

Index

(Note that tables are indicated by **bold** page numbers and illustrations by *italics*).

- absolute risk 238
- acceptable risk *see* risk, acceptable
- acquired immunity, determinant of disease 236–7
- Africa, sanitation (in 1990 and 2000) **99**
- animal faeces (warm-blooded), microbiological water quality indicators 294, **295**
- ascariasis
 - Israel 141–2
 - Mexico 150–5, 201
 - quality audit (QA) **203**
 - wastewater reuse, quality audit (QA) **203**
- attributable risk 238
- Australia
 - Melbourne case studies 274–6
 - drinking water quality 156
 - Sydney Water case studies **267–8**, 272–4
 - hazards and ranking scheme **273**
- Bacillus* spores 298
- bacterial probability density function, recreational water quality 35–6
- bacterial regrowth, endemic waterborne disease 72
- bacteriophages 295–7
 - defined 291
 - limitations as indicators 298–9
 - major groups of indicator coliphages **296**
 - phages in water environments 296
- Bacteroides fragilis*
 - bacteriophages 291
 - detection 302
- bargaining
 - bureaucratic model 219
 - principal agent model 218
 - Sobel–Takahashi multi-stage model 218
- bathing/beaches (sea/freshwater)
 - bather shedding 280
 - primary classification of beaches 281–2, **282**
 - quality, monitoring and assessing, management strategies 281–2, **282**
 - risk, economic approach 211–14
 - see also* recreational water quality
- beneficiaries, identifying for cost recovery 343–4
- benefits, economic evaluation of water and sanitation interventions 340–4, **342**

- bifidobacteria 294
 - defined 291
- BMJ guidelines, economic evaluation **334–5**
- Brazil, incidence of endemic GI disease **78**
- California standards, coliforms 23–4
- Campylobacter* infection
 - disease outbreak causes, UK 263
 - hypothetical study, drinking water, guideline development in practice 394–401
 - Netherlands, DALYs **55**
 - Sweden 122–4
- Canada
 - drinking water case studies, epidemiology/risk assessment 155–6
 - French–Canadian population, seroprevalence **68**
- cancer, risk, acceptable 56
- case-control studies, epidemiology 144
- cause-effect 248–9
- Chadwick, Edwin, on public health issues (historical) 228–9
- chemical pollutants, TDI 19
- chemical risk, vs microbiological risk 258–9
- chemical risk paradigm *see* risk assessment
- China, diarrhoeal disease study 79–80
- cholera epidemic, Peru, economic evaluation 343
- chromogenic substances 299
- clostridia
 - Clostridium perfringens*, defined 290
 - indicator development 294–5
 - sulphite-reducing clostridia 281, 290
- cohort studies 143–4
- coliforms, faecal (FC) 289–93
 - bacteriophages (phages) 291
 - Bacteroides fragilis* bacteriophages 291
 - bifidobacteria 291
 - California standards 23–4
 - Campylobacter* infection **55**, 122–4, 263
 - case studies, recreational water 146–9
 - coliphages 291, 296
 - defined **290**
 - defined substrate methods 293
 - Escherichia coli* (*E. coli*) 54, 281, 290
 - Guidelines for Water Reuse*, USEPA/USAID 370–3
 - history 289
 - identification schemes 289–93
 - Klebsiella* 290, 292
 - membrane filtration method 292
 - most probable number method 291–2
 - survival in different media **93**
- TC quality standard 23
- thermotolerant coliforms 290
- wastewater, guidelines 28–31
- coliphages 291, 296
 - defined 291
 - F-RNA 295, 297
 - indicator **296**
- communication *see* risk communication
- community-managed drinking water supplies
 - application of framework 386–8
 - management by water source committee 387
- community-managed waste management, application of framework 388–9
- contingent valuation 349–50
- coprostanol 297
- cost-effectiveness, and willingness-to-pay **338–9**
- Critical Control Points (CPs) 269
 - corrective actions 385
 - risk management 382–5
- crops, pathogen and indicator survival **93**
- cross-sectional studies 143
- Cryptosporidium* case studies in risk assessment 55, 166–73, **263**
 - aetiology, management deficiencies **262**
 - caveats 172
 - identification 300
 - input exposure variables 167–70
 - mean oocyst levels estimated by different methods **170**
 - oocyst levels, reservoir samples **168–9**
 - Milwaukee episode (1993) 67, 72
 - Monte Carlo simulation 166, 171–2
 - opportunity cost analysis 213
 - results and point estimates 171, **189**
 - computed point estimates for daily risk **171**
 - summary of trials, daily infection risk **172**
- cultural theory
 - and acceptable risk 215–17
 - fright factors 215–16
 - media interest 216–17
- data collection, BMJ **334**
- decision-making, environmental health 249–52
- defined substrate methods 293
- developing countries
 - DALYs (1990) **50**
 - diarrhoeal disease 62–3, 78–80
 - drinking water treatment systems **362**
 - economic evaluation
 - interventions in water and sanitation 331–57

