

# **The Immunological Basis for Immunization Series**

Module 20:  
*Salmonella enterica* serovar  
Typhi (typhoid) vaccines

**Immunization, Vaccines and Biologicals**



World Health  
Organization

# **The Immunological Basis for Immunization Series**

Module 20:  
*Salmonella enterica* serovar  
Typhi (typhoid) vaccines

**Immunization, Vaccines and Biologicals**



World Health  
Organization

WHO Library Cataloguing-in-Publication Data

The immunological basis for immunization series: module 20: *salmonella enterica* serovar Typhi (typhoid) vaccines.

(Immunological basis for immunization series ; module 20)

1.Salmonella typhi - microbiology. 2.Typhoid fever - immunology. 3.Typhoid-paratyphoid vaccines - therapeutic use. 4.Vaccination.  
I.World Health Organization. II.Series.

ISBN 978 92 4 150261 0

(NLM classification: WC 270)

**© World Health Organization 2011**

All rights reserved. Publications of the World Health Organization are available on the WHO web site ([www.who.int](http://www.who.int)) or can be purchased from WHO Press, World Health Organization, 20 Avenue Appia, 1211 Geneva 27, Switzerland (tel.: +41 22 791 3264; fax: +41 22 791 4857; e-mail: [bookorders@who.int](mailto:bookorders@who.int)). Requests for permission to reproduce or translate WHO publications – whether for sale or for noncommercial distribution – should be addressed to WHO Press through the WHO web site ([http://www.who.int/about/licensing/copyright\\_form/en/index.html](http://www.who.int/about/licensing/copyright_form/en/index.html)).

The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted lines on maps represent approximate border lines for which there may not yet be full agreement.

The mention of specific companies or of certain manufacturers' products does not imply that they are endorsed or recommended by the World Health Organization in preference to others of a similar nature that are not mentioned. Errors and omissions excepted, the names of proprietary products are distinguished by initial capital letters.

All reasonable precautions have been taken by the World Health Organization to verify the information contained in this publication. However, the published material is being distributed without warranty of any kind, either expressed or implied. The responsibility for the interpretation and use of the material lies with the reader. In no event shall the World Health Organization be liable for damages arising from its use.

---

**The Department of Immunization, Vaccines and Biologicals  
thanks the donors whose unspecified financial support  
has made the production of this document possible.**

This module was produced for Immunization, Vaccines and Biologicals, WHO, by:

Professor Myron M Levine with inputs from  
Professor Marcelo B Sztein and Dr Marcela F Pasetti.

*Printed in October 2011*

**Copies of this publication as well as additional materials  
on immunization, vaccines and biological may be requested from:**

World Health Organization  
Department of Immunization, Vaccines and Biologicals  
CH-1211 Geneva 27, Switzerland  
• *Fax:* + 41 22 791 4227 • *Email:* vaccines@who.int •

© World Health Organization 2010

All rights reserved. Publications of the World Health Organization can be obtained from WHO Press, World Health Organization, 20 Avenue Appia, 1211 Geneva 27, Switzerland (tel: +41 22 791 3264; fax: +41 22 791 4857; email: [bookorders@who.int](mailto:bookorders@who.int)). Requests for permission to reproduce or translate WHO publications – whether for sale or for noncommercial distribution – should be addressed to WHO Press, at the above address (fax: +41 22 791 4806; email: [permissions@who.int](mailto:permissions@who.int)).

The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted lines on maps represent approximate border lines for which there may not yet be full agreement.

The mention of specific companies or of certain manufacturers' products does not imply that they are endorsed or recommended by the World Health Organization in preference to others of a similar nature that are not mentioned. Errors and omissions excepted, the names of proprietary products are distinguished by initial capital letters.

All reasonable precautions have been taken by the World Health Organization to verify the information contained in this publication. However, the published material is being distributed without warranty of any kind, either expressed or implied. The responsibility for the interpretation and use of the material lies with the reader. In no event shall the World Health Organization be liable for damages arising from its use.

The named authors alone are responsible for the views expressed in this publication.

**Printed by the WHO Document Production Services, Geneva, Switzerland**

---

# Contents

<i>Abbreviations and acronyms</i> .....	<i>v</i>
<i>Preface</i> .....	<i>vii</i>
<b>1. The organism and the disease</b> .....	<b>1</b>
1.1 <i>Introduction</i> .....	1
1.2 <i>Bacteriology</i> .....	2
1.3 <i>Epidemiology</i> .....	3
1.4 <i>Epidemiology of other enteric fever agents: <i>Salmonella</i> Paratyphi A, B and C</i> .....	6
<b>2. The pathogenesis and response to infection</b> .....	<b>7</b>
2.1 <i>Pathogenesis of <i>Salmonella</i> Typhi and <i>Salmonella</i> Paratyphi disease</i> .....	7
2.2 <i>Clinical and epidemiologic significance of Vi-negative <i>S. Typhi</i></i> .....	9
2.3 <i>Immune response to wild type <i>Salmonella</i> Typhi</i> .....	9
<b>3. Typhoid vaccines</b> .....	<b>11</b>
3.1 <i>Current WHO guidelines for typhoid vaccine use</i> .....	11
3.2 <i>Licensed typhoid vaccines</i> .....	11
<b>4. Immune responses to currently licensed typhoid vaccines</b> .....	<b>14</b>
4.1 <i>Ty21a live oral vaccine</i> .....	14
4.2 <i>Purified Vi polysaccharide</i> .....	15
<b>5. Vaccine efficacy</b> .....	<b>17</b>
5.1 <i>Ty21a</i> .....	17
5.2 <i>Vi vaccine</i> .....	21
<b>6. Vaccine formulation issues</b> .....	<b>23</b>
6.1 <i>Ty21a</i> .....	23
6.2 <i>Vi</i> .....	23
<b>7. Vaccine schedule issues</b> .....	<b>24</b>
7.1 <i>Ty21a</i> .....	24
7.2 <i>Vi</i> .....	25
<b>8. Vaccine effectiveness</b> .....	<b>27</b>
8.1 <i>Ty21a</i> .....	27
8.2 <i>Vi</i> .....	27
<b>9. Future prospects</b> .....	<b>28</b>
9.1 <i>New generation vaccines under development</i> .....	28
9.2 <i>Immune response to the new generation typhoid vaccines</i> .....	29
<b>References</b> .....	<b>31</b>

---

---

# Abbreviations and acronyms

ASC	antibody secreting cell
CFU	colony-forming unit
CI	confidence interval
CMI	cell-mediated immune response
CTL	cytotoxic T-lymphocyte
DNA	deoxyribonucleic acid
ELISA	enzyme-linked immunosorbent assay
EPI	Expanded Programme on Immunization
EU	ELISA units
GM	geometric mean
GMT	geometric mean titre
Hib	Haemophilus influenzae type b
IFN	interferon
Ig	immunoglobulin
IL	interleukin
LPS	lipopolysaccharide
MLST	multilocus sequence typing
NTS	non-typhoidal Salmonella
PBMC	peripheral blood mononuclear cell
PCR	polymerase chain reaction
PFGE	pulsed field gel electrophoresis
rEPA	recombinant exoprotein
TCM	T central memory
TCR	T-cell receptor
TEM	T effector memory
Th	T helper
TM	memory T-cells
TNF	tumour necrosis factor

---

预览已结束，完整报告链接和二维码如下：

[https://www.yunbaogao.cn/report/index/report?reportId=5\\_29260](https://www.yunbaogao.cn/report/index/report?reportId=5_29260)

