

INFECTIOUS DIARRHOEA IN THE YOUNG

Strategies for Control in Humans and Animals

Editor:
S. TZIPORI

INFECTIOUS DIARRHOEA IN THE YOUNG

Strategies for Control in Humans and Animals

Proceedings of an International Seminar on Diarrhoeal
Disease in South East Asia and the Western Pacific Region,
Geelong, Australia, 10-15 February 1985

Editor:

Saul Tzipori

Attwood Institute for Veterinary Research
Melbourne, Australia

Editorial Committee:

Graeme Barnes, Ruth Bishop

Royal Children's Hospital, Melbourne, Australia

and

Ian Holmes, Roy Robins-Browne

Department of Microbiology, University of Melbourne,
Melbourne, Australia



1985

EXCERPTA MEDICA, Amsterdam - New York - Oxford

© 1985 Elsevier Science Publishers B.V. (Biomedical Division)

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise without the prior written permission of the publisher, Elsevier Science Publishers B.V., Biomedical Division, P.O. Box 1527, 1000 BM Amsterdam, The Netherlands.

Special regulations for readers in the USA - This publication has been registered with the Copyright Clearance Center Inc. (CCC), 27 Congress Street, Salem, MA 01970, USA. Information can be obtained from the CCC about conditions under which photocopies of parts of this publication may be made in the USA. All other copyright questions, including photocopying outside the USA, should be referred to the copyright owner, Elsevier Science Publishers B.V., unless otherwise specified.

International Congress Series No. 674

ISBN 0 444 80720 9

Published by:

Elsevier Science Publishers B.V. (Biomedical Division)

P.O. Box 211

1000 AE Amsterdam

The Netherlands

Sole distributors for the USA and Canada:

Elsevier Science Publishing Company Inc.

52 Vanderbilt Avenue

New York, NY 10017

USA

Library of Congress Cataloging-in-Publication Data

International Seminar on Diarrhoeal Disease in South

East Asia and the Western Pacific Region (1985 :

Geelong, Vic.)

Infectious diarrhoea in the young.

(International congress series ; no. 674)

Includes index.

1. Diarrhea in children-Congresses. 2. Diarrhea in animals-Congresses. 3. Diarrhea in children-Asia, Southeastern-Congresses. 4. Diarrhea in animals-Asia, Southeastern-Congresses. 5. Diarrhea in children-Pacific area-Congresses. 6. Diarrhea in animals-Pacific Area-Congresses. I. Tzipori, Saul. II. Bishop, Ruth. III. Title. IV. Series. [DNLM: 1: Communicable Disease Control-congresses. 2. Diarrhea-veterinary-congresses. 3. Diarrhea, Infantile-congresses.]

W3 EX89 no. 674 / WS 312 I61i 1985]

RJ456.D5158 1985

618.92'3427

85-20533

ISBN 0-444-80720-9 (U.S.)

Printed in The Netherlands

PREFACE

The seminar on diarrhoeal disease held in February 1985 in Australia, was part of a series of Research for Development Seminars established and sponsored largely by The Australian Development Assistance Bureau (ADAB) with a view to providing a scientific forum to focus on problems in South East Asia and the Western Pacific (SEA & WP) region.

The seminar on infectious diarrhoea in children and neonates of domestic animals was a unique venture; it encompassed all aspects of microbiology including viruses, bacteria and protozoa; gut immunity and immunization; epidemiology and diagnosis; treatment and control. In addition, the seminar brought together research scientists and clinicians from developing and developed countries. The meeting attracted approximately 180 scientists including over 40 from the SEA & WP region, and 30 from other overseas countries.

The meeting was also designed to bring together medical and veterinary scientists concerned with enteric infections, as in the area of gastroenterology, probably more than in any other scientific field, a considerable portion of the available knowledge is complementary, and is a consequence of collaborative and comparative studies between the medical and the veterinary fields.

It was appropriate that the seminar be held in Australia, where the importance of livestock production is vital, and where major advances in understanding the causes of acute diarrhoea in humans and domestic animals have been made in recent years. Together with expert colleagues specially invited from other countries, the Committee hoped to share some of this knowledge with medical and veterinary scientists from the SEA & WP region.

