

Contents

Foreword	5
Preface	7

Part 1

Setting the Scene

1 Introduction	18
<i>Peter E. Hartmann</i>	
2 Breast Milk, Global Health and Sustainable Development	20
<i>Leith Greenslade</i>	
2.1 The Importance of Empowered Mothers	20
2.2 The Benefits of Breast Milk	20
2.3 Breastfeeding as an Equity Strategy	21
2.4 The Cost-Effectiveness of Breastfeeding	23
2.5 Breastfeeding's Poor Performance	23
2.6 Barriers to Breastfeeding	24
2.7 A Collective Failure to Respond	25
2.8 Investments in Breastfeeding Innovations	26
2.9 Breaking Breastfeeding Barriers: a Call to Action	27
2.10 Breastfeeding and the Sustainable Development Goals	28
3 Data Collection on Infant Feeding	32
<i>Maria Quigley</i>	
3.1 Data Collection on Infant Feeding	32
3.1.1 What Data Need to be Collected	32
3.1.2 Who Collects Data and How	32
3.2 Problems with Data Collection	36
3.2.1 How Exclusive is Exclusive Breastfeeding?	37
3.2.2 Does Breastfeeding Include Breast Milk Feeding?	37
3.2.3 How to Collect Complex Feeding Data: Preterm Infants, Multiples	37
3.3 Conclusion	37
4 How Breastfeeding Works: Anatomy and Physiology of Human Lactation	39
<i>Melinda Boss, Peter E. Hartmann</i>	
4.1 Introduction	39
4.2 Background	39
4.3 Gross Anatomy	44
4.3.1 History	44
4.3.2 Foetal and Pubertal Development	45
4.3.3 Non-Lactating Adult Breast	46
4.3.4 Pregnancy	48
4.3.5 Lactating Breast	54

4.4	Physiology	56
4.4.1	Origin of Milk	56
4.4.2	Secretory Differentiation	58
4.4.3	Secretory Activation	59
4.4.4	Milk Ejection	64
4.4.5	Infant Suck, Swallow, and Breathe	66
4.4.6	Established Lactation	67
4.4.7	Reference Ranges	70
4.5	Changes to Physiology in Mother and Infant	72
4.5.1	Menstrual Cycle	74
4.5.2	Weaning and Involution	74
4.6	Conclusion	75
5	Why Breastfeeding?	78
	<i>Berthold Koletzko</i>	
5.1	Introduction	78
5.2	The Evolution of Lactation	78
5.3	Assessing Health Effects of Breastfeeding	81
5.4	Breastfeeding and Maternal Health	82
5.5	Breastfeeding and Infant Health	82
5.6	Conclusion	86

Part 2

Different Perspectives

6	Introduction.	92
	<i>Rafael Pérez-Escamilla</i>	
7	Human Milk: Bioactive Components and Their Effects on the Infant and Beyond	93
	<i>Donna Geddes, Foteini Kakulas</i>	
7.1	What Science Tells Us about Human Milk	93
7.2	Key Properties of Human Milk and their Functions	93
7.2.1	Fat	95
7.2.2	Protein	96
7.3	Carbohydrate: Lactose	99
7.3.1	Human milk oligosaccharides (HMOs)	99
7.4	Vitamins and Minerals	100
7.5	Human Milk Microbiome	101
7.6	Appetite Factors	101
7.7	Metabolites	102
7.8	New Discoveries	103
7.8.1	Cells	103
7.8.2	MicroRNA	105
7.9	What Does the Future Hold?	107

