach		Age (years) 0-4	5-9	10-17	18+	All ages
Gordon	#	50	46	31	86	213
	%*	23.5	21.6	14.6	40.4	(26.5)**
Sheraton	#	88	96	50	95	329
Religious	%	26.7	29.2	15.2	28.9	(40.1)
Sheraton	#	19	33	14	44	110
	%	17.3	30.0	12.7	40.0	(13.2)
Rishon	#	30	35	30	67	162
Lezion	%	18.5	21.6	18.5	41.4	(20.2)
All	#	187	210	125	292	814
	%	23.0	25.8	15.3	35.9	100

* % row
** % column

Table 7 shows the distribution of adult study population (18+ age group) by age groups and beaches. The age distribution in these age groups was almost similar among the beaches. For each beach the age groups 25-34 and 35-44 were the largest (18% and 13% respectively for all beaches together).

Table 8 shows the distribution of the study population by swimming status, age groups and beaches only for those bathers that were reached by telephone. The percentage of swimmers and non-swimmers were similar in 0-4-year-old age group with a slight excess for non-swimmers for each beach except of Sheraton Religious where the percentage of non-swimmers was two fold higher (18% and 41% for swimmers and non-swimmers respectively for all beaches together). There were more swimmers than non-swimmers for all ages (65% and 35%, respectively).

Table 7

The distribution of all bathers 18+ year old interviewed on the beach by age groups and beaches

Beach		Age (years)					
		18-24	25-34	35-44	45-54	55+	18+
Gordon	#	3	38	32	5	8	86
	%	1.4	17.8	15.0	2.3	3.8	40.4
Sheraton	#	4	49	35	5	2	95
Religious	%	1.2	14.9	10.6	1.5	.6	28.9
Sheraton	#	3	22	16	1	2	44
	%	2.7	20.0	14.5	.9	1.8	40.0
Rishon	#	1	36	22	3	5	67
Lezion	%	0.6	22.2	13.6	1.9	3.1	41.4
All	#	11	145	105	14	17	292
	%	1.3	17.8	12.9	1.7	2.0	35.9

* % of all ages (see Table 6)

Table 8

The distribution of the study population (# and % from all ages included in the morbidity analysis by beaches, swimming status and age groups[1]

Age groups		Gordon		Sheraton Religious		Sheraton		Rishon Lezion		All	
		sw	nsw	sw	nsw	sw	nsw	sw	nsw	sw	nsw
0-4	#	30	16	35	53	12	5	22	8	99	82
	*%	22	25	18	41	18	12	18	20	19	30
5-9	#	36	7	76	18	25	8	33	0	170	33
	%	26	11	40	14	38	20	29	0	33	12
10-17	#	24	6	43	3	12	2	30	0	109	11
	%	18	9	22	2	18	5	25	0	21	4
18-34	#	20	19	21	31	9	14	19	17	69	81
	%	15	30	11	24	14	35	16	44	14	30
35-44	#	17	14	13	22	8	8	11	11	49	55
	%	12	22	7	17	12	20	9	28	10	20
45+	#	9	2	3	1	0	3	5	3	17	11
	%	7	3	2	1	0	7	3	8	3	3
18+	#	36	35	37	54	17	25	35	31	135	147
	%	34	55	20	42	26	62	28	70	27	53
All	#	136	64	191	128	66	40	120	39	513	271
	%	100	100	100	100	100	100	100	100	100	100
	**%	68	32	60	40	62	38	75	25	65	35

1 excluding persons with unknown age or non-included in data analyses (total 784 persons)

* % column

** % row

sw - swimmers

nsw - non-swimmers

Table 9 shows the distribution of the study population by swimming status, sex and beaches only for those bathers that were reached by telephone. The percentage of swimmers among male bathers was higher than that of swimmers among female bathers (77% for males and 56% for females for all beaches).

Table 9

The distribution of the study population included in the morbidity analysis by swimming status, beaches and sex[1]

Sex		Gordon sw	Gordon nsw	Sheraton Religious sw	Sheraton Religious nsw	Sheraton sw	Sheraton nsw	Rishon Lezion sw	Rishon Lezion nsw	All sw	All nsw
males	#	71	19	89	41	37	12	65	7	262	79
	%	79	21	69	31	76	24	90	10	77	23
females	#	65	47	102	89	29	28	55	32	251	196
	%	58	42	53	47	51	49	63	37	56	44

1 excluding persons with unknown age or non-included in data analyses (total 788 persons)

% row

Table 10 shows the distribution of the study population by country of maternal origin and beaches. Most of the population (86% for all beaches together) was Israeli born.

Table 10

The distribution of the study population interviewed on the beach by the mother's country of origin

Beach		Country of origin: Israel	Asia	Africa	Europe	America	Total
Gordon	#	175	10	1	19	8	213
	%	82.2	4.7	0.5	8.9	3.8	100
Sheraton Religious	#	302	2	3	16	6	329
	%	91.8	0.6	0.9	4.9	1.8	100
Sheraton	#	90	9	4	4	3	110
	%	81.8	8.2	3.6	3.6	2.7	100
Rishon Lezion	#	130	6	6	15	5	162
	%	80.2	3.7	3.7	9.3	3.1	100
All	#	697	27	14	54	22	814
	%	85.6	3.4	1.7	6.6	2.7	100

% row

Table 11 shows the distribution of the study population according to mothers' education. The highest percentage of persons with mother of above high-school education was at Sheraton Religious beach (55%) as compared with other beaches (32, 44 and 35% for Sheraton, Gordon and Rishon Lezion beaches, respectively). The Sheraton Religious beach showed the lower percentage of persons with mother of primary school education (3,3%) as compared with 20-33% for other beaches.

Table 11

The distribution of the study population interviewed on the beach by the mother's education

Beach		Mother's education				
		Primary School	High School	Above-High School	Unknown	All
Gordon	#	42	72	94	3	213
	%	20.6	33.8	44.1	1.4	100
Sheraton	#	11	125	180	13	329
Religious	%	3.3	38.0	54.7	4.0	100
Sheraton	#	36	38	35	1	110
	%	32.7	34.5	31.8	0.9	100
Rishon	#	37	65	56	4	162
Lezion	%	22.8	40.1	34.6	2.5	100
All	#	126	300	365	21	814
	%	15.6	36.9	44.9	2.6	100

% row

Table 12 shows the distribution of families in the study population by beach and by the social status of the mother. The social status was defined by the commonly used English system of social status classification with some modification for Israel. Most of the mothers were housewifes or were of middle and upper social status. The percentage of the study population having housewifes-mothers was 44%. The highest percentage of housewifes was at Sheraton Religious beach (58%) as compared with 29%-49% on other beaches. The social status of the population was rather similar for each of the study beaches.

Table 13 shows the distribution of the study population by month of interview. Most of the population (79%) was interviewed in July and August. On Sheraton beach, most of the population was interviewed in June. Gordon was the only beach on which the population was interviewed also in September.

Table 14 shows the distribution of bathers by swimming status as extracted from the beach questionnaire. Seven percent (7%) were the bathers whose head was splashed by wave, but not their face. These bathers were included into non-swimmers category, as well as those children that sat and played on the shore but whose face was not immersed in the water (3%). However the possibility that occasionally water was swallowed by them does exist. Eight percent(8%) of the bathers did not enter the water at all, 7% entered up to hips level and 9% up to shoulder level without immersing either head or face in the water.

4.4 Swimming-associated health risk

Appendixes 5a-5e show the incidence rates by beaches for all symptoms studied for swimmers and non-swimmers for the 0-4, 5-9, 10-17 and 18+ age groups, and for all ages.

Tables 15 and 16 summarize the incidence rates by swimming status for selected symptoms and diseases by beaches for the 0-4-year-old age group and all ages respectively.

Table 12

The distribution of the study population interviewed on the beach by the mother's social status

Beach		Mother's social status						
		High	High-Medium	Medium	Medium-Low	Housewife	Student	Total
Gordon	#	22	57	53	14	62	5	213
	%	10.3	26.8	24.9	6.5	29.1	2.3	100
Sheraton	#	0	125	9	2	190	3	329
Religious	%	0	38.0	2.7	0.6	57.8	0.9	100
Sheraton	#	0	44	7	0	54	5	110
	%	0	40.0	6.3	0	49.2	4.5	100
Rishon	#	6	65	33	0	54	4	162
Lezion	%	7	40.1	20.4	0	33.3	2.5	100
All	#	28	286	102	16	354	17	814
	%	3.4	35.1	12.5	2.0	43.5	2.1	100

% row

Table 13

The distribution of the study population by months, beaches and swimming status

Month		Gordon		Sheraton Religious		Sheraton		Rishon Lezion		All	
		sw	nsw	sw	nsw	sw	nsw	sw	nsw	sw	nsw
June	#	-	-	18	35	55	32	-	-	73	67
	*%			9	27	83	80			14	24
July	#	96	39	123	56	11	8	80	28	310	133
	%	71	61	65	44	17	20	67	72	60	49
August	#	25	13	50	37	-	-	40	11	115	59
	%	18	20	26	29			33	28	22	22
Sept-	#	15	12	-	-	-	-	-	-	15	12
ember	%	11	19							11	18
All	#	136	64	191	128	66	40	120	39	513	271
	%	100	100	100	100	100	100	100	100	100	100

* % column
sw - swimmers
nsw - non-swimmers

Table 14
Distribution of bathers by their swimming status

Swimming status		Gordon	Sheraton Religious	Sheraton	Rishon Lezion	All
Entered the water, the face was immersed in water or swallowed water	#	136	191	66	120	513
	%	68	60	62	75	65
The head, but not face was splashed by waves	#	20	20	8	9	57
	%	10	6	7	6	7
Sat on the shore but the face was not immersed in water	#	5	9	5	3	22
	%	3	3	5	2	3
The body was immersed in the water up to shoulder level	#	9	54	2	7	72
	%	4	17	2	4	9
The body was immersed in the water up to hips level	#	9	29	13	6	57
	%	4	9	12	4	7
Did not enter the water	#	21	16	12	14	63
	%	11	5	11	9	8
All	#	200	319	106	159	784
	%	100	100	100	100	100

* % column

Table 15
Incidence rates by swimming status for selected symptoms and diseases for 0-4-year old age group

Symptoms and Diseases	Gordon		Sheraton Religious		Rishon Lezion		Sheraton	
	sw	nsw	sw	nsw	sw	nsw	sw	nsw
Enteric	16.7	12.5	<2.9	9.4	18.2	12.5	16.7	40.0
Highly credible enteric	<3.3	12.5	<2.9	1.9	4.5	<12.5	<8.3	<20.0
Respiratory	13.3	12.5	14.3	7.5	27.3	25.0	8.3	<20.0
Highly credible Respiratory	6.7	<6.3	5.7	1.9	4.5	<12.5	<8.3	<20.0
Fever	6.7	12.5	2.9	<1.9	9.1	<12.5	<8.3	<20.0
Skin	<3.3	<6.3	<2.9	<1.9	4.5	12.5	<8.3	<20.0
Diarrhoea	10.0	12.5	<2.9	7.5	13.6	12.5	16.7	20.0
Stomach-ache	6.7	<6.3	<2.9	<1.9	4.5	<12.5	<8.3	20.0
Vomiting	<3.3	<6.3	1.9	1.9	<4.5	<12.5	<8.3	<20.0
# OF SAMPLING DAY	6		8		5		2	
# of Swimmers	30		35		22		12	
# of Non-swimmers	16		53		8		5	

Table 16

Incidence rates by swimming status for selected symptoms and diseases for all ages

Symptoms and Diseases	Gordon sw	Gordon nsw	Sheraton Religious sw	Sheraton Religious nsw	Rishon Lezion sw	Rishon Lezion nsw	Sheraton sw	Sheraton nsw
Enteric	6.6	4.7	1.0	4.7	11.7	5.1	12.1	12.5
Highly credible enteric	0.7	3.1	1.6	0.8	2.5	<2.6	4.5	2.5
Respiratory	5.9	7.8	5.2	5.5	11.7	7.7	7.6	<2.5
Highly credible respiratory	1.5	<1.6	1.6	0.8	1.7	<2.6	4.5	<2.5
Fever	2.2	3.1	0.5	<0.8	2.5	<2.6	4.5	2.5
Skin	0.7	<1.6	0.5	<0.8	2.5	2.6	1.5	2.5
Diarrhoea	4.4	3.1	<0.5	3.1	7.5	5.1	3.0	7.5
Stomach-ache	2.2	1.6	1.0	0.8	4.2	<2.6	3.0	5.0
Vomiting	<0.7	<1.6	<0.5	0.8	<0.8	<2.6	6.1	<2.5
# OF SAMPLING DAY	6		8		5		2	
# of Swimmers	136		191		120		66	
# of Non-swimmers	64		128		40		39	

Table 17

Swimming-associated incidence rates (swimmer minus non-swimmer) per 100 persons by bathing beaches

Age	Symptoms	*Swimming-Assoc. rate per 100 persons* Gordon	Sheraton Religious	Rishon Lezion
0-4 yr	Enteric	4.2	>-6.5	5.7
0-4 yr	HC enteric	>-9.2	>-1.0	>8.0
	Respiratory	0.8	6.8	2.3
	HC Respiratory	>0.4	3.8	>8.0
	Fever	-5.8	>1.9	>-3.4
	Skin	-	-	-8.0
All ages	Enteric	1.9	-3.7	6.6
	HC enteric	-2.4	0.8	>1.0
	Respiratory	-1.9	-0.3	4.0
	HC Respiratory	1.5	0.8	>-0.8
	Fever	-0.9	>-0.3	>1.0
	Skin	0.7	0.3	-0.1

HC - highly credible (see text for definitions)

Based on Tables 15 and 16, Table 17 shows the swimming-associated incidence rates (incidence rate of swimmers minus that of non-swimmers) for Gordon, Sheraton Religious and Rishon Lezion beaches for the 0-4-year old age group and all ages. Sheraton beach was not included because of the relatively small population number tested there. The symptoms presented in this table include total enteric, highly credible (HC) enteric, respiratory, HC respiratory, fever and skin sores.