This meeting was timely, since recent advances in technology have indicated that vaccination against some enteric infections may soon be possible. The seminar was, in a way, a tribute to Dr Ruth Bishop and Dr Ian Holmes who by demonstrating the probable significance of rotavirus as a cause of acute diarrhoea in children back in 1974, not only unearthed an important pathogen, but also marked the beginning of an exciting decade of vigorous and sustained global research on infections of the gastrointestinal tract. These activities led to the identification of a considerable number of enteric pathogens previously unrecognized or ill-defined. These developments coupled with newly acquired molecular biological tools, provided an unprecedented opportunity for development of sensitive and rapid diagnostic tests, better definition of mode of action of virulence attributes, and opened new horizons for development of control measures.

In formulating the scientific program for the seminar, the Committee defined 3 major areas it wished the participants to address: the relative significance of various causes of diarrhoea in countries of the region; attributes of enteric pathogens that are relevant to the theme of treatment and control; and present-day and future options available for treatment and control of diarrhoeal disease.

This volume is a documentation of contributions made by scientists at the seminar, they are organized into 14 sections largely according to the format and order in which they were presented.

The Seminar to a large extent fulfilled its major objectives. However, in my view, the one that stood out most clearly was the excellent dialogue which developed among scientists sharing a common interest, quite independent of origin, social background, or profession.

SAUL TZIPORI

MARCH 1985

ORGANIZING COMMITTEE

Seminar President

Dr A.K. Lascelles, Chief Research Scientist, McMaster Laboratory, CSIRO, Sydney.

Executive Committee

Dr G. Barnes, Director of Gastroenterology, Royal Children's Hospital, Melbourne
 Dr R.F. Bishop, Principal Research Fellow (NH & MRC) Gastroenterology, Royal Children's Hospital, Melbourne

Dr I.H. Holmes, Reader in Microbiology, University of Melbourne

Dr R. Robins-Browne, Reader in Microbiology, University of Melbourne

Dr S. Tzipori, Head of Enteritis, Attwood Institute for Veterinary Research, Victorian Department of Agriculture

Advisory Body

Dr J.A. Craven, Director, Attwood Institute for Veterinary Research, Victorian Department of Agriculture

Prof. I. Gust, Director of Virology, Fairfield Hospital, Melbourne

Dr G. Mitchell, Head of Immunoparasitology, Walter & Eliza Hall, Melbourne

Prof. D. White, Department of Microbiology, University of Melbourne

Seminar Secretariat

Maree Withers)

Helen Phillips)

Karen Davies)

Stephen Peart)

The Attwood Institute for Veterinary Research

Seminar Typist)

Margaret Parkinson)

ACKNOWLEDGEMENTS

Major Sponsors

Australian Development Assistance Bureau
Attwood Institute for Veterinary Research
United Nations Children's Fund (UNICEF)

Biotechnology Australia Pty. Ltd., Sydney
The Commonwealth Foundation
Victorian State Government
Commonwealth Government of Australia

World Health Organization, WHO (Geneva)
American Medical International (Aust) A.M.I. Pty. Ltd
Royal Children's Hospital, Melbourne
The Procter & Gamble Company, (Ohio, U.S.A.)
F.H. Faulding & Co. Ltd
Nestlé Australia Ltd
Department of Microbiology, University of Melbourne
Australian Pig Industry Research Committee (APIRC)
The British Council

Donations

The Ian Potter Foundation
ANZ Banking Group Limited
Carlton and United Breweries Limited
Oxoid Australia Pty. Limited
Westpack Banking Corporation Limited

The Committee is grateful for the assistance it received from the staff of Ansett Airlines of Australia, and Qantas Airways.

CONTENTS

OPENING SESSION

- Global problems of acute diarrhea in young children
R.E. Black 3
- A veterinary clinician's perspective of diarrhea in neonatal food-producing animals
O.M. Radostits 9

NATIONAL OVERVIEWS - MEDICAL

- Diarrhoeal disease in non-urban aboriginal children
M. Gracey 21
- Viral diarrhoea in children in Australia
G. Grohmann 25
- Non-viral infectious diarrhoea in the young: A metropolitan Australian overview
S. Cameron 29
- Infectious diarrhoea as a major public health problem - A profile of the case and its management in Indonesia
R. Soeprono 33
- Acute diarrhoea and rotavirus infection in newborn babies and children in Yogyakarta, Indonesia
Y. Soenarto, S. Haksokusodo, R. Bishop and G. Barnes 38
- Infective diarrhoea in Malaysian children
K.L. Yap and A.H. Aziz 42
- Infectious diarrhoea in young children in Singapore
K.T. Goh 46
- Overview of acute infectious diarrhoea in Chinese young children - Its epidemiology and etiology
Xu Zhaoyu 50
- Pattern of diarrhoeal diseases and molecular epidemiology of human rotavirus in children of Hong Kong
J.S. Tam, W.W.S. Kum and Mun-Hong Ng 54