- water and sanitation improvements **98**
 - global burden of disease (1990) study **50**
 - guideline implementation 360–3, **361**
 - problems with setting standards 363–5, **364–5**
 - incidence of endemic GI disease **76–7**, 74–80
 - tourism 379
 - wastewater treatment systems **362**
- diarrhoeal disease
 - studies **62–3**, 79–80
 - travellers' diarrhoea **78**
 - see also* coliforms; infections; streptococci; *specific organisms*
- disability
 - classes and indicator diseases **47**
 - measuring 46–7
 - see also* DALYs
- Disability Adjusted Life Years (DALYs) 52–6
 - causes of DALYs 96–88
 - definitions 45
 - level of acceptable risk 56
 - lost years of life (YLL) 45
 - years lived with disability (YLD) 45–6
 - developed and developing regions (1990) **50**
 - GI disease 52–4
 - chain model 52–4
 - global burden of disease (GBD) study **50**, 43–59
 - guidelines, use in derivation 52–6
 - infection with thermophilic *Campylobacter*, Netherlands **55**
 - integrating health effects of exposure
 - one agent 54–5
 - several agents 55
- disease burden approach
 - risk, acceptable 35–8, 56, 211
 - see also* global disease burden; infectious disease
- disease process, conceptual model **176**, 181
- DNA sensing 303
- DNA/RNA probe-based rRNA targets 303
- dose–response analysis 163–6, 187–8
 - best-fit dose–response parameters **165**
 - chemical risk paradigm 163–5
 - classical risk assessment framework 257
 - exponential and beta-Poisson functions **164**
 - population 5
- drinking water quality
 - case studies
 - epidemiology, risk assessment 155–6
 - rotavirus disease **180**
 - Cryptosporidium* oocysts, reservoir raw water samples **168**
 - hypothetical study of *Campylobacter* sp. 394–401
 - acceptable risk and health targets 396–7
 - assessment of environmental exposure 394–6
 - public health status 400–1
 - risk management 397–400
 - trial study setting 394
 - inequality of risk **221**
 - ingestion, lognormal distribution model 167
 - and microbiological risk **259**, **263**
 - pollution by storm run-off **260**
 - reverse-osmosis filters, in intervention studies 144–5, 155
 - under-reporting of infectious disease **131**
 - USA (1995–1996) **127**
 - see also* quality audit (QA)
- drinking water quality guidelines (GDWQ) 18–22
 - European guidelines 18
 - faecal indicator organisms 20–1
 - indicators **4**
 - and international/national guidelines 132–3
 - operational/national guidelines 21–2
 - pathogens, reviewed in GDWQ **20**
- drinking water treatment systems
 - application of framework 386–8
 - developed vs developing countries **362**
- ecological/correlational studies 142–2
- economic evaluation and priority setting,
 - interventions in water and sanitation 331–57
 - application of guidelines 340–55
 - benefit inclusion 340–4
 - benefits to society of interventions **342**
 - identifying beneficiaries for cost recovery 343–4
 - benefit valuation 346–50
 - contingent valuation 349–50
 - household production function 348
 - market price of goods and activities 346–8
 - methods of valuation **347**
 - revealed preferences 348–9
- BMJ guidelines **334–5**
- comparisons with health interventions 332
- cost effectiveness and willingness to pay for services **338–9**