The swimming-associated incidence rates for total enteric symptoms were positive for Gordon and Rishon Lezion beaches (4.2 and 5.7, and 1.9 and 6.6 for 0-4-year age group and all ages, respectively). For Sheraton Religious beach, the swimming-associated incidence rates for total enteric symptoms were negative.

Data analysis was also performed for swimming-associated health risk (not related to the microbial pollution of the seawater. The swimming- associated rates for respiratory and HC respiratory were positive for all beaches for 0-4-year age group. These results indicate that there was no association between the incidence of enteric symptoms and bathing beaches.

4.5 Analysis by "high", "medium" and "low" bacterial densities

Morbidity analysis was performed by age groups (0-4, 5-9, 10-17, 18+ and all ages), bathing beaches, bacterial indicator concentration ("high", "medium" and "low") and swimming status of bathers (swimmers and non-swimmers). Morbidity analysis was done for all those that had at least one symptom recorded ("sick"), and for highly credible enteric and respiratory symptoms (having high fever and/or visited physician or nurse and/or had laboratory tests) performed.

The distribution of all morbidity symptoms among bathers is shown by "high", "medium" and "low" bacterial concentration in seawater separately for each bacterial indicator. The bacterial concentrations were calculated as the geometric mean of bacterial concentrations of two water samples drawn on the day of the sampling. The analysis of morbidity according to "high", "medium" and "low" bacterial densities for all bathers is shown in Appendix 6a-6d for FC and Ent for the 0-4-year-old age group and for all ages.

Based on Appendix 6a-6d, tables 18-21 show the incidence rates/100 persons for enteric, respiratory and highly credible enteric and respiratory symptoms for 0-4-year olds and all age groups by "high", "medium" and "low" concentrations of fecal coliforms (FC) and enterococci (Ent) for swimmers and non-swimmers. These tables also show the swimming-associated rate (swimmers minus non-swimmers) and rate ratio between swimmers and non-swimmers for each level of bacterial indicators. For enteric symptoms and highly credible no difference in swimming-associated rates between "high", "medium" and "low" levels of both bacterial indicators, was found.

For the 0-4-year-old age group, the higher swimming-associated rate for enteric and highly credible enteric symptoms in "high" as compared with "medium" and "low" bacterial levels was observed for FC (Table 20) (9.6, 6.1 and 1.8, respectively for enteric and -2.4, 3.8 and 2.1 respectively for highly credible enteric symptoms). The rate ratio for enteric symptoms for FC was 2.2, 1.8 and 1.1, respectively. However these differences were not statistically significant, and for FC the swimming-associated rates for respiratory symptoms were higher in "high" as compared with the other two levels of bacterial indicators.

4.6 Analysis for enterococci by "low" and "high" densities excluding Sheraton Religious Beach

Another analysis was performed only for enterococci, the most reliable bacterial indicator (Cabelli, 1983) by low (range 2-30) and high (range 31-150) densities. In this analysis Sheraton Religious beach was excluded since the behaviour of religious population bathing on this beach was different: men and women bathe separately, and women often enter the sea fully dressed,

rather than in a bathing suit, and therefore may represent a confounding factor. Tables 22 and 23 show the distribution of incidence rates for enteric and respiratory symptoms by low and high densities for 0-4-year-old age groups and all ages excluding Sheraton Religious beach. The incidence rates of enteric and highly credible enteric symptoms at high enterococcal densities were higher among swimmers than those among non-swimmers for all ages only (swimming-associated rates 6.3 and 1.6, respectively). However, the incidence rates of respiratory and highly credible respiratory symptoms were also higher among swimmers than among non-swimmers (swimming-associated rates 10.1 and 3.3 respectively).

Table 18

The distribution of incidents rates for enteric and respiratory symptoms by different levels of Faecal coliforms for all ages for all bathers

Symptom	Bact. level	Rates per 100 persons			Rate ratio
		sw	nsw	sw-nsw	
Enteric	low	7.2	6.1	1.1	1.2
	medium	8.4	6.8	1.6	1.2
	high	0.9	4.6	-3.7	-
Highly credible enteric	low	1.7	1.5	0.2	1.1
	medium	1.8	1.7	0.1	1.1
	high	<0.9	1.1	1.1	
Respira-tory	low	6.7	7.6	-0.9	-
	medium	7.1	3.4	3.7	2.1
	high	8.4	6.9	1.5	1.2
Highly credible respira-tory	low	2.2	<1.3	2.2	-
	medium	1.3	<0.9	1.3	-
	high	2.8	1.1	1.7	2.5
Popul-ation	low	180	66	-	-
	medium	226	118	-	-
	high	107	87	-	-

Table 19

The distribution of incidents rates for enteric and respiratory symptoms by different levels of Enterococci for all ages for all bathers

Symptom	Bact. level	Rates per 100 persons			Rate ratio
		sw	nsw	sw-nsw	
Enteric	low	4.6	4.8	-0.2	
	medium	4.7	10.3	-5.6	
	high	6.1	9.0	-2.9	
Highly credible enteric	low	0.6	<1.6	0.6	
	medium	2.8	2.0	0.8	1.4
	high	<0.9	1.8	-1.8	
Respira-tory	low	3.5	9.5	-6.0	
	medium	9.8	2.0	7.8	4.9
	high	8.5	6.4	2.1	1.3
Highly credible respira-tory	low	0.6	<1.6	0.6	-
	medium	2.8	<1.0	2.8	-
	high	2.5	0.9	1.8	2.8
Popul-ation	low	173	63		
	medium	214	98		
	high	118	109		

Table 20

The distribution of incidents rates for enteric and respiratory symptoms by different levels of Faecal coliforms for all bathers of 0 to 4 year-old age group

Symptom	Bact. level	Rates per 100 persons			Rate ratio
		sw	nsw	sw-nsw	
Enteric	low	17.6	15.8	1.8	1.1
	medium	13.5	7.4	6.1	1.8
	high	17.9	8.3	9.6	2.2
Highly credible enteric	low	2.9	5.3	-2.4	0.5
	medium	3.8	<0.4	3.8	-
	high	3.7	1.6	2.1	2.3
Respira-tory	low	17.6	15.8	1.8	1.1
	medium	13.5	7.4	6.1	1.8
	high	17.9	8.3	9.6	2.2
Highly credible respira-tory	low	8.8	<5.3	8.8	-
	medium	<2.7	<0.4	-	-
	high	7.1	2.8	4.3	2.5
Popul-ation	low	34	19		
	medium	37	27		
	high	28	36		

Table 21

The distribution of incidence rates for enteric and respiratory symptoms by different levels of Enterococci for all bathers of 0 to 4 year-old age group

Symptom	Bact. level	Rates per 100 persons			Rate ratio
		sw	nsw	sw-nsw	
Enteric	low	7.7	4.3	3.4	1.8
	medium	17.5	20.0	-2.5	0.9
	high	6.7	13.6	-6.9	0.5
Highly credible enteric	low	<3.9	<4.3	0.0	-
	medium	2.5	6.7	-4.2	0.4
	high	<3.3	4.5	-4.5	-
Respira-tory	low	6.7	20.0	-13.3	0.3
	medium	13.6	6.8	6.8	2.0
	high	10.8	12.2	-1.4	0.9
Highly credible respira-tory	low	3.8	<4.3	3.8	-
	medium	5.0	<6.7	5.0	-
	high	6.7	2.3	4.4	2.9
Popul-ation	low	26	23		
	medium	40	15		
	high	30	44		

Table 22

The distribution of incidents rates for enteric and respiratory symptoms by two levels* of Enterococci for 0-4 year-old age group excluding Sheraton Religious Beach

Symptom	Bact. level	Rates per 100 persons			Rate ratio
		sw	nsw	sw-nsw	
Enteric	low	12.9	13.1	0.2	1.0
	high	21.2	21.4	0.2	1.0
	all	17.2	17.2	0.0	
Highly credible enteric	low	<3.2	6.7	-6.7	
	high	3.0	7.1	-4.1	
	all	1.6	6.9	-5.3	
Respira-tory	low	9.7	20.0	-10.3	
	high	24.2	7.1	17.1	3.4
	all	17.2	13.8	3.4	1.2
Highly credible respira-tory	low	6.5	<6.7	6.5	
	high	3.0	<7.1	-3.0	
	all	4.7	<3.4	4.7	
Popul-ation	low	31	15		
	high	33	14		
	all	64	29		

* low range : 2-30; median 14, geometric mean 9;
high range:31-51; median 40, geometric mean 40;
all range : 2-51; median 20, geometric mean 17.

Table 23

The distribution of incidents rates for enteric and respiratory symptoms by two levels* of Enterococci for all ages excluding Sheraton Religious Beach

Symptom	Bact. level	Rates per 100 persons			Rate ratio
		sw	nsw	sw-nsw	
Enteric	low	6.5	7.3	0.8	
	high	13.1	6.8	6.3	1.9
	all	9.6	7.0	2.6	1.4
Highly credible enteric	low	0.6	1.8	-0.2	
	high	3.9	2.3	1.6	1.7
	all	2.2	2.1	0.1	1.0
Respira-tory	low	4.7	10.9	-6.2	
	high	12.4	2.3	10.1	5.4
	all	8.4	5.6	2.8	1.5
Highly credible respira-tory	low	1.2	<1.8	1.2	
	high	3.3	<1.1	3.3	
	all	2.2	<2.1	0.1	1.0
Popul-ation	low	222	78		
	high	283	192		
	all	505	270		

* low range : 2-30; median 14, geometric mean 9;
high range: 31-51; median 40, geometric mean 40;
all range : 2-51; median 20, geometric mean 17

4.7 Blood analysis for rotavirus

Table 24 shows the response of the study population regarding blood donation. Forty (40) of the grand total of 814 individuals (4.0%) donated at least one blood sample. Out of them, 24 (2.9% of the grand total) individuals donated double blood samples and 16 (2.0%) single blood sample. Among these, 22 individuals (2.2%), agreed to donate two blood samples only after they were taken to the beach and back home by the project staff (Table 25). However, (74%) of the population absolutely refused to donate any blood sample (Table 24).