Overview of the enteric pathogens of diarrhoea in a pediatric population in Korea: The role of enterotoxigenic <i>E. coli</i> , rotavirus and other bacterial pathogens <i>Kwang Wook Ko</i>	61
Enteric pathogens associated with paediatric diarrhoea in Thailand. An overview <i>S. Sarasombath</i>	64
Diarrhoea in Bangladesh: An overview of research conducted between 1962-1984 <i>M.M. Rahaman</i>	69
Etiology and epidemiology of acute diarrhoeal diseases in India <i>S.C. Pal, G.B. Nair and B.C. Deb</i>	73
Acute diarrhoea in children in southern India <i>V.I. Mathan and M.M. Mathan</i>	80
Overview of problems associated with diarrhoea in Pakistan <i>A. Waheed</i>	84
Overview of epidemiology of diarrhoeal diseases in Pakistan <i>A. Ghafoor, M.A. Khan, J. Iqbal and M.I. Burney</i>	88
Infectious diarrhoea: A major problem among Sri Lankan children <i>T. Vitarana and K. Velauthapillai</i>	92
Some aspects of bacterial and virus associated diarrhoea in Sri Lankan children <i>L. Mendis</i>	95
Epidemiology of acute childhood diarrhoea in Burma <i>Kyaw Moe</i>	99
Niue overview on diarrhoeal diseases <i>A. Mitikulena</i>	104
Etiology, epidemiology and national problems associated with diarrhoea in young children in Papua New Guinea <i>J. Biddulph</i>	106
Prospective study of diarrhea in infants and young children of a peri-urban Philippine community: Morbidity patterns and etiologies <i>M. Saniel, A. Santa Maria, E. Sanvictores, F. Leaño, R. Mate, E. Duñgog and T. Tupasi</i>	113

Aetiology and epidemiology of childhood enteritis in low socio-economic populations in South Africa	
<i>H.J. Koornhof</i>	117

Epidemiology of diarrhoeal diseases in South America	
<i>L.R. Trabulsi, M.R.F. Toledo, B.S.O. Ceballos and J.A.N. Candeias</i>	121

NATIONAL OVERVIEWS - VETERINARY

National overview - Colibacillosis in young pigs	
<i>N. Hartaningsih and M.Z. Hassan</i>	129

Enteric infections of young domestic animals in West Malaysia	
<i>Z. Mahmood</i>	131

Infectious diarrhoea in the young: Causes of enteric infections in animal industries in Singapore	
<i>H. Loh</i>	135

Diarrhoeal diseases of neonatal animals in China	
<i>Cheng Xiangjing</i>	138

Infectious diarrhoeal diseases of veterinary importance in Korea	
<i>Y.D. Yoon, J.M. Kim and J.M. Park</i>	141

Diarrhoeal disease of livestock and poultry in the north-eastern part of Thailand	
<i>W. Santivat, N. Meemark, A. Wapakpet and B. Sakoonpanich</i>	146

Neonatal diarrhoea of pigs in Taiwan: Aetiology, epidemiology and treatment	
<i>R.M. Chu, P.C. Yang and W.F. Chang</i>	151

Infectious diarrhoea affecting young food animals in Pakistan	
<i>M.M. Ahmad</i>	156

Infectious diarrhoea in young livestock in Sri Lanka	
<i>D.D. Wanasinghe</i>	158

The causes and economic significance of enteric infections in domestic animals	
<i>Saw Plei Saw</i>	160

MECHANISMS OF DIARRHOEA

Functional and structural response of the intestine to enteric infections	
<i>R. Hamilton, J. MacLeod and D. Butler</i>	165

Factors affecting microbial association with mucosal surface of the gut <i>D.C. Savage</i>	172
---	-----

The spiral-shaped inhabitants of intestinal mucosa in normal and diarrhoeal humans and animals: Pointers to novel determinants of pathogenicity <i>A. Lee</i>	181
--	-----