8	The Psychological Effects of Breastfeeding	119
	<i>Jennifer Hahn-Holbrook</i>	
8.1	Introduction	119
8.2	Psychological Implications for Mothers.	119
8.2.1	Oxytocin and Prolactin	119
8.2.2	Maternal Bonding	120
8.2.3	Maternal Stress Regulation.	121
8.2.4	Maternal Coping Strategies	123
8.2.5	Postpartum Depression	124
8.3	Psychological Impacts of Breastfeeding on the Infant	125
8.3.1	Attachment	125
8.3.2	Temperament	125
8.4	Psychological Barriers to Breastfeeding.	126
8.4.1	Societal Pressures	127
8.4.2	The Mother's Partner	128
8.4.3	Mental Health Barriers	129
8.5	Conclusions	129
9	Sociological and Cultural Influences upon Breastfeeding	137
	<i>Amy Brown</i>	
9.1	Societal Attitudes Towards Breastfeeding	140
9.1.1	Perceptions of the Breast.	140
9.1.2	Perceptions of Breast Milk	141
9.1.3	Attitudes to Breastfeeding in Public	141
9.1.4	Attitudes Towards Formula Milk.	143
9.2	Societal Attitudes Towards Mothering	144
9.2.1	Postnatal Depression	145
9.2.2	Work	146
9.3	Familial Influences	147
9.3.1	Fathers/Partner	148
9.3.2	A Woman's Own Mother	148
9.4	Ethnicity, Acculturation, and Religion.	149
9.4.1	Ethnicity in Western Regions	149
9.4.2	Acculturation	150
9.4.3	Religious and Cultural Beliefs	150
9.5	The Way Forward.	153
9.6	Summary	154
10	Breastfeeding Promotion: Politics and Policy.	163
	<i>Ashley M. Fox</i>	
10.1	Introduction	163
10.2	The Three Frames of Breastfeeding Politics	165
10.2.1	Breastfeeding as a Women's Rights Issue	165
10.2.2	Breastfeeding as a Children's Rights Issue	166
10.2.3	Breastfeeding as a Global Social Justice Issue	168
10.3	Critiques and Tensions in the Three Frames	170
10.3.1	Tension 1: Trade-offs Between Mothers' Rights and Children's Rights Frame.	171
10.3.2	Tension 2: Different Standards for Developed and Developing Countries?	172
10.4	Conclusion	173

11	Human Milk in Economics Context	176
	<i>Subhash Pokhrel</i>	
11.1	Economics of Lactation	176
11.1.1	Breastfeeding as an Economic Decision	176
11.1.2	Private Costs of Breastfeeding and Formula Feeding	178
11.1.3	Supporting Women who Choose to Breastfeed	179
11.2	Economics of Breastfeeding Support	179
11.2.1	Benefits to Infants and Children	180
11.2.2	Benefits to Mothers	181
11.2.3	Benefits to National Health Systems	182
11.2.4	Benefits to Wider Society	184
11.2.5	Cost-Effectiveness of Breastfeeding Promotion/Support Interventions	184
11.3	Making the Business Case for Breastfeeding Promotion and Support	186
11.3.1	Return on Investment (ROI) Analysis	186
11.3.2	The ROI from Breastfeeding Promotion/Support Interventions: an Example	187
11.4	Summary	190
12	Commercial Aspects of Breastfeeding: Products and Services	194
	<i>Rebecca Mannel</i>	
12.1	Introduction	194
12.2	Breastfeeding Products	194
12.2.1	Milk Expression	194
12.2.2	Alternative Methods of Feeding	195
12.2.3	Breastfeeding Challenges	197
12.3	Human Milk Products	199
12.3.1	Banked Donor Milk	199
12.3.2	Other Milk Products	201
12.3.3	Other Human Milk Uses	201
12.3.4	Milk From Other Mothers	202
12.3.5	Internet Purchasing of Milk	202
12.4	Lactation Service Providers	202
12.4.1	International Board Certified Lactation Consultants	202
12.4.2	Other Lactation Training and Certification	203
12.4.3	Mother-to-Mother/Peer Support	204
12.4.4	Levels of Lactation Care	204
12.4.5	Insurance Coverage	205
12.4.6	Licensure/Regulation	205
12.5	Conclusion	206
13	The Promotion of Breastfeeding	211
	<i>Rowena Merritt</i>	
13.1	Breastfeeding Promotion	211
13.1.1	The Milk Code	211
13.1.2	Breastfeeding Promotion	212
13.1.3	Promotional Work and the Code	212
13.2	Social Marketing and Breastfeeding Rates	213
13.2.1	Defining Critical Social Marketing	213
13.2.2	Learning from the Competition	213