Table 24

The response of the study population to blood donation

	#	%
Grand total population interviewed on the beach	814	100.0
Total population reached by telephone	784	96.3
Were not reached by telephone	30	3.7
Donated at least one blood sample (of grand total)	40	4.9
Donated two blood samples (of grand total)	24	2.9
Donated only one blood sample (of grand total)	16	2.0
Agreed to donate blood samples and was taken to the beach by the project staff, but did not donate any blood samples	3	0.4
Agreed to donate blood samples on the phone but actually did not	54	6.6
Would agree to donate blood samples if the center for blood donation was close to their house	80	9.8
Refused to donate blood samples	601	73.8
Unknown	6	0.7

Among the 24 persons who donated double blood samples 14 (58%) were swimmers and 10 (42%) non-swimmers. The age distribution was 17% for 0-4 year-olds, 2% for 5-9 year-olds, 13% for 10-17 year-olds and 45% for 18 and above.

All 24 double sera were positive for rotavirus in both samples (readings at A405/A630 in dynatech MR 600 instrument -dual beam quatient -ranged from 193 to 1758). None of the second sera showed any significant rise in readings when compared with the first serum reading. Among the 24 persons, only two persons had enteric symptoms (Table 26); one of them was a swimmer, the other a non-swimmer.

Among the 16 persons who donated single blood samples, 15 were positive (readings above 32) and one negative (below 40).

For comparison with the other studies conducted in Egypt and USA to select an appropriate recreation water quality criterion see article by Fattal et al. entitled: Appropriate Recreational Water Quality Criterion for Marine Bathers in Israel.

Table 25

Distribution of the 40 single and double blood samples

Response to blood donation	Blood samples			
	Double		Single	
	#	%*	#	%*
Agreed to donate blood samples after telephone interview	2	0.2	6	0.7
Agreed to donate blood samples after being taken to the beach and back home by the project staff	22	2.7	10	1.2

Table 26

The relationship between rotavirus antibodies and gastrointestinal symptoms among those bathers who donated two blood samples*

Symptom		Readings for rotavirus	
		1st blood	2nd blood
diarrhoea	sw	1481	1188
diarrhoea + fever	nsw	1321	1374

* for two individuals only

4.8 Comparison with the other studies

For comparison with the other study conducted in Israel, see article by Fattal et al. entitled: Bathers as a possible source of contamination for swimming-associated illness at marine bathing beaches.

5. DISCUSSION

Since this is the final phase of the project, this discussion will consider the findings from the overall program.

The results of this programme along with those of Calderon and Dufour (personal communication, 1988) from a study conducted at a fresh water beach (papers from the two studies will be submitted for publication in the same issue of the American Journal of Public Health) clearly show that the bathers themselves can be a significant source of the pathogens responsible for swimming-associated illness when there is heavy beach usage and limited water exchange at the beach. This conclusion has three implication of a somewhat practical nature. The first is the paradox concerning the use of horizontal surf breakers. While their use creates calm waters better suited for young children, it also increases the risk of illness, especially for this age group. The

second issue is the validity of water quality criteria or standards based on sewage-derived faecal indicators to situations where the bathers themselves are the major sources of the indicators and potential pathogens. The third is the applicability of monitoring data obtained in such a situation to the prediction of swimming-associated illness rates and classification of bathing beaches. The susceptibility of the bathing population to infection should be no different whether the source of the agent is intrinsic or extrinsic to them. The ratios of indicator to pathogen in the water, and the degree of exposure, could however be quite variable when the source of the pathogens is the bathers themselves. If the data base is sufficiently large, the criteria should be valid. The use of the monitoring data obtained in a predictive on regulatory mode is inappropriate since the risk of illness is not predictable and cannot be reduced by conventional source control. Therefore, water samples collected during compliance monitoring against established standards should be taken during times and at locations which are least subject to contamination from the bather themselves.

The illness-indicator points obtained from the Israeli study fall between the regression lines obtained from the United States and Egyptian studies. Because of these results and the confounding effect of contamination by the bathers themselves, it was impossible to select the most appropriate criterion among those available from studies in other countries. Additionally, more extensive studies are needed to establish an appropriate criterion for Israel.

The cooperation of the participants in the study in providing blood samples was very poor, and the number obtained was insufficient for establishing aetiology. All 24 double sera were positive for rotavirus, and no seroconversion was observed.

The success in obtaining blood samples could be improved by:

1. emphasizing the importance of such a research to the participants and more support from different health services, including the Ministry of Health;

2. offering special awards, such as money or gifts, to increase motivation for blood donations;

3. offering special transportations for blood donors from their homes to the bathing beaches and back;

4. sending nurses to the donors' homes, rather than asking them to come to the regional clinics to provide the blood sample. Potential donors of blood samples would not go to a regional clinic.

Even with all these changes, it may not be possible to obtain the number of samples needed to clearly establish the aetiology of the swimming-associated illnesses reported.

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APPENDICES

Appendix.1

Environmental Health Laboratory
Hebrew University of Jerusalem, Israel
POB 1172, Telephone 02-247414

Research on Morbidity and Bacteriological Quality of Sea water
Bacteriological Testing of Sea water

Date:_____ Day of week: _____

Name of beach: _____

Colour of flag:_____ (White=swimming allowed, Red= swimming allowed with caution, Black= swimming forbidden)

Time sample taken: _____

Sample temperature: _____

Wind direction:_____ Wave height (cm):_____ Air temperature: _____

Time of sample arrival in laboratory: _____

Temperature of sample at time of arrival: _____

Time of sample plating:_____ Sample pH: _____

Growth medium bacteria	Sample volume	No. of bacteria on plate	CFU/100 ml*
FC (WHO) reference method)	---------	----------	
Faecal coliforms	---------	----------	
ME	---------	----------	
Enterococci	---------	----------	
Morgenstern & Katzenelson	---------	----------	
Staphilococcus aureus	---------	----------	

* CFU = Colony Forming Units

Appendix 2

Hebrew University of Jerusalem
POB 1172 Telephone 02-247414
Research on Morbidity and Bacteriological Quality of Sea-water at Bathing Beaches

Personal Questionnaire - At the Beach

Name of respondant:_____ Date:_____
Family name:_____ Day of week: _____
Family number:_____ Beach name: _____
Address: _____ Time of interview:_____
Who is the respondant? a-mother; b-father; c-grandmother; d-other, detail_____

1- Do you have a telephone at home? (Write the number) _____ If not, can you be called at work? (First priority for the mother's telephone at work. If the number is negative, say "Thank you and good-bye").
   If yes, what is the telephone number at work?_____
   When can we call you? Date _____, time _____
2- What time did you reach the beach today? _____
3- What time do you plan to leave the beach today? _____
   (See telephone questionnaire, Question 1 for exact time of leaving the beach)
4- Write in Table 1 the information on family members who are at the beach today (employment and education of parents only should be recorded).

Table 1.

Information on family members and swimming status

No	Name	Sex	Birth: Date Yr	Country of birth	Employment/ vocation	Education (# of years)	Swimming status*
1							
2							
3							
4							
5							
6							
7							
8							

* Swimming status (enter the code into the Table 2)
1. Entered the water and the face was immersed into the water, or swallowed the water.
2. The head, but not face was splashed by waves.
3. Sat on the shore but the face was not immersed into the water.
4. The body only up to shoulder level was immersed into the water.
5. The body only up to hip level was immersed into the water.
6. Did not enter the water at all
7. Other:_____

Appendix 2 (cont)

5- Whether any of the family members has today or had yesterday any of the symptoms listed in Table 2. Write the name and insert "1" under the appropriate symptom/s. For a negative answer leave blank under the other symptoms.

Table 2

List of symptoms that family members have today or had yesterday

Name Code	Cough	Cold	Chest	Throa	Vomiting	Stomach ache	Nausea	Diarrhea	Fever	Skin	Sun burn	Eyes	Head ache	Ear-ache	Doctor	Lab test	Home bound # of days
1																	
2																	
3																	
4																	
5																	

Appendix 3

Explanation letter for interviewee

Reseach on Morbidity and Bacteriological Quality of
Sea-water at Bathing Beaches

The Hebrew University-Hadassah Medical School is conducting a medical project investigating whether a connection exists between morbidity and the microbiological quality of sea-water at bathing beaches. Due to the national and international significance of this research, the World Health Organization has agreed to fund the project together with the partial support of the Environmental Protection Service of the Ministry of the Interior in Jerusalem.

Four beaches where bathing is permitted have been selected for this research. Sample of sea-water will be taken from these beaches for bacteriological tests of the sanitary quality of sea-water used for bathing. In addition, families with children who are bathing at these beaches will be requested to fill out a short questionnaire at the seashore and a telephone questionnaire which should determine whether there were any symptoms or disease for several days after visiting the sea-shore.

Obviously, the details provided to the interviewers will be confidential and not used for any purpose outside of the above research.

Your participation in this project will not take much of your time but the success of this research certainly depends to a large extent on your willingness to help, and on precise answers to the questions.

Ms. Linda is responsible for this project and she will be interviewing you both at the beach and on the telephone. We will be most grateful for your assistance in meeting this challenge.

Thanking you in advance for your cooperation,

Dr B. Fattal,
Project Manager

To continue the interview which we conducted at the beach, I will call you on the telephone as we arranged on _____ at _____ o'clock.

Sincerely, Linda

Appendix 4

Environmental Health Laboratory
Hebrew University of Jerusalem, Israel
POB 1172, Telephone 02-247214
Telephone Interview

Family name:_____ Date: _____
Respondant name: _____ Day of week: _____
Family code: _____
Who is the respondant? a-mother; b-father; c-grandmother; d-other, detail_____

1- When did you leave the beach on the day of the interview? _____
2- Write in Table 1 who, of those interviewed on the beach, has since the interview visited any beach or pool. Write the swimming status as coded in Table 2 of Beach Interview and the name of the beach or pool.

Table 1
Family members who have been to beach/pool since the interview

	1	2	3	4	5	6	7	8
Family member who was at the beach								
Did he swim?								
Name of beach/pool								

3- In Table 2, write who, of those interviewed, developed any of the listed symptoms since the interview. For a positive answer insert "1" under the appropriate symptom. For a negative answer leave blanks.

Table 2
List of symptoms which appeared after visit to the beach

Name Code	Cough	Cold	Chest	Throat	Vomiting	Stomach ache	Nausea	Diarrhea	Fever	Skin	Sunburn	Eyes	Head ache	Ear-ache	Doctor	Latest	Home bound # of days
1																	
2																	
3																	
4																	
5																	
6																	
7																	
8																	

4. Whether the member of the family agrees to donate two blood samples (yes/no)
5. The probable date of the first blood sample _____; hour _____
   The actual date _____; name of physician _____
6. The probable date of the second blood sample _____; hour _____
   The actual date _____; name of physician _____

Appendix 5a

TABLE MSPAB6A
EPIDEMIOLOGICAL STUDY OF MEDITERRANEAN SEA POLLUTION
ENVIRONMENTAL HEALTH LABORATORY, JERUSALEM, ISRAEL

SEASON: 1986

ASSOCIATION BETWEEN MICROBIAL QUALITY OF SEAWATER AND MORBIDITY AMONG BATHERS:DISTRIBUTION OF SYMPTOMS FOR ALL BATHERS BY THE CONCENTRATION OF BACTERIAL INDICATORS (MEDIAN(ME), RANGE(RN), LOGMEAN(G.M.)) IN SEAWATER AND BY: BEACHES, SWIMMERS(Sw), NON-SWIMMERS(NSW) AND AGE GROUPS
(NUMBER OF CASES; RATES PER 100 PERSONS AND STANDARD ERRORS)

AGE GROUP(YRS): 0-4
SEX: BOTH

BEACH:GORDON

# OF DAYS IN FIELD	POPULATION #	SYMPTOMS 1 COU.	2 COLD	3 PAIN	4 THR.	5 VOM.	6 STOM	7 NAU.	8 DIA.	9 FEV.	10 SKI.	11 SUN.	12 RED.	13 HEAD	14 ENT.	15 RES.	16 SICK	17 HC.E	18 HC.R
6	30		4				2		3	2		1			5	4	9		2
SW	16		13.3				6.7		10.0	6.7		3.3			16.7	13.3	30.0		6.7
			6.2				4.6		5.5	4.6		3.3			6.8	6.2	8.4		4.6
6	16	1	1						2	2					2	2	4	2	
NSW		6.3	6.3						12.3	12.5					12.5	12.5	25.0	12.5	
		6.1	6.1						8.3	8.3					8.3	8.3	10.8	8.3	
6	46	1	5				2		5	4		1			7	6	13	2	2
BOTH		2.2	10.9				4.3		10.9	8.7		2.2			15.2	13.0	28.3	4.3	4.3
		2.2	4.6				3.0		4.6	4.2		2.2			5.3	5.0	6.6	3.0	3.0