Development of mucosal receptors for enteropathogenic <i>Escherichia coli</i> (strain RDEC-1) in the rabbit at weaning: In vivo and in vitro correlations <i>H. Shoham, C.P. Cheney, E.P. Kelly and E.C. Boedeker</i>	186
--	-----

UPDATE ON VIRAL ENTERITIS

Epidemiology of rotavirus infections based on analysis of genome RNA <i>I.H. Holmes</i>	195
--	-----

Human rotavirus serotypes <i>H.B. Greenberg and R.D. Shaw</i>	201
--	-----

Antigenically distinct rotaviruses of human and animal origin <i>L.J. Saif and K.W. Theil</i>	208
--	-----

Antigenic determinants coded by rotavirus genes <i>M.L. Dyal-Smith, I. Lazdins, S. Sonza, G. Tregear and I.H. Holmes</i>	215
---	-----

Cloning the rotavirus genome: The implications for vaccine development <i>P.R. Gunn, S. Clark, G.W. Both and A.R. Bellamy</i>	221
--	-----

Enteric viral infections in young animals <i>M.S. McNulty</i>	231
--	-----

Norwalk and other small round viruses <i>H.B. Greenberg and K. Midthun</i>	240
---	-----

Enteric adenoviruses <i>E. Uren, C. Ross, H. Sjogren and I. Jack</i>	248
---	-----

The Berne/Breda group of enteric viruses <i>M.C. Horzinek, J. Ederveen and M. Weiss</i>	253
--	-----

BACTERIAL PATHOGENESIS

Pathogenesis of bacterial diarrhoea - An overview <i>R.M. Robins-Browne</i>	259
--	-----

Pilus-adhesins of enterotoxigenic <i>Escherichia coli</i> and their receptors <i>R.E. Isaacson</i>	267
Monoclonal antibody analyses of the cholera-related enterotoxin family <i>R.A. Finkelstein</i>	273

UPDATE ON DIARRHOEAGENIC BACTERIA

Colibacillosis in newborn piglets associated with class 2 enterotoxigenic <i>Escherichia coli</i> <i>I. Links, R. Love and P. Greenwood</i>	281
Salmonella <i>D.C.A. Candy, M.P. Osborne, S.J. Haddon, T.S. Wallis, W.G. Starkey and J. Stephen</i>	288
Campylobacteriosis in children: Strategies for control <i>M.J. Blaser</i>	294
<i>Aeromonas</i> gastroenteritis: Epidemiology <i>M. Gracey and V. Burke</i>	302

UPDATE ON ENTERIC PROTOZOA

Amoebiasis and other protozoa <i>J.M. Goldsmid</i>	307
Giardiasis <i>I.C. Roberts-Thomson</i>	316
The treatment of giardiasis <i>P.F.L. Boreham and R.W. Shepherd</i>	320
Cryptosporidiosis: Infection and disease <i>S. Tzipori</i>	327

MOLECULAR APPROACHES TO DIAGNOSIS

Genetic approaches to the diagnosis of enteropathogenic bacterial infections <i>K. Wachsmuth, Ø. Olsvik and W. Cook</i>	337
DNA hybridization in the identification of enteroinvasive <i>Escherichia coli</i> and <i>Shigella</i> in children with dysentery <i>O. Sethabutr, P. Echeverria, D.N. Taylor, T. Pal and B. Rowe</i>	350

New insights in the epidemiology and pathogenesis of amoebiasis <i>J.R.L. Forsyth</i>	357
--	-----

MAJOR PATHOGENS OF HUMANS AND ANIMALS

Relative importance of enteropathogens effecting humans <i>R.E. Black</i>	365
A comparative study on important pathogens causing diarrhoea in calves and piglets <i>S. Tzipori</i>	371

TREATMENT AND CONSEQUENCES OF DIARRHOEA

Dehydration, metabolic and nutritional consequences of infant diarrhea, and oral rehydration <i>M.M. Levine</i>	383
Early home rehydration therapy <i>W. Varavithya, V. Pichaipat, R. Mangklasiri, P. Thanomsingh and P. Pavabutara</i>	390
Oral rehydration in calves <i>I.V. Jerrett</i>	396
Secondary sugar intolerance <i>G.P. Davidson, D. Goodwin, G. Edgeley, J. Erlich and T. Robb</i>	401
Nutrition and diarrhoea in babies <i>R. Hamilton, D. Butzner, P. Miniats and C. Guzman</i>	407
Nutrition and diarrhoea in animals <i>J.A. Craven</i>	412