13.2.3	The Mother's Perspective	213
13.2.4	What We Know	214
13.3	Learning from the Formula Milk Industry	214
13.3.1	Advertising Strategies	214
13.3.2	Promotion by Healthcare Professionals	215
13.4	Conclusions	215
14	Infant Feeding in History: an Outline	219
	<i>Maureen Minchin</i>	
14.1	Overview and Introduction	219
14.1.1	Infant Feeding in Antiquity.	220
14.2	The Middle Ages and Renaissance	221
14.2.1	Infant Feeding in the Renaissance.	221
14.3	17th to 18th Century	222
14.3.1	Infant Feeding in the 17 th and 18 th Century.	222
14.4	The 19th Century	223
14.4.1	Infant Feeding in the 19 th Century	223
14.5	The 20th Century	225
14.5.1	Infant Feeding in the 20 th Century	226
14.6	The 21st Century	231
14.6.1	Infant Feeding in the 21 st Century	232
14.7	Current Overview and Conclusion	234

Part 3

Human Milk in Special Circumstances

15	Introduction	242
	<i>Paula P. Meier</i>	
16	Human Milk in the Neonatal Intensive Care Unit	244
	<i>Paula P. Meier, Beverly Rossman, Tricia J. Johnson, Janet L. Engstrom, Rebecca A. Hoban, Kousiki Patra, Harold R. Bigger</i>	
16.1	Introduction	244
16.2	Human Milk Feedings for Premature Infants: Health Outcomes, Costs, and Mechanisms of Protection	244
16.2.1	Health Outcomes of HM Feedings	244
16.2.2	Cost of Human Milk Feedings	246
16.2.3	Protective Mechanisms of HM for Premature Infants	246
16.2.4	Protection via HM Feedings	246
16.2.5	Donor HM as a Supplement/Substitute for HM	247
16.2.6	Summary – Human Milk Feedings for Premature Infants	248
16.3	Prioritising Initiation and Maintenance of Established Lactation in Mothers of Premature Infants in the NICU	249
16.3.1	Breast Pump Dependency	249
16.3.2	Strategies to Prioritise Established Lactation for Breast Pump-Dependent Mothers	250
16.3.3	Summary – Prioritising Initiation and Maintenance of Established Lactation	252

16.4	Managing Human Milk Feeding in the NICU	252
16.4.1	Variability in Pumped HM in the NICU	252
16.4.2	Safe Handling of Human Milk in the NICU	254
16.4.3	Summary – Managing Human Milk Feeding	261
16.5	Feeding at Breast in the NICU	261
16.5.1	Maternal Goals and Expectations	261
16.5.2	Developmentally-Based Breastfeeding Processes	262
16.5.3	Physiologic Immaturity	263
16.5.4	Summary – Feeding at Breast	267
16.6	Overall Summary	267
17	A Collective View of Human Milk Banking	282
	<i>João Aprigio Guerra de Almeida, Ben Hartmann, Kiersten Israel-Ballard, Guido E. Moro</i>	
17.1	Introduction	282
17.2	Interviewer: What is Human Milk Banking?	282
17.2.1	Defining Human Milk Banking	282
17.2.2	History and Future	283
17.3	Why Human Milk Banks?	286
17.4	The Selling of Breastmilk	289
17.4.1	Expert Collective Views	289
17.5	Legal Aspect: Guidelines, Standards, Regulations, and Governing Bodies	290
17.6	Opening a Milk Bank	294
17.6.1	Expert Collective Views	294
17.7	Low-Middle Income Countries	299
17.7.1	Expert Collective Views	299
17.8	Key Considerations	300
17.9	Conclusions	301
18	Pasteurisation	304
	<i>Lukas Christen</i>	
18.1	Introduction	304
18.2	Pasteurisation Methods	304
18.2.1	Pasteurisation of Human Milk	304
18.2.2	Thermal Pasteurisation	305
18.2.3	LTLT or Holder Pasteurisation	306
18.2.4	HTST or Flash Pasteurisation	306
18.2.5	Pressure Pasteurisation	306
18.2.6	Ultrasound Pasteurisation or Ultrasonication	306
18.2.7	Ultrasound and Thermal Combination or Thermo-Ultrasonication	307
18.2.8	Ultraviolet Irradiation	307
18.2.9	Electron, X-Ray, and Gamma Irradiation	308
18.2.10	Microwave Irradiation	308
18.2.11	Pulsed Electric Field	308
18.2.12	Oscillating Magnetic Field	308
18.2.13	Bactofugation (Separation by Weight)	308
18.2.14	Filtration (Separation by Size)	308
18.3	Potential Alternative Pasteurisation Methods for Human Milk	308