BEACH:SHERATON RELIGIOUS

# OF DAYS IN FIELD	POPULATION #	SYMPTOMS 1 COU.	2 COLD	3 PAIN	4 THR.	5 VOM.	6 STOM	7 NAU.	8 DIA.	9 FEV.	10 SKI.	11 SUN.	12 RED.	13 HEAD	14 ENT.	15 RES.	16 SICK	17 HC.E	18 HC.R
8	35	2	1		2					1						5	5		2
SW		5.7	2.9		5.7					2.9						14.3	14.3		5.7
		3.9	2.8		3.9					2.8						5.9	5.9		3.9
8	53		4			1			4						5	4	8	1	1
NSW			7.5			1.9			7.5						9.4	7.5	15.1	1.9	1.9
			3.8			1.9			3.6						4.0	3.5	4.9	1.9	1.9
8	88	2	5		2	1			4	1					5	9	13	1	3
BOTH		2.3	5.7		2.3	1.1			4.5	1.1					5.7	10.2	14.8	1.1	3.4
		1.8	2.8		1.3	1.1			2.2	1.1					2.5	3.2	3.8	1.1	1.9

BEACH:SHERATON

# OF DAYS IN FIELD	POPUL-ATION #	SYMPTOMS 1 COU.	2 COLD	3 PAIN	4 THR.	5 VOM.	6 STOM	7 NAU.	8 DIA.	9 FEV.	10 SKI.	11 SUN.	12 RED.	13 HEAD	14 ENT.	15 RES.	16 SICK	17 HC.E	18 HC.R
2	12		1						2				2	1	2	1	4		
SW			8.3						16.7				16.7	8.3	16.7	8.3	33.3		
			8.0						10.8				10.8	8.0	10.8	8.0	13.6		
2	5						1		1						2		2		
NSW							20.0		20.0						40.0		40.0		
							17.9		17.9						21.9		21.9		
2	17		1				1		3				2	1	4	1	6		
BOTH			5.9				5.9		17.6				11.8	5.9	23.5	5.9	35.3		
			5.7				5.7		9.2				7.8	5.7	10.3	5.7	11.6		

BEACH:RISHON LEZION

# OF DAYS IN FIELD	POPUL-ATION #	SYMPTOMS 1 COU.	2 COLD	3 PAIN	4 THR.	5 VOM.	6 STOM	7 NAU.	8 DIA.	9 FEV.	10 SKI.	11 SUN.	12 RED.	13 HEAD	14 ENT.	15 RES.	16 SICK	17 HC.E	18 HC.R
5	22		6				1		3	2	1		1		4	6	10	1	1
SW			27.3				4.5		13.6	9.1	4.5		4.5		18.2	27.3	45.5	4.5	4.5
			9.5				4.4		7.3	6.1	4.4		4.4		8.2	9.5	10.6	4.4	4.4
5	8		2						1		1				1	2	4		
NSW			25.0						12.5		12.5				12.5	25.0	50.0		
			15.3						11.7		11.7				11.7	15.3	17.7		
5	30		8				1		4	2	2		1		5	8	14	1	1
BOTH			26.7				3.3		13.3	6.7	6.7		3.3		16.7	26.7	46.7	3.3	3.3
			8.1				3.3		6.2	4.6	4.6		3.3		6.8	8.1	9.1	3.3	3.3

(*)-LOG MEAN OF SAMPLES DRAWN ON THE SAME DAY

NOTE:- IN THE COLUMNS OF THE LISTED SYMPTOMS, BY DECENDING ORDER: NUMBER OF POSITIVE CASES; RATE PER 100 PERSONS; AND STANDARD ERROR

SYMPTOMS:

1)COU.: HEAVY COUGH 2)COLD: COLD 3)PAIN: PAIN IN CHEST
4)THR.: THROAT INFECTION 5)VOM.: VOMITING 6)STOM: STOMACHACHE
7)NAU.: NAUSEA 8)DIA.: DIARRHEA 9)FEV.: FEVER
10)SKI.: SKIN SORES 11)SUN.: SUNBURNT 12)RED.: RED OR INFECTED EYES
13)HEAD: HEADACHE
14)ENT.: ENTERIC INCLUDES PERSONS HAVING AT LEAST ONE OF THE FOLLOWING SYMPTOMS: VOMITING, STOMACHACHE, NAUSEA, DIARRHEA
15)RES.: RESPIRATORY INCLUDES PERSONS HAVING AT LEAST ONE OF THE FOLLOWING SYMPTOMS: HEAVY COUGH, COLD, THROAT INFECTION, PAIN IN CHEST
16)SICK: PERSON WITH AT LEAST ONE OF THE LISTED SYMPTOMS
17)HC.E: ENTERIC WITH FUO. OR/AND ABSENT FROM WORK OR/AND VISIT NURSE OR PHYSICIAN OR/AND PERFORM LAB TEST
18)HC.R: RESPIRATORY WITH FUO OR/AND ABSENT FROM WORK OR/AND VISIT NURSE OR PHYSICIAN OR/AND PERFORM LAB TEST

Appendix 5b

TABLE MSPAB6A No. 2
EPIDEMIOLOGICAL STUDY OF MEDITERRANEAN SEA POLLUTION
ENVIRONMENTAL HEALTH LABORATORY, JERUSALEM, ISRAEL

SEASON: 1986

ASSOCIATION BETWEEN MICROBIAL QUALITY OF SEAWATER AND MORBIDITY AMONG BATHERS:DISTRIBUTION OF SYMPTOMS FOR ALL BATHERS BY THE CONCENTRATION OF BACTERIAL INDICATORS (MEDIAN(ME), RANGE(RN), LOGMEAN(G.M.)) IN SEAWATER AND BY: BEACHES, SWIMMERS(Sw), NON-SWIMMERS(NSW) AND AGE GROUPS
(NUMBER OF CASES; RATES PER 100 PERSONS AND STANDARD ERRORS)

AGE GROUP(YRS): 5-9
SEX: BOTH

BEACH:GORDON

# OF DAYS IN FIELD	POPULATION #	SYMPTOMS 1 COU.	2 COLD	3 PAIN	4 THR.	5 VOM.	6 STOM	7 NAU.	8 DIA.	9 FEV.	10 SKI.	11 SUN.	12 RED.	13 HEAD	14 ENT.	15 RES.	16 SICK	17 HC.E	18 HC.R
6	36		1						2	1	1			2	2	1	5	1	
SW			2.8						5.6	2.8	2.8			5.6	5.6	2.8	13.9	2.8	
			2.7						3.8	2.7	2.7			3.8	3.8	2.7	5.8	2.7	
6	7						1								1		1		
NSW							14.3								14.3		14.3		
							13.2								13.2		13.2		
6	43		1				1		2	1	1			2	3	1	6	1	
BOTH			2.3				2.3		4.7	2.3	2.3			4.7	7.0	2.3	14.0	2.3	
			2.3				2.3		3.2	2.3	2.3			3.2	3.9	2.3	5.3	2.3	

BEACH:SHERATON RELIGIOUS

# OF DAYS IN FIELD	POPULATION #	SYMPTOMS 1 COU.	2 COLD	3 PAIN	4 THR.	5 VOM.	6 STOM	7 NAU.	8 DIA.	9 FEV.	10 SKI.	11 SUN.	12 RED.	13 HEAD	14 ENT.	15 RES.	16 SICK	17 HC.E	18 HC.R
8	76				1							1		1		1	2		1
SW					1.3							1.3		1.3		1.3	2.6		1.3
					1.3							1.3		1.3		1.3	1.8		1.3
8	18													1			1		
NSW														5.6			5.6		
														5.4			5.4		
8	94				1							1		2		1	3		1
BOTH					1.1							1.1		2.1		1.1	3.2		1.1
					1.1							1.1		1.5		1.1	1.8		1.9

BEACH:SHERATON

# OF DAYS IN FIELD	POPUL-ATION #	SYMPTOMS 1 COU.	2 COLD	3 PAIN	4 THR.	5 VOM.	6 STOM	7 NAU.	8 DIA.	9 FEV.	10 SKI.	11 SUN.	12 RED.	13 HEAD	14 ENT.	15 RES.	16 SICK	17 HC.E	18 HC.R
2	25		1		2	3				2	1	1	2		3	3	7	2	2
SW			4.0		8.0	12.0				8.0	4.0	4.0	8.0		12.0	12.0	28.0	8.0	8.0
			3.9		5.4	6.5				5.4	3.9	3.9	5.4		6.5	6.5	9.0	5.4	5.4
2	8										1						1		
NSW											12.5						12.5		
											11.7						11.7		
2	33		1		2	3				2	2	1	2		3	3	8	2	2
BOTH			3.0		6.1	9.1				6.1	6.1	3.0	6.1		9.1	9.1	24.2	6.1	6.1
			3.0		4.2	5.0				4.2	4.2	3.0	4.2		5.0	5.0	7.5	4.2	4.2

BEACH:RISHON LEZION

# OF DAYS IN FIELD	POPUL-ATION #	SYMPTOMS 1 COU.	2 COLD	3 PAIN	4 THR.	5 VOM.	6 STOM	7 NAU.	8 DIA.	9 FEV.	10 SKI.	11 SUN.	12 RED.	13 HEAD	14 ENT.	15 RES.	16 SICK	17 HC.E	18 HC.R
5	33	1	6				1		3	1	1	1	1	1	4	7	12	2	1
SW		3.0	18.2				3.0		9.1	3.0	3.0	3.0	3.0	3.0	12.1	21.2	36.4	6.1	3.0
		3.0	6.7				3.0		5.0	3.0	3.0	3.0	3.0	3.0	5.7	7.1	8.4	4.2	3.0
5	0																		
NSW																			
5	33	1	6				1		3	1	1	1	1	1	4	7	12	2	1
BOTH		3.0	18.2				3.0		9.1	3.0	3.0	3.0	3.0	3.0	12.1	21.2	36.4	6.1	3.0
		3.0	6.7				3.0		5.0	3.0	3.0	3.0	3.0	3.0	5.7	7.1	8.4	4.2	3.0

(*)-LOG MEAN OF SAMPLES DRAWN ON THE SAME DAY

NOTE:- IN THE COLUMNS OF THE LISTED SYMPTOMS, BY DECENDING ORDER: NUMBER OF POSITIVE CASES; RATE PER 100 PERSONS; AND STANDARD ERROR

SYMPTOMS:

1)COU.: HEAVY COUGH
2)COLD: COLD
3)PAIN: PAIN IN CHEST
4)THR.: THROAT INFECTION
5)VOM.: VOMITING
6)STOM: STOMACHACHE
7)NAU.: NAUSEA
8)DIA.: DIARRHEA
9)FEV.: FEVER
10)SKI.: SKIN SORES
11)SUN.: SUNBURNT
12)RED.: RED OR INFECTED EYES
13)HEAD: HEADACHE
14)ENT.: ENTERIC INCLUDES PERSONS HAVING AT LEAST ONE OF THE FOLLOWING SYMPTOMS: VOMITING, STOMACHACHE, NAUSEA, DIARRHEA
15)RES.: RESPIRATORY INCLUDES PERSONS HAVING AT LEAST ONE OF THE FOLLOWING SYMPTOMS: HEAVY COUGH, COLD, THROAT INFECTION, PAIN IN CHEST
16)SICK: PERSON WITH AT LEAST ONE OF THE LISTED SYMPTOMS
17)HC.E: ENTERIC WITH FUO. OR/AND ABSENT FROM WORK OR/AND VISIT NURSE OR PHYSICIAN OR/AND PERFORM LAB TEST
18)HC.R: RESPIRATORY WITH FUO OR/AND ABSENT FROM WORK OR/AND VISIT NURSE OR PHYSICIAN OR/AND PERFORM LAB TEST

Appendix 5c

TABLE MSPAB6A No. 3
EPIDEMIOLOGICAL STUDY OF MEDITERRANEAN SEA POLLUTION
ENVIRONMENTAL HEALTH LABORATORY, JERUSALEM, ISRAEL