GUT IMMUNOLOGY

IgA antibodies and gut immunity <i>D. Rowley</i>	419
Mucus and gut immunity <i>G.N. Cooper</i>	428
Gut responses to local infection <i>D. Keljo, R. Hamilton and D. Butler</i>	434
Potential of gut immune responses with reference to ruminants <i>A.K. Lascelles, K.J. Beh and T.K.S. Mukkur</i>	438

PREVENTION OF DIARRHOEA BY VACCINATION

- Vaccine strategies for prevention of rotavirus diarrhea
*H. Greenberg, P. Offit, Cam-Tu Thi Tran, A. Kapikian, W. Robinson,
 R. Shaw, R. Gaeta and R. Bellamy* 447
- Passive immunity to coronavirus and rotavirus infections in swine and
 cattle: Enhancement by maternal vaccination
L.J. Saif 456
- Vaccines against bacterial enteric infections of man
M.M. Levine 468
- Oral anti-Shigella vaccines - A model system
D.J. Kopecko, S.B. Formal and L.S. Baron 473
- Prevention by vaccination - Animal bacteria
S. Clark, A. Cahill, C. Stirzaker, P. Greenwood and S. Tzipori 481
- Can we control the diarrhoeal diseases?
M.H. Merson 488

ABSTRACTS OF POSTERS

- Adherence and invasive potential of classical enteropathogenic Escherichia
 coli (EPEC)
M.D. Miliotis, J.L. Richardson and H.J. Koornhof 499
- Haemagglutinin of *Vibrio cholerae*
W. Chaicumpa, A. Boonthorn, T. Kalumbhaheti and P. Tapchaisri 500
- Oral and parenteral administration of normal intestinal bacterial vaccines
 in humans and animals
V. Rusch, R.M. Hyde and T.D. Luckey 501
- The use of colony incompatibility studies to investigate strains of *E. coli*
 and *Salmonella*
K.A. Bettelheim 502
- A *Yersinia* survey done at the Adelaide Children's Hospital
S.R. Davis, I.D. Attenborough and D.J. Hansman 503
- List of participants 505
- Index of authors 513

OPENING SESSION

GLOBAL PROBLEMS OF ACUTE DIARRHEA IN YOUNG CHILDREN

ROBERT E. BLACK, M.D., M.P.H.

Center for Vaccine Development, University of Maryland School of Medicine,
Baltimore, Maryland

Acute diarrhea remains one of the most important health problems in developing countries. This illness, commonly defined by an increase in the frequency and fluidity of bowel movements relative to the usual pattern of each individual, has been found to be a major contributor to illness and death in children of the developing world.

A review by the World Health Organization of 24 community-based surveillance studies carried out in 18 developing countries indicated that the median mortality rates for diarrhea in children under five years of age were highest in the under one and one year age groups, with a rate of 20 deaths per 1000 children per year (1). Furthermore, this review indicated that the diarrheal morbidity rates were also highest in the first two years of life with rates of 2-3 episodes per year per child. Based on this review, it was calculated that children less than five years old in Africa, Asia (excluding China), and Latin America had approximately one billion episodes of diarrhea per year, resulting in 4.6 million deaths.

In the last several years, national diarrheal disease control programs and the World Health Organization have conducted a series of diarrhea morbidity and mortality surveys (2). By the end of 1983, 45 such surveys had been carried out. The surveys of children less than five years old confirmed the high total and "diarrhea-associated" mortality rates and further indicated that in individual countries up to 60% of all deaths were associated with diarrhea. Substantial regional differences were also apparent with the highest total and "diarrhea-associated" mortality rates being in African countries. In these countries an average of 49% of the deaths were associated with diarrhea, compared with 19% in Asian countries.

These surveys also indicated that the diarrheal morbidity rate continues to be substantial. The number of diarrheal episodes per child per year ranged from less than two for East Asian countries to 2.5 for South Asian countries and nearly five for African countries.

Although high mortality rates persist in many areas, it is important to note that substantial reductions in mortality rates have occurred in many countries in the last 20 years. Among the countries in Latin America, the infant mortality rate has fallen from an average of 72 per 1000 live births in