19	Human Immunodeficiency Virus (HIV)	313
	<i>Anna Coutsoudis</i>	
19.1	Research Perspective.	313
19.1.1	Development of Infant Feeding Guidelines	313
19.2	Risk Factors for Transmission.	315
19.2.1	Non-exclusive Breastfeeding.	315
19.2.2	Breast Pathology	315
19.2.3	ARVs in Breastmilk	315
19.3	Remaining Research Questions	315
19.3.1	ARV Therapy	315
19.3.2	ARVs and Breastmilk Components	316
19.3.3	Role of Vaccines	316
19.4	Safe Breastfeeding Strategies	316
19.4.1	Exclusive Breastfeeding in the First 6 Months	316
19.4.2	Breastmilk Pasteurisation/Heat Treatment.	316
19.5	Infant Feeding Options	317
19.5.1	Developed Countries	317
19.5.2	Developing Countries.	317
19.6	Policy Implications of Infant Feeding Recommendations	318
20	Breastfeeding and the Use of Medications	323
	<i>Thomas W. Hale, Teresa Ellen Baker</i>	
20.1	Introduction.	323
20.2	Evaluating the Age of the Infant.	323
20.3	Neonatal Pharmacokinetics.	324
20.4	Maternal Drug in Human Milk	324
20.5	Bioavailability	325
20.6	Calculating Infant Exposure.	326
20.7	Review of Important Selected Drug Classes	326
20.7.1	Analgesics	326
20.7.2	Anti-Infectives	328
20.7.3	Antidepressants	328
20.7.4	Immune Modulating Agents.	330
20.7.5	Monoclonal Antibodies.	331
20.7.6	Recreational Drugs	331
20.7.7	Drugs Altering Milk Supply.	333
20.8	Summary	333

Part 4

The Way Forward

21 Introduction. 342
Leith Greenslade

22 Scaling-up Breastfeeding Protection, Promotion, and Support Programmes 343
Rafael Pérez-Escamilla

22.1 Introduction 343

22.2 Key Principles for Scaling-up of Breastfeeding Programmes 345

22.3 Key Concepts behind Scaling-up of National Breastfeeding Programmes 346

22.3.1 Breastfeeding Protection, Promotion, and Support 346

22.3.2 Scaling-up 346

22.3.3 Implementation Science 347

22.3.4 Social Marketing 350

22.3.5 Key Ingredients of Successful Large-Scale Breastfeeding Programmes 352

22.3.6 A Model for Scaling-up of Breastfeeding Programmes 355

22.3.7 Indicators for Scaling-up of Breastfeeding Programmes 356

22.4 WHO Tool 357

22.5 The World Breastfeeding Trends Initiative (WBT) 359

22.6 Conclusions and Vision for the Future 361

23 Towards a Common Understanding of Human Lactation 365
Melinda Boss, Peter E. Hartmann

23.1 Preface 369

23.1.1 Alphabetical List of Terms. 366

Part 5

Addendum

24 Epilogue 388

25 List of Figures. 391

26 List of Tables 395

27 Index of Authors 396

Index 399