BATHING
SEASON: 1986

ASSOCIATION BETWEEN MICROBIAL QUALITY OF SEAWATER AND MORBIDITY AMONG BATHERS:DISTRIBUTION OF SYMPTOMS FOR ALL BATHERS BY THE CONCENTRATION OF BACTERIAL INDICATORS (MEDIAN(ME), RANGE(RN), LOGMEAN(G.M.)) IN SEAWATER AND BY: BEACHES, SWIMMERS(Sw), NON-SWIMMERS(NSW) AND AGE GROUPS
(NUMBER OF CASES; RATES PER 100 PERSONS AND STANDARD ERRORS)

AGE GROUP(YRS): 10-17
SEX: BOTH

BEACH:GORDON

# OF DAYS IN FIELD	POPULATION #	SYMPTOMS 1 COU.	2 COLD	3 PAIN	4 THR.	5 VOM.	6 STOM	7 NAU.	8 DIA.	9 FEV.	10 SKI.	11 SUN.	12 RED.	13 HEAD	14 ENT.	15 RES.	16 SICK	17 HC.E	18 HC.R
6	24								1						1		1		
SW									4.2						4.2		4.2		
									4.1						4.1		4.1		
6	6																		
NSW																			
6	30								1						1		1		
BOTH									3.3						3.3		3.3		
									3.3						3.3		3.3		

BEACH:SHERATON RELIGIOUS

# OF DAYS IN FIELD	POPULATION #	SYMPTOMS 1 COU.	2 COLD	3 PAIN	4 THR.	5 VOM.	6 STOM	7 NAU.	8 DIA.	9 FEV.	10 SKI.	11 SUN.	12 RED.	13 HEAD	14 ENT.	15 RES.	16 SICK	17 HC.E	18 HC.R
8	45		2		1		1							2	1	3	4		
SW			4.7		2.3		2.3							4.7	2.3	7.0	9.3		
			3.2		2.3		2.3							3.2	2.3	3.9	4.4		
8	3																		
NSW																			
8	48		2		1		1							2	1	3	4		
BOTH			4.3		2.2		2.2							4.3	2.2	6.5	8.7		
			3.0		2.2		2.2							3.0	2.2	3.8	9.2		1.9

BEACH:SHERATON

# OF DAYS IN FIELD	POPUL-ATION #	SYMPTOMS 1 COU.	2 COLD	3 PAIN	4 THR.	5 VOM.	6 STOM	7 NAU.	8 DIA.	9 FEV.	10 SKI.	11 SUN.	12 RED.	13 HEAD	14 ENT.	15 RES.	16 SICK	17 HC.E	18 HC.R
2	12						2					2			2		4		
SW							16.7					16.7			16.7		33.3		
							10.8					10.8			10.8		13.6		
2	2						1								1		1		
NSW							50.0								50.0		50.0		
							35.4								35.4		35.4		
2	14						3					2			3		5		
BOTH							21.4					14.3			21.4		35.7		
							11.0					9.4			11.0		12.8		

BEACH:RISHON LEZION

# OF DAYS IN FIELD	POPUL-ATION #	SYMPTOMS 1 COU.	2 COLD	3 PAIN	4 THR.	5 VOM.	6 STOM	7 NAU.	8 DIA.	9 FEV.	10 SKI.	11 SUN.	12 RED.	13 HEAD	14 ENT.	15 RES.	16 SICK	17 HC.E	18 HC.R
5	30		1				1		2			1	1	1	3	1	6		
SW			3.3				3.3		6.7			3.3	3.3	3.3	10.0	3.3	20.0		
			3.3				3.3		4.6			3.3	3.3	3.3	5.5	3.3	7.3		
5	0																		
NSW																			
5	30		1				1		2			1	1	1	3	1	6		
BOTH			3.3				3.3		6.7			3.3	3.3	3.3	10.0	3.3	20.0		
			3.3				3.3		4.6			3.3	3.3	3.3	5.5	3.3	7.3		

(*)-LOG MEAN OF SAMPLES DRAWN ON THE SAME DAY
NOTE:- IN THE COLUMNS OF THE LISTED SYMPTOMS, BY DECENDING ORDER: NUMBER OF POSITIVE CASES; RATE PER 100 PERSONS; AND STANDARD ERROR

SYMPTOMS:

1)COU.: HEAVY COUGH
2)COLD: COLD
3)PAIN: PAIN IN CHEST
4)THR.: THROAT INFECTION
5)VOM.: VOMITING
6)STOM: STOMACHACHE
7)NAU.: NAUSEA
8)DIA.: DIARRHEA
9)FEV.: FEVER
10)SKI.: SKIN SORES
11)SUN.: SUNBURNT
12)RED.: RED OR INFECTED EYES
13)HEAD: HEADACHE
14)ENT.: ENTERIC INCLUDES PERSONS HAVING AT LEAST ONE OF THE FOLLOWING SYMPTOMS: VOMITING, STOMACHACHE, NAUSEA, DIARRHEA
15)RES.: RESPIRATORY INCLUDES PERSONS HAVING AT LEAST ONE OF THE FOLLOWING SYMPTOMS: HEAVY COUGH, COLD, THROAT INFECTION, PAIN IN CHEST
16)SICK: PERSON WITH AT LEAST ONE OF THE LISTED SYMPTOMS
17)HC.E: ENTERIC WITH FUO. OR/AND ABSENT FROM WORK OR/AND VISIT NURSE OR PHYSICIAN OR/AND PERFORM LAB TEST
18)HC.R: RESPIRATORY WITH FUO OR/AND ABSENT FROM WORK OR/AND VISIT NURSE OR PHYSICIAN OR/AND PERFORM LAB TEST

Appendix 5d

TABLE MSPAB6A No. 4
EPIDEMIOLOGICAL STUDY OF MEDITERRANEAN SEA POLLUTION
ENVIRONMENTAL HEALTH LABORATORY, JERUSALEM, ISRAEL

BATHING SEASON: 1986

ASSOCIATION BETWEEN MICROBIAL QUALITY OF SEAWATER AND MORBIDITY AMONG BATHERS:DISTRIBUTION OF SYMPTOMS FOR ALL BATHERS BY THE CONCENTRATION OF BACTERIAL INDICATORS (MEDIAN(ME), RANGE(RN), LOGMEAN(G.M.)) IN SEAWATER AND BY: BEACHES, SWIMMERS(Sw), NON-SWIMMERS(NSW) AND AGE GROUPS
(NUMBER OF CASES; RATES PER 100 PERSONS AND STANDARD ERRORS)

AGE GROUP(YRS): 18+
SEX: BOTH

BEACH:GORDON

# OF DAYS IN FIELD	POPULATION #	SYMPTOMS 1 COU.	2 COLD	3 PAIN	4 THR.	5 VOM.	6 STOM	7 NAU.	8 DIA.	9 FEV.	10 SKI.	11 SUN.	12 RED.	13 HEAD	14 ENT.	15 RES.	16 SICK	17 HC.E	18 HC.R
6	46		3				1							1	1	3	4		
SW			6.5				2.2							2.2	2.2	6.5	8.7		
			3.6				2.2							2.2	2.2	3.6	4.2		
6	35		1		2								1	2		3	5		
NSW			2.9		5.7								2.9	5.7		8.6	14.3		
			2.8		3.9								2.8	3.9		4.7	5.9		
6	81		4		2		1						1	3	1	6	9		
BOTH			4.9		2.5		1.2						1.2	3.7	1.2	7.4	11.1		
			2.4		1.7		1.2						1.2	2.1	1.2	2.9	3.5		

BEACH:SHERATON RELIGIOUS

# OF DAYS IN FIELD	POPULATION #	SYMPTOMS 1 COU.	2 COLD	3 PAIN	4 THR.	5 VOM.	6 STOM	7 NAU.	8 DIA.	9 FEV.	10 SKI.	11 SUN.	12 RED.	13 HEAD	14 ENT.	15 RES.	16 SICK	17 HC.E	18 HC.R
8	37		1				1				1			2	1	1	4		
SW			2.7				2.7				2.7			5.4	2.7	2.7	10.8		
			2.7				2.7				2.7			3.7	2.7	2.7	5.1		
8	54		3				1							1	1	3	5		
NSW			5.8				1.9							1.9	1.9	5.8	9.3		
			3.1				1.8							1.8	1.8	3.1	3.9		
8	91		4				2				1			3	2	4	9		
BOTH			4.4				2.2				1.1			3.3	2.2	4.4	9.9		
			2.1				1.5				1.1			1.9	1.9	2.1	3.1		

BEACH:SHERATON

SYMPTOMS

# OF DAYS IN FIELD	POPUL-ATION #	1 COU.	2 COLD	3 PAIN	4 THR.	5 VOM.	6 STOM	7 NAU.	8 DIA.	9 FEV.	10 SKI.	11 SUN.	12 RED.	13 HEAD	14 ENT.	15 RES.	16 SICK	17 HC.E	18 HC.R
2	17				1	1				1			2		1	1	3	1	1
SW					5.9	5.9				5.9			11.8		5.9	5.9	17.8	5.9	5.9
					5.7	5.7				5.7			7.8		5.7	5.7	9.2	5.7	5.7
2	25								2	1		2		2	2		6	1	
NSW									8.0	4.0		8.0		8.0	8.0		24.0	4.0	
									5.4	3.9		5.4		5.4	5.4		8.5	3.9	
2	42				1	1			2	2		2	2	2	3	1	9	2	1
BOTH					2.4	2.4			4.8	4.8		4.8	4.8	4.8	7.1	2.4	21.4	4.8	2.4
					2.4	2.4			3.3	3.3		3.3	3.3	3.3	4.0	2.4	6.3	3.3	2.4

BEACH:RISHON LEZION

SYMPTOMS

# OF DAYS IN FIELD	POPUL-ATION #	1 COU.	2 COLD	3 PAIN	4 THR.	5 VOM.	6 STOM	7 NAU.	8 DIA.	9 FEV.	10 SKI.	11 SUN.	12 RED.	13 HEAD	14 ENT.	15 RES.	16 SICK	17 HC.E	18 HC.R
5	35						2		1		1	1		1	3		6		
SW							5.7		2.9		2.9	2.9		2.9	8.6		17.1		
							3.9		2.8		2.8	2.8		2.8	4.7		6.4		
5	31				1				1						1	1	1		
NSW					3.2				3.2						3.2	3.2	3.2		
					3.2				3.2						3.2	3.2	3.2		
5	66				1		2		2		1	1		1	4	1	7		
BOTH					1.5		3.0		3.0		1.5	1.5		1.5	6.1	1.5	10.6		
					1.5		2.1		2.1		1.5	1.5		1.5	2.9	1.5	3.8		

(*)-LOG MEAN OF SAMPLES DRAWN ON THE SAME DAY

NOTE:- IN THE COLUMNS OF THE LISTED SYMPTOMS, BY DECENDING ORDER: NUMBER OF POSITIVE CASES; RATE PER 100 PERSONS; AND STANDARD ERROR

SYMPTOMS:

1)COU.: HEAVY COUGH
2)COLD: COLD
3)PAIN: PAIN IN CHEST
4)THR.: THROAT INFECTION
5)VOM.: VOMITING
6)STOM: STOMACHACHE
7)NAU.: NAUSEA
8)DIA.: DIARRHEA
9)FEV.: FEVER
10)SKI.: SKIN SORES
11)SUN.: SUNBURNT
12)RED.: RED OR INFECTED EYES
13)HEAD: HEADACHE
14)ENT.: ENTERIC INCLUDES PERSONS HAVING AT LEAST ONE OF THE FOLLOWING SYMPTOMS: VOMITING, STOMACHACHE, NAUSEA, DIARRHEA
15)RES.: RESPIRATORY INCLUDES PERSONS HAVING AT LEAST ONE OF THE FOLLOWING SYMPTOMS: HEAVY COUGH, COLD, THROAT INFECTION, PAIN IN CHEST
16)SICK: PERSON WITH AT LEAST ONE OF THE LISTED SYMPTOMS
17)HC.E: ENTERIC WITH FUO. OR/AND ABSENT FROM WORK OR/AND VISIT NURSE OR PHYSICIAN OR/AND PERFORM LAB TEST
18)HC.R: RESPIRATORY WITH FUO OR/AND ABSENT FROM WORK OR/AND VISIT NURSE OR PHYSICIAN OR/AND PERFORM LAB TEST

Appendix 5e

TABLE MSPAB6A No. 5
EPIDEMIOLOGICAL STUDY OF MEDITERRANEAN SEA POLLUTION
ENVIRONMENTAL HEALTH LABORATORY, JERUSALEM, ISRAEL