- economic evaluation and priority setting,
 - interventions in water and sanitation
 - cost effectiveness and willingness to pay for services (*cont'd*)
 - cost inclusion 344–5
 - categorisation of health interventions **345**
 - discounting future costs and benefits 350–2
 - present value of future incomes and discount rates **351**
 - disease costs to society 82–3
 - effectiveness 352–4
 - framework 333–6, 340–54
 - identifying beneficiaries for cost recovery 343–4
 - risk of bathing vs costs of treatment 211–14
 - uncertainty 352–4
 - willingness-to-pay 336–7, **338–9**
- ELISA 300
- endemic level of disease, defined 234
- enterococci 290
 - defined 290
- environmental exposure to disease
 - assessment 10, 188
 - chemical risk paradigm 162–3
 - drinking water, avoidance of acute GI infection 394–401
 - harmonised risk assessment 10
 - measured 395–6
 - predictive 395
 - risk 396
- environmental health, decision-making 249–52
- epidemic, defined 234
- epidemiology and risk assessment 135–60
 - analytical studies
 - case-control studies 144
 - cohort studies 143–4
 - cross-sectional studies 143
 - ecological or correlational studies 142–2
 - relationship between exposure and disease 139
 - case studies 146–56
 - drinking water 155–6
 - non-exposure-related risk factors for gastroenteritis **148**
 - recreational water 146–9
 - wastewater reuse
 - exposure and degree of storage **152**
 - Mexico 150–5, 201
 - descriptive and analytical 241–2
 - elements of study 136–41
 - epidemiological risk, types 238–9
 - evaluation of chance and bias 139–41
 - formulation of question or hypotheses 137
 - measurements of exposure and disease status 138–9
 - policy-making 242
 - practitioners' skills 238–42
 - selection of exposure indicators 138
 - selection of study populations 137
 - setting or evaluating microbiological guidelines 145–6
 - summary/discussion 157–8
 - surveillance, public health 240–1
 - types
 - analytical 142–4
 - descriptive 141–2
 - experimental or intervention studies 144–5
- Escherichia coli* (*E. coli*) 54, 281, 290
 - confirmation 291–2
 - defined 290
 - O157:H7 300
 - toxins 54
- EU, disease outbreaks, (1986-1996), under-reporting **131**
- EU guidelines
 - drinking water quality 18
 - recreational water quality, microbiological guideline design 33
- excreta disposal/excreta management *see* sanitation
- excreta-related infections *see* faecal indicator microorganisms; infections
- experimental studies, epidemiology, risk assessment 144–5
- extrapolation uncertainty 218
- faecal indicator organisms 376–8
 - animal faeces (warm-blooded) 294, **295**
 - current applicability 303–4
 - drinking water quality guidelines (GDWQ) 20–1
 - faecal–oral pathogens, transmission routes **95**
 - key 290
 - transmission routes, pathogen and indicator survival in different media **93**
 - see also* coliforms, faecal (FC); streptococci, faecal (FS)
- faecal sludge treatment, technical options 106
- faecal sterol biomarkers 297
- faeces of warm-blooded animals, microbiological water quality indicators 294, **295**
- FISH (fluorescence in situ hybridisation) 302

- framework for guideline development
 - community-managed drinking water supplies 386–8
 - community-managed waste management 388–9
 - economic evaluation, interventions in water and sanitation 333–6, 340–54
 - elements and implementation, harmonised assessment of infection risk 9–16
 - hypothetical studies, Stockholm 393–410
 - drinking water, study of *Campylobacter* sp. 394–401
 - recreational water, study of avoidance of acute GI infection 401–6
 - wastewater reuse, study of hepatitis A infection 406–10
 - quality audit (QA) **191**, 191–9
 - risk assessment 256–8
- 'framing effect', acceptable risk 215
- France, waterborne disease study 69, 72–3
- freshwater, pathogen and indicator survival **93**
- fright factors, cultural theory 215–16

- gastrointestinal disease *see* infections
- gene sequence based methods 301–2
- giardiasis
 - disease outbreak causes, UK 263
 - identification 300
 - risk, US goal 11, 209
 - transmission 173
- global burden of disease (GBD) study 43–59
 - GBD estimate, applications 51–6
 - international guidelines 57–8
 - major outcomes of study 47–51
 - causes of DALYs by developed and developing regions (1990) **50**
 - causes of death/GBD estimates (1990 and 1998) **48–9**
 - disease and injury attributable to selected risk factors **50**
 - use of DALYs in guideline derivation 52–6
 - measuring population health 44–7
 - measuring disability 46–7
 - years of life lost 45
 - years lived with a disability 45–6
 - problems of assessing disease burden in relation to water quality 56–7
- groundwater pollution, risks from sanitation 105
- guideline development framework
 - hypothetical studies 393–410
 - discussion 410
 - drinking water, study of *Campylobacter* sp. 394–401
 - recreational water, study of avoidance of acute GI infection 401–6
 - wastewater reuse, study of hepatitis A infection 406–10
- guideline implementation 359–74
 - case study 370–3
 - background 370
 - methodology 371
 - results 372
 - risk of infection and disease from various pathogens **372**
 - cost implications 369
 - current position 17–41
 - and international/national guidelines 38
 - developing countries
 - compliance with standards **361**
 - vs developed 360–3
 - problems with setting standards 363–5, **364–5**
 - selecting water and wastewater treatment systems **362**
 - stepwise implementation of standards 366–9
 - and international guidelines/national regulations 373
 - principle of equity 369
 - standards, improvement of water quality **367**
 - wastewater, faecal coliforms (FC) 28–31
 - see also* drinking water; recreational water; wastewater and excreta use
 - Guidelines for Water Reuse*, USEPA/USAID 370–3
 - Guillain–Barré syndrome 54, 55
- harmonised assessment of risk 1–16
- harmonised framework for guideline development *see* framework for guideline development
- hazard analysis
 - and acceptable risk, microbiological quality 378–9
 - risk management plan 381–5
- Hazard Analysis and Critical Control Points (HACCP) 3, 162, 187, 265–70
 - principles **265**
 - scoring risks, Sydney Water, Australia **267–8**, 272–4
 - worksheet **267, 275**