BATHING SEASON: 1986

ASSOCIATION BETWEEN MICROBIAL QUALITY OF SEAWATER AND MORBIDITY AMONG BATHERS:DISTRIBUTION OF SYMPTOMS FOR ALL BATHERS BY THE CONCENTRATION OF BACTERIAL INDICATORS (MEDIAN(ME), RANGE(RN), LOGMEAN(G.M.)) IN SEAWATER AND BY: BEACHES, SWIMMERS(Sw), NON-SWIMMERS(NSW) AND AGE GROUPS (NUMBER OF CASES; RATES PER 100 PERSONS AND STANDARD ERRORS)

AGE GROUP(YRS): ALL AGES
SEX: BOTH

BEACH:GORDON

# OF DAYS IN FIELD	POPUL-ATION #	SYMPTOMS 1 COU.	2 COLD	3 PAIN	4 THR.	5 VOM.	6 STOM	7 NAU.	8 DIA.	9 FEV.	10 SKI.	11 SUN.	12 RED.	13 HEAD	14 ENT.	15 RES.	16 SICK	17 HC.E	18 HC.R
6	136		8				3		6	3	1	1		3	9	8	19	1	2
SW			5.9				2.2		4.4	2.2	.7	.7		2.2	6.6	5.9	14.0	.7	1.5
			2.0				1.3		1.8	1.3	.7	.7		1.3	2.1	2.0	3.0	.7	1.0
6	64	1	2		2		1		2	2			1	2	3	5	10	2	
NSW		1.6	3.1		3.1		1.6		3.1	3.1			1.6	3.1	4.7	7.8	15.6	3.1	
		1.6	2.2		2.2		1.6		2.2	2.2			1.6	2.2	2.6	3.4	4.5	2.2	
6	200	1	10		2		4		8	5	1	1	1	5	12	13	29	3	2
BOTH		.5	5.0		1.0		2.0		4.0	2.5	.5	.5	.5	2.5	6.0	6.5	14.5	1.5	1.0
		.5	1.5		.7		1.0		1.4	1.1	.5	.5	.5	2.1	1.7	1.7	2.5	.9	.7

BEACH:SHERATON RELIGIOUS

# OF DAYS IN FIELD	POPUL-ATION #	SYMPTOMS 1 COU.	2 COLD	3 PAIN	4 THR.	5 VOM.	6 STOM	7 NAU.	8 DIA.	9 FEV.	10 SKI.	11 SUN.	12 RED.	13 HEAD	14 ENT.	15 RES.	16 SICK	17 HC.E	18 HC.R
8	191	2	4		4		2			1	1	1		5	2	10	15		3
SW		1.0	2.1		2.1		1.0			.5	.5	.5		2.6	1.0	5.2	7.9		1.6
		.7	1.0		1.0		.7			.5	.5	.5		1.2	.7	1.6	1.9		.9
8	128		7			1	1		4					2	6	7	14	1	1
NSW			6.5			.6	.8		3.1					1.8	4.7	5.5	10.9	.8	.8
			2.0			.8	.8		1.5					1.1	1.9	2.0	2.8	.8	.8
8	319	2	11		4	1	3		4	1	1	1		7	8	17	29	1	4
BOTH		.8	8.4		1.3	.3	.9		1.3	.3	.3	.3		2.2	2.5	5.3	9.1	.3	1.3
		.4	1.0		.8	.3	.5		.6	.3	.3	.3		.8	.9	1.3	1.8	.3	.5

BEACH:SHERATON

# OF DAYS IN FIELD	POPUL-ATION #	SYMPTOMS 1 COU.	2 COLD	3 PAIN	4 THR.	5 VOM.	6 STOM	7 NAU.	8 DIA.	9 FEV.	10 SKI.	11 SUN.	12 RED.	13 HEAD	14 ENT.	15 RES.	16 SICK	17 HC.E	18 HC.R
2	66		2		3	4	2		2	3	1	3	6	1	8	5	16	3	3
SW			3.0		4.5	6.1	3.0		3.0	4.5	1.5	4.5	9.1	1.5	12.1	7.6	27.3	4.5	4.5
			2.1		2.6	2.9	2.1		2.1	2.6	1.5	2.6	3.5	1.5	4.0	3.3	5.5	2.6	2.6
2	40						2		3	1	1	2		2	5		10	1	
NSW							5.0		7.5	2.5	2.5	5.0		5.0	12.5		25.0	2.5	
							3.4		4.2	2.5	2.5	3.4		3.4	5.2		6.8	2.5	
2	106		2		3	4	4		5	4	2	5	6	3	13	5	28	4	3
BOTH			1.9		2.8	3.8	3.8		4.7	3.8	1.9	4.7	5.7	2.8	12.3	4.7	26.4	3.8	2.8
			1.3		1.6	1.9	1.9		2.1	1.9	1.3	2.1	2.2	1.6	3.2	2.1	4.3	1.9	1.6

BEACH:RISHON LEZION

# OF DAYS IN FIELD	POPUL-ATION #	SYMPTOMS 1 COU.	2 COLD	3 PAIN	4 THR.	5 VOM.	6 STOM	7 NAU.	8 DIA.	9 FEV.	10 SKI.	11 SUN.	12 RED.	13 HEAD	14 ENT.	15 RES.	16 SICK	17 HC.E	18 HC.R
5	120	1	13				5		9	3	3	3	3	3	14	14	34	3	2
SW		.8	10.8				4.2		7.5	2.5	2.5	2.5	2.5	2.5	11.7	11.7	28.3	2.5	1.7
		.8	2.8				1.8		2.4	1.4	1.4	1.4	1.4	2.9	2.9	2.9	4.1	1.4	1.2
5	39		2		1				2		1				2	3	5		
NSW			5.1		2.6				5.1		2.6				5.1	7.7	12.8		
			3.5		2.5				3.5		2.5				3.5	4.3	5.4		
5	159	1	15		1		5		11	3	4	3	3	3	16	17	39	3	2
BOTH		.6	9.4		.6		3.1		6.9	1.9	2.5	1.9	1.9	1.9	10.1	10.7	24.5	1.9	1.3
		.6	2.3		.6		1.4		2.0	1.1	1.2	1.1	1.1	1.1	2.4	2.5	3.4	1.1	.9

(*)-LOG MEAN OF SAMPLES DRAWN ON THE SAME DAY
NOTE:- IN THE COLUMNS OF THE LISTED SYMPTOMS, BY DECENDING ORDER: NUMBER OF POSITIVE CASES; RATE PER 100 PERSONS; AND STANDARD ERROR

SYMPTOMS:
1)COU.: HEAVY COUGH
2)COLD: COLD
3)PAIN: PAIN IN CHEST
4)THR.: THROAT INFECTION
5)VOM.: VOMITING
6)STOM: STOMACHACHE
7)NAU.: NAUSEA
8)DIA.: DIARRHEA
9)FEV.: FEVER
10)SKI.: SKIN SORES
11)SUN.: SUNBURNT
12)RED.: RED OR INFECTED EYES
13)HEAD: HEADACHE
14)ENT.: ENTERIC INCLUDES PERSONS HAVING AT LEAST ONE OF THE FOLLOWING SYMPTOMS: VOMITING, STOMACHACHE, NAUSEA, DIARRHEA
15)RES.: RESPIRATORY INCLUDES PERSONS HAVING AT LEAST ONE OF THE FOLLOWING SYMPTOMS: HEAVY COUGH, COLD, THROAT INFECTION, PAIN IN CHEST
16)SICK: PERSON WITH AT LEAST ONE OF THE LISTED SYMPTOMS
17)HC.E: ENTERIC WITH FUO. OR/AND ABSENT FROM WORK OR/AND VISIT NURSE OR PHYSICIAN OR/AND PERFORM LAB TEST
18)HC.R: RESPIRATORY WITH FUO OR/AND ABSENT FROM WORK OR/AND VISIT NURSE OR PHYSICIAN OR/AND PERFORM LAB TEST

App. 6a

TABLE MSPAB6A No. 1
EPIDEMIOLOGICAL STUDY OF MEDITERRANEAN SEA POLLUTION
ENVIRONMENTAL HEALTH LABORATORY, JERUSALEM, ISRAEL

ASSOCIATION BETWEEN MICROBIAL QUALITY OF SEAWATER AND MORBIDITY AMONG BATHERS: DISTRIBUTION OF SYMPTOMS FOR ALL BATHERS BY THE CONCENTRATION OF BACTERIAL INDICATORS (MEDIAN(ME), RANGE(RN), LOGMEAN(G.M.)) IN SEAWATER AND BY: BEACHES, SWIMMERS(SW), NON-SWIMMERS(NSW) AND AGE GROUPS (NUMBER OF CASES; RATES PER 100 PERSONS AND STANDARD ERRORS)

BATHING SEASON: 1986 — AGE GROUP(YRS): 0-4
BACTERIAL INDICATOR: FAECAL COLIFORMS (CFO/100 ML) (LOG MEAN(*)) — SEX: BOTH

BEACH: ALL BEACHES

BACT. CONCEN-TRATION	# OF DAYS IN FIELD	POPUL-ATION #	1 COU.	2 COLD	3 PAIN	4 THR.	5 VOM.	6 STOM	7 NAU.	8 DIA.	9 FEV.	10 SKI.	11 SUN.	12 RED.	13 HEAD	14 ENT.	15 RES.	16 SICK	17 HC.E	18 HC.R
ME=13	7	34		6				1		5	4		1	1		6	6	14	1	3
RN=0-20	SW			17.6				2.9		14.7	11.8		2.9	2.9		17.6	17.6	41.2	2.9	8.8
G.M= 3				6.5				2.9		6.1	5.5		2.9	2.9		6.5	6.3	8.4	2.9	4.9
*	7	19	1	2						3	1					3	3	6	1	
	NSW		5.3	10.5						15.8	5.3					15.8	15.8	31.6	5.3	
			5.1	7.0						8.4	5.1					8.4	8.4	10.7	5.1	
*	7	53	1	8				1		8	5		1	1		9	9	20	2	3
	BOTH		1.9	15.1				1.9		15.1	9.4		1.9	1.9		17.0	17.0	37.7	3.8	5.7
			1.9	4.9				1.9		4.9	4.0		1.9	1.9		5.2	5.2	6.7	2.6	3.2
ME= 36	9	37		5				2		3		1		2	1	5	5	9		
RN=25-69	SW			13.5				5.4		8.1		2.7		5.4	2.7	13.5	13.5	24.3		
G.M. 38				5.6				3.7		4.5		2.7		3.7	2.7	5.6	5.6	7.1		
*	9	27		2				1		3	1	1				4	2	7	1	
	NSW			7.4				3.7		11.1	3.7	3.7				14.8	7.4	25.9	9.7	
				5.0				3.6		6.0	3.6	3.6				6.8	5.0	8.4	3.6	
*	9	64		7				3		6	1	2		2	1	9	7	16	1	
	BOTH			10.9				4.7		9.4	1.6	3.1		3.1	1.6	14.1	10.9	25.0	1.8	
				3.9				2.6		3.6	1.6	2.2		2.2	1.6	4.3	3.9	5.4	1.6	
ME= 191	5	28	2	1		2					1						5	5		2
RN=104-652	SW		7.1	3.6		7.1					3.6						17.9	17.9		7.1
G.M. 248			4.9	3.5		4.9					3.5						7.2	7.2		4.9
*	5	36		3			1			2						3	3	5	1	1
	NSW			8.3			2.8			5.6						8.3	8.3	13.9	2.8	2.8
				4.6			2.7			3.8						4.6	4.6	5.8	2.7	2.7
	5	64	2	4		2	1			2	1					3	8	10	1	8
	BOTH		3.1	6.3		3.1	1.6			3.1	1.8					4.7	12.5	15.5	1.6	4.7
			2.2	5.0		2.2	1.6			2.2	1.6					2.8	4.1	4.5	1.5	2.6

App. 6a (cont)

ME=34	21	99	2	12	2		3	8	5	1	1	3	1	11	1	28	1	5
RN=0-652	SW		2.0	12.1	2.0		3.0	8.1	5.1.	1.0	1.0	3.0	1.0	11.1	16.2	28.3	1.0	5.1
G.M= 26			1.4	3.3	1.9		1.7	2.7	2.2	1.0	1.0	1.7	1.0	3.2	3.7	9.5	1.0	2.2
*	21	82	1	7		1	1	8	2	1				10	8	18	3	1
	NSW		1.2	8.5		1.2	1.2	9.8	2.4	1.2				12.2	9.8	22.0	3.7	1.2
			1.2	3.1		1.2	1.2	3.3	1.7	1.2				3.6	3.3	4.6	2.1	1.2
	21	181	3	19	2	1	4	16	7	2	1	3	1	21	24	46	4	6
	BOTH		1.7	10.5	1.1	.6	2.2	8.8	3.9	1.1	.6	1.7	.6	11.6	13.3	25.4	2.2	3.3
			.9	2.3	.8	.6	1.1	2.1	1.4	.8	.6	.9	.6	2.4	2.5	3.2	1.1	1.3

(*)-LOG MEAN OF SAMPLES DRAWN ON THE SAME DAY

NOTE:- IN THE COLUMNS OF THE LISTED SYMPTOMS, BY DECENDING ORDER: NUMBER OF POSITIVE CASES; RATE PER 100 PERSONS; AND STANDARD ERROR

SYMPTOMS:

1)COU.: HEAVY COUGH	2)COLD: COLD	3)PAIN: PAIN IN CHEST
4)THR.: THROAT INFECTION	5)VOM.: VOMITING	6)STOM: STOMACHACHE
7)NAU.: NAUSEA	8)DIA.: DIARRHEA	9)FEV.: FEVER
10)SKI.: SKIN SORES	11)SUN.: SUNBURNT	12)RED.: RED OR INFECTED EYES

13)HEAD: HEADACHE

14)ENT.: ENTERIC INCLUDES PERSONS HAVING AT LEAST ONE OF THE FOLLOWING SYMPTOMS: VOMITING, STOMACHACHE, NAUSEA, DIARRHEA

15)RES.: RESPIRATORY INCLUDES PERSONS HAVING AT LEAST ONE OF THE FOLLOWING SYMPTOMS: HEAVY COUGH, COLD, THROAT INFECTION, PAIN IN CHEST

16)SICK: PERSON WITH AT LEAST ONE OF THE LISTED SYMPTOMS

17)HC.E: ENTERIC WITH FUO. OR/AND ABSENT FROM WORK OR/AND VISIT NURSE OR PHYSICIAN OR/AND PERFORM LAB TEST

18)HC.R: RESPIRATORY WITH FUO OR/AND ABSENT FROM WORK OR/AND VISIT NURSE OR PHYSICIAN OR/AND PERFORM LAB TEST

TABLE MSPAB6A No. 1
EPIDEMIOLOGICAL STUDY OF MEDITERRANEAN SEA POLLUTION
ENVIRONMENTAL HEALTH LABORATORY, JERUSALEM, ISRAEL

ASSOCIATION BETWEEN MICROBIAL QUALITY OF SEAWATER AND MORBIDITY AMONG BATHERS:DISTRIBUTION OF SYMPTOMS FOR ALL BATHERS BY THE CONCENTRATION OF BACTERIAL INDICATORS (MEDIAN(ME), RANGE(RN), LOGMEAN(G.M.)) IN SEAWATER AND BY: BEACHES, SWIMMERS(SW), NON-SWIMMERS(NSW) AND AGE GROUPS (NUMBER OF CASES; RATES PER 100 PERSONS AND STANDARD ERRORS)

BATHING SEASON: 1986
BACTERIAL INDICATOR: FAECAL COLIFORMS (CFO/100 ML) (LOG MEAN(*))
BEACH: ALL BEACHES

AGE GROUP(YRS): ALL AGES
SEX: BOTH

BACT. CONCEN-TRATION	# OF DAYS IN FIELD	POPUL-ATION #	1 COU.	2 COLD	3 PAIN	4 THR.	5 VOM.	6 STOM	7 NAU.	8 DIA.	9 FEV.	10 SKI.	11 SUN.	12 RED.	13 HEAD	14 ENT.	15 RES.	16 SICK	17 HC.E	18 HC.R
ME=13	7	180		12			1	3		9	5	2	4	6	4	13	12	95	3	4
RN=0-20	SW			6.7			.6	1.7		5.0	2.8	1.1	2.2	3.3	2.2	7.2	6.7	19.4	1.7	2.2
G.M= 3				1.9			.6	1.0		1.6	1.2	.8	1.1	1.3	1.1	1.9	1.9	2.9	1.0	1.1
	7	66	1	3		1		1		3	1		1	1	3	4	5	13	1	
	NSW		1.5	4.5		1.5		1.5		4.5	1.5		1.5	1.5	4.5	6.1	7.6	19.7	1.5	
			1.5	2.6		1.5		1.5		2.6	1.5		1.5	1.5	2.6	2.9	3.3	4.9	1.5	
	7	246	1	15		1	1	4		12	6	2	5	7	7	17	17	48	4	4
	BOTH		.4	6.1		.4	.4	1.6		4.9	2.4	.8	2.0	2.8	2.8	6.9	6.9	19.5	1.6	1.5
			.4	1.5		.4	.4	.8		1.4	1.0	.6	.9	1.1	1.1	1.6	1.6	2.5	.8	.8
ME= 36	9	226	1	12		3	3	8		8	4	4	4	3	4	19	16	40	4	3
RN=25-69	SW		.4	5.3		1.3	1.3	3.5		3.5	1.8	1.8	1.8	1.3	1.8	8.4	7.1	7.7	1.8	1.3
G.M. 38			.4	1.5		.8	.8	1.2		1.2	.9	.9	.9	.8	.9	1.8	1.7	2.5	.9	.8
*	9	118		2		2		2		6	2	2	1		1	8	4	15	2	
	NSW			1.7		1.7		1.7		5.1	1.7	1.7	.8		.8	6.8	3.4	12.7	1.7	
				1.2		1.2		1.2		2.0	1.2	1.2	.8		.8	2.3	1.7	3.1	1.2	
*	9	344	1	14		5	3	10		14	6	6	5	3	5	27	20	55	6	3
	BOTH		.3	4.1		1.5	.9	2.9		4.1	1.7	1.7	1.5	.9	1.5	7.8	5.8	16.0	1.7	.9
			.3	1.1		.6	.5	.9		1.1	.7	.7	.6	.5	.6	1.5	1.3	2.0	.7	.5
ME= 191	5	107	2	3		4		1			1				4	1	9	11		3
RN=104-652	SW		1.9	2.6		3.7		.9			.9				3.7	.9	8.4	10.3		2.8
G.M. 248			1.3	1.6		1.8		.9			.9				1.8	.9	2.7	2.9		1.6
*	5	87		6			1	1		2					2	4	6	11	1	1
	NSW			6.9			1.1	1.1		2.3					2.3	4.6	6.9	12.6	1.1	1.1
				2.7			1.1	1.1		1.6					1.6	2.2	2.7	3.6	1.1	1.1
	5	194	2	9		4	1	2		2	1				6	5	15	22	1	4
	BOTH		1.0	4.6		2.1	.5	1.0		1.0	.5				3.1	2.6	7.7	11.3	.5	2.1
			.7	1.5		1.0	.5	.7		.7	.5				1.2	1.1	1.9	2.3	.5	1.0

App. 6b (cont)

ME=34	21	513	3	27	7	4	12	17	10	6	8	9	12	33	37	86	7	10
RN=0-652	SW		.6	5.3	1.4	.8	2.3	3.3	1.9	1.2	1.6	1.8	2.3	6.4	7.2	16.8	1.4	1.9
G.M= 26			.3	1.0	.5	.4	.7	.8	.6	.5	.5	.6	.7	1.1	1.1	1.6	.5	.6
*	21	271	1	11	3	1	4	11	3	2	2	1	6	16	15	39	4	1
	NSW		.4	4.1	1.1	.4	1.5	4.1	1.1	.7	.7	.4	2.2	5.9	5.5	14.4	1.5	.9
			.4	1.2	.6	.4	.7	1.2	.6	.5	.5	.4	.9	1.4	1.4	2.1	.7	.4
	21	784	4	38	10	5	16	28	13	8	10	10	18	49	52	125	11	11
	BOTH		.5	4.8	1.3	.6	2.0	3.6	1.7	1.0	1.3	1.3	2.3	6.3	6.6	15.9	1.4	1.4
			.3	.8	.4	.3	.5	.7	.5	.4	.4	.4	.5	.9	.9	1.3	.4	.4

(*)-LOG MEAN OF SAMPLES DRAWN ON THE SAME DAY

NOTE:- IN THE COLUMNS OF THE LISTED SYMPTOMS, BY DECENDING ORDER: NUMBER OF POSITIVE CASES; RATE PER 100 PERSONS; AND STANDARD ERROR

SYMPTOMS:

1)COU.: HEAVY COUGH
2)COLD: COLD
3)PAIN: PAIN IN CHEST
4)THR.: THROAT INFECTION
5)VOM.: VOMITING
6)STOM: STOMACHACHE
7)NAU.: NAUSEA
8)DIA.: DIARRHEA
9)FEV.: FEVER
10)SKI.: SKIN SORES
11)SUN.: SUNBURNT
12)RED.: RED OR INFECTED EYES
13)HEAD: HEADACHE
14)ENT.: ENTERIC INCLUDES PERSONS HAVING AT LEAST ONE OF THE FOLLOWING SYMPTOMS: VOMITING, STOMACHACHE, NAUSEA, DIARRHEA
15)RES.: RESPIRATORY INCLUDES PERSONS HAVING AT LEAST ONE OF THE FOLLOWING SYMPTOMS: HEAVY COUGH, COLD, THROAT INFECTION, PAIN IN CHEST
16)SICK: PERSON WITH AT LEAST ONE OF THE LISTED SYMPTOMS
17)HC.E: ENTERIC WITH FUO. OR/AND ABSENT FROM WORK OR/AND VISIT NURSE OR PHYSICIAN OR/AND PERFORM LAB TEST
18)HC.R: RESPIRATORY WITH FUO OR/AND ABSENT FROM WORK OR/AND VISIT NURSE OR PHYSICIAN OR/AND PERFORM LAB TEST

App. 6c

TABLE MSPAB6A No. 1
EPIDEMIOLOGICAL STUDY OF MEDITERRANEAN SEA POLLUTION
ENVIRONMENTAL HEALTH LABORATORY, JERUSALEM, ISRAEL

ASSOCIATION BETWEEN MICROBIAL QUALITY OF SEAWATER AND MORBIDITY AMONG BATHERS:DISTRIBUTION OF SYMPTOMS FOR ALL BATHERS BY THE CONCENTRATION OF BACTERIAL INDICATORS (MEDIAN(ME), RANGE(RN), LOGMEAN(G.M.)) IN SEAWATER AND BY: BEACHES, SWIMMERS(Sw), NON-SWIMMERS(NSW) AND AGE GROUPS (NUMBER OF CASES; RATES PER 100 PERSONS AND STANDARD ERRORS)

BATHING SEASON: 1986 — AGE GROUP(YRS): 0-4
BACTERIAL INDICATOR: ENTEROCCOCI (CFO/100 ML) (LOG MEAN(*)) — SEX: BOTH

BEACH: ALL BEACHES

BACT. CONCEN-TRATION	# OF DAYS IN FIELD	POPUL-ATION #	.1 COU.	2 COLD	3 PAIN	4 THR.	5 VOM.	6 STOM.	7 NAU.	8 DIA.	9 FEV.	10 SKI.	11 SUN.	12 RED.	13 HEAD	14 ENT.	15 RES.	16 SICK	17 HC.E	18 HC.R
ME= 6	7	26		2						2	2			1		2	2	5		1
RN=2-17	SW			7.7						7.7	7.7			3.8		7.7	7.7	19.2		3.8
G.M= 7				5.2						5.2	5.2			3.8		5.2	5.2	7.7		3.8
	7	23	1	3						1						1	4	5		
	NSW		4.3	13.0						4.3						4.3	17.4	21.7		
			4.3	7.0						4.3						4.3	7.9	8.6		
	7	49	1	5						3	2			1		3	6	10		1
	BOTH		2.0	10.2						6.1	4.1			2.0		6.1	12.2	20.4		2.0
			2.0	4.3						3.4	2.8			2.0		3.4	4.7	5.8		2.0
ME= 38	7	40		8				1		6	2	1	1	2	1	7	8	16	1	2
RN=23-44	SW			20.0				2.5		15.0	5.0	2.3	2.5	5.0	2.5	17.5	20.0	40.0	2.5	5.0
G.M. 34				6.3				2.5		5.6	3.4	2.5	2.5	3.4	2.5	6.0	6.3	7.7	2.3	3.4
*	7	15		1				1		2	1	1				3	1	5	1	
	NSW			.6.7				6.7		13.3	6.7	6.7				20.0	6.7	33.3	6.7	
				6.4				6.4		8.8	6.4	6.4				10.3	6.4	12.2	6.4	
*	9	55		9				2		8	3	2	1	2	1	10	9	21	2	2
	BOTH			16.4				3.6		14.5	5.5	3.5	1.8	3.6	1.8	18.2	16.4	38.2	3.6	3.6
				5.0				2.5		4.8	3.1	2.5	1.8	2.5	1.8	5.2	5.0	6.6	2.5	2.5
ME= 65	6	30	2	2		2		2			1					2	6	7		2
RN=51-150	SW		6.7	6.7		6.7		6.7			3.3					6.7	20.0	23.3		6.7
G.M. 77			4.6	4.6		4.6		4.6			3.3					4.6	7.3	7.7		4.6
*	6	44		3			1			5	1					6	3	8	2	1
	NSW			6.8			2.3			11.4	2.3					13.6	6.8	18.2	4.5	2.3
				3.8			2.2			4.8	2.2					5.2	3.8	5.8	3.1	2.2
	6	74	2	5		2	1	2		5	2					8	9	15	2	3
	BOTH		2.7	6.8		2.7	1.4	2.7		6.8	2.7					10.8	12.2	20.3	2.7	4.1
			1.9	2.9		1.9	1.8	1.9		2.9	1.9					3.6	3.8	4.7	1.9	2.3

App. 6c (cont)

MR=35	20	96	2	12	2		3	8	5	1	1	3	1	11	16	28	1	5
RN=2-150	SW		2.1	12.5	2.1		3.1	8.3	5.2	1.0	1.0	3.1	1.0	11.5	16.7	29.2	1.0	5.2
G.M= 25			1.5	3.4	1.5		1.8	2.8	2.3	1.0	1.0	1.8	1.0	3.3	3.8	4.6	1.0	2.3
*	20	82	1	7		1	1	8	2	1				10	8	18	3	1
	NSW		1.2	8.5		1.2	1.2	9.8	2.4	1.2				12.2	9.8	22.0	3.7	1.2
			1.2	3.1		1.2	1.2	3.3	1.7	1.2				3.6	3.3	4.6	2.1	1.2
	20	178	3	19	2	1	4	16	7	2	1	3	1	21	24	46	4	6
	BOTH		1.7	10.7	1.1	.6	2.2	9.0	3.9	1.1	.6	1.7	.6	11.8	13.5	25.8	2.2	3.4
			1.0	2.3	.8	.6	1.1	2.1	1.5	.8	.6	1.0	.6	2.4	2.6	3.3	1.1	1.4

(*)-LOG MEAN OF SAMPLES DRAWN ON THE SAME DAY
NOTE:- IN THE COLUMNS OF THE LISTED SYMPTOMS, BY DECENDING ORDER: NUMBER OF POSITIVE CASES; RATE PER 100 PERSONS; AND STANDARD ERROR

SYMPTOMS:

1)COU.: HEAVY COUGH
2)COLD: COLD
3)PAIN: PAIN IN CHEST
4)THR.: THROAT INFECTION
5)VOM.: VOMITING
6)STOM: STOMACHACHE
7)NAU.: NAUSEA
8)DIA.: DIARRHEA
9)FEV.: FEVER
10)SKI.: SKIN SORES
11)SUN.: SUNBURNT
12)RED.: RED OR INFECTED EYES
13)HEAD: HEADACHE
14)ENT.: ENTERIC INCLUDES PERSONS HAVING AT LEAST ONE OF THE FOLLOWING SYMPTOMS: VOMITING, STOMACHACHE, NAUSEA, DIARRHEA
15)RES.: RESPIRATORY INCLUDES PERSONS HAVING AT LEAST ONE OF THE FOLLOWING SYMPTOMS: HEAVY COUGH, COLD, THROAT INFECTION, PAIN IN CHEST
16)SICK: PERSON WITH AT LEAST ONE OF THE LISTED SYMPTOMS
17)HC.E: ENTERIC WITH FUO. OR/AND ABSENT FROM WORK OR/AND VISIT NURSE OR PHYSICIAN OR/AND PERFORM LAB TEST
18)HC.R: RESPIRATORY WITH FUO OR/AND ABSENT FROM WORK OR/AND VISIT NURSE OR PHYSICIAN OR/AND PERFORM LAB TEST

TABLE MSPAR6A No. 1
EPIDEMIOLOGICAL STUDY OF MEDITERRANEAN SEA POLLUTION
ENVIRONMENTAL HEALTH LABORATORY, JERUSALEM, ISRAEL

ASSOCIATION BETWEEN MICROBIAL QUALITY OF SEAWATER AND MORBIDITY AMONG
BATHERS:DISTRIBUTION OF SYMPTOMS FOR ALL
BATHERS BY THE CONCENTRATION OF BACTERIAL INDICATORS
(MEDIAN(ME), RANGE(RN), LOGMEAN(G.M.)) IN
SEAWATER AND BY: BEACHES, SWIMMERS(SW),
NON-SWIMMERS(NSW) AND AGE GROUPS
(NUMBER OF CASES; RATES PER 100 PERSONS AND STANDARD ERRORS)

BATHING SEASON: 1986
BACTERIAL INDICATOR: ENTEROCCOCI
(CFO/100 ML) (LOG MEAN(*))

AGE GROUP(YRS):
ALL AGES
SEX: BOTH

BEACH: ALL BEACHES

BACT. CONCEN-TRATION	# OF DAYS IN FIELD	POPUL-ATION #	1 COU.	2 COLD	3 PAIN	4 THR.	5 VOM.	6 STOM	7 NAU.	8 DIA.	9 FEV.	10 SKI.	11 SUN.	12 RED.	13 HEAD	14 ENT.	15 RES.	16 SICK	17 HC.E	18 HC.R
ME= 6	7	173		6			1	1		16	2	3	3	5	2	8	6	25	1	1
RN=2-17	SW			3.5			.6	.6		3.5	1.2	1.7	1.7	2.9	1.2	4.6	3.5	14.5	.6	.6
G.M= 7				1.4			.6	.6		1.4	.8	1.01	1.0	1.3	.8	1.6	1.4	2.7	.6	.6
	7	63	1	3		2		1		2			1	1	2	3	6	11		
	NSW		1.6	4.8		3.2		1.5		3.2			1.6	1.6	3.2	4.8	9.5	17.5		
			1.6	2.7		2.2		1.6		2.2			1.6	1.6	2.2	2.7	3.7	4.8		
	7	236	1	9		2	1	2		8	2	3	4	6	4	11	12	36	1	1
	BOTH		.4	3.8		.8	.4	.8		3.4	.8	1.3	1.7	2.5	1.7	4.7	5.1	15.3	.4	.4
			.4	1.2		.6	.4	.6		1.2	.6	.7	.8	1.0	.8	1.4	1.4	2.3	.4	.4
ME= 38	7	214	1	17		3	3	8		11	7	3	5	4	6	22	21	48	6	6
RN=23-44	SW		.5	7.9		1.4	1.4	3.7		5.1	3.3	1.4	2.3	1.9	2.8	10.3	9.8	22.4	2.8	2.8
G.M. 34			.5	1.8		.8	.8	1.3		1.5	1.2	.8	1.0	.9	1.1	2.1	2.0	2.9	1.1	1.1
*	7	98		2				2		4	2	2	1		2	6	2	13	2	
	NSW			2.0				2.0		4.1	2.0	2.0	1.0		2.0	6.1	2.0	13.3	2.0	
				1.4				1.4		2.0	1.4	1.4	1.0		1.4	2.4	1.4	3.4	1.4	
*	7	312	1	19		3	3	10		15	9	5	6	4	8	28	23	61	8	6
	BOTH		.3	6.1		1.0	1.0	3.2		4.8	2.9	1.5	1.9	1.3	2.6	9.0	7.4	19.6	2.6	1.9
			.3	1.4		.6	.6	1.0		1.2	.9	.7	.8	.6	.9	1.6	1.5	2.2	.9	.8
ME= 65	6	118	2	4		4		3			1				4	3	10	13		3
RN=51-150	SW		1.7	3.4		3.4		2.5			.8				3.4	2.5	8.5	11.0		2.5
G.M. 77			1.2	1.7		1.7		1.4			.8				1.7	1.4	2.6	2.9		1.4
*	6	109		6		1	1	1		5	1				2	7	7	15	2	1
	NSW			5.5		.9	.9	.9		4.6	.9				1.8	6.4	6.4	13.8	1.8	.9
				2.2		.9	.9	.9		2.0	.9				1.3	2.3	2.3	3.3	1.3	.9
	6	227	2	10		5	1	4		5	2				6	10	17	28	2	4
	BOTH		.9	4.4		2.2	.4	1.8		2.2	.9				2.6	4.4	7.5	12.3	.9	1.8
			.8	1.4		1.0	.4	.9		1.0	.8				1.1	1.4	1.7	2.2	.9	.9

App. 6d (cont)

ME=35	20	505	3	27	7	4	12	17	10	6	8	9	12	33	37	86	7	10
RN=2-150	SW		.6	5.3	1.4	.8	2.4	3.4	2.0	1.2	1.6	1.8	2.4	6.5	7.3	17.0	1.4	2.0
G.M= 25			.3	1.0	.5	.4	.7	.8	.6	.3	.6	.6	.7	1.1	1.2	1.7	.5	.5
*	20	270	1	11	3	1	4	11	3	2	2	1	6	16	15	39	4	1
	NSW		.4	4.1	1.1	.4	1.5	4.1	1.1	.7	.7	.4	2.2	5.9	5.6	14.4	1.5	.4
			.4	1.2	.6	.4	.7	1.2	.6	.5	.5	.4	.9	1.4	1.4	2.1	.7	.4
	20	775	4	38	10	5	16	28	13	8	10	10	18	49	52	125	11	11
	BOTH		.5	4.9	1.3	.6	2.1	3.6	1.7	1.0	1.3	1.3	2.3	6.3	6.7	16.1	1.4	1.4
			.3	.8	.4	.3	.5	.7	.5	.4	.4	.4	.5	.9	.9	1.2	.4	.4

(*)-LOG MEAN OF SAMPLES DRAWN ON THE SAME DAY

NOTE:- IN THE COLUMNS OF THE LISTED SYMPTOMS, BY DECENDING ORDER: NUMBER OF POSITIVE CASES; RATE PER 100 PERSONS; AND STANDARD ERROR

SYMPTOMS:

1)COU.: HEAVY COUGH
2)COLD: COLD
3)PAIN: PAIN IN CHEST
4)THR.: THROAT INFECTION
5)VOM.: VOMITING
6)STOM: STOMACHACHE
7)NAU.: NAUSEA
8)DIA.: DIARRHEA
9)FEV.: FEVER
10)SKI.: SKIN SORES
11)SUN.: SUNBURNT
12)RED.: RED OR INFECTED EYES
13)HEAD: HEADACHE
14)ENT.: ENTERIC INCLUDES PERSONS HAVING AT LEAST ONE OF THE FOLLOWING SYMPTOMS: VOMITING, STOMACHACHE, NAUSEA, DIARRHEA
15)RES.: RESPIRATORY INCLUDES PERSONS HAVING AT LEAST ONE OF THE FOLLOWING SYMPTOMS: HEAVY COUGH, COLD, THROAT INFECTION, PAIN IN CHEST
16)SICK: PERSON WITH AT LEAST ONE OF THE LISTED SYMPTOMS
17)HC.E: ENTERIC WITH FUO. OR/AND ABSENT FROM WORK OR/AND VISIT NURSE OR PHYSICIAN OR/AND PERFORM LAB TEST
18)HC.R: RESPIRATORY WITH FUO OR/AND ABSENT FROM WORK OR/AND VISIT NURSE OR PHYSICIAN OR/AND PERFORM LAB TEST

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