- health education
 - and behavioral modification 246
 - example of risk communication 319
 - health impact assessments (HIAs) 250–1
 - health targets, benefits **13**
 - hedonic pricing 348
 - helminths
 - standards 28, 32
 - survival in different media **93**
 - hepatitis A
 - case study in wastewater irrigation 372
 - wastewater reuse, guideline development framework, hypothetical study 406–10
 - hepatitis E 378
 - hypothetical studies *see* risk, acceptable

 - immunity, acquired 236–7
 - immunomagnetic separation, and other rapid culture based methods 301
 - index organism, defined 288
 - indicator *see* faecal indicator organisms
 - infections (general/gastrointestinal) 61–89
 - aetiology 62–3
 - chain model **53**
 - control by sanitation 91–115
 - costs to society 82–3
 - see also* economic evaluation
 - endemic waterborne disease in industrialized countries 68–74, 81–2
 - health significance of bacterial regrowth 72
 - intervention studies 70–2
 - environmental health decision-making 249–52
 - exposure indicators, epidemiology and risk assessment 138
 - faecal sludge, *see also* wastewater and excreta in agriculture and aquaculture
 - faecal streptococci and enterococci 293–4
 - harmonised assessment of risk 1–16
 - acceptable risk 10–13, 207–26
 - expanded version **9**
 - framework elements and implementation 9–16
 - further development 16
 - future guidelines 6–9
 - indicators and good practice requirements by guideline area **4**
 - necessity 4–6
 - public health status 15–16
 - risk management 13–14
 - World Health Organization guidelines on water quality 2
 - incidence
 - developing countries 74–80
 - endemic disease 74–9
 - industrialized countries 63–74, 81–2
 - indicator diseases **47**
 - inequality of risk **221**
 - and international guidelines/national regulations 112
 - and international/national guidelines 83, 158
 - interventions 247–50
 - outbreak, defined 234
 - risk factors, non-exposure-related **148**
 - routes of transmission 231–4
 - surveillance and waterborne outbreaks 117–34
 - Sweden 118–24
 - USA 124–8
 - transmission routes 92–6, 231–2
 - faecal–oral pathogen transmission routes **95**
 - under-reporting 130–2
 - water-related diseases **232**
- information
- trusted sources **324**
 - see also* risk communication
- Inoviridae 296 **298**
- International Life Sciences Institute (ILSI) 177–8
- intervention measures
- epidemiology, risk assessment 144–5
 - public health 245–50
 - risk management 404–5
- Israel, *Ascaris* infection 141–2
- Klebsiella* infection 290, 292
- detection 300
- latrines *see* sanitation, technical options
- Legionella* infection, detection 300, 302
- Leviviridae 296 **298**
- Lubbock, health effect study 68
-
- mathematical modelling (quantitative risk assessment) 242–3
- media interest
- cultural theory 216–17
 - triggers **321**
- membrane filtration method, coliforms (FC) 292
- Mexico, wastewater reuse case studies, epidemiology 150–5, 201
- microbiological methods 299–303
- fast detections using chromogenic substances 299

- microbiological methods (*cont'd*)
 - future developments 302–3
 - gene sequence based methods, FISH and PCR 301–2
 - immunomagnetic separation (IMS)/culture and other rapid methods 301
 - monoclonal and polyclonal antibodies 300
 - most probable number (MPN) method 291–2
- microbiological risk, drinking water 259–64
 - vs chemical risk 258–9
 - multiple barriers 261
 - origins 259–60
 - outbreak aetiology 262–4
 - cryptosporidiosis outbreaks, management deficiencies **262**
 - scenarios **263**
 - pollution by storm run-off **260**
 - quantitative assessment (QMRA) 162
 - sources **259**
- microbiological water quality indicators 287–314
 - current applicability of faecal indicators 303–4
 - emerging microbiological methods 299–303
 - indicator development 289–97
 - bacteriophages 295–7
 - definitions, indicator and index microorganisms **288**
 - faecal sterol biomarkers 297
 - sulphite-reducing clostridia and other anaerobes 281, 190, 294–5
 - and international/national guidelines 304
 - pathogen models and index microorganisms 297–9
 - see also* coliforms; streptococci
- microbiological water quality regulation 378–89
 - defining hazards and acceptable levels of risk 378–9
 - drinking water supply 386–8
 - and international guidelines/national regulation 377–8, 389
 - objectives 376–8
 - risk management 380–5
 - critical control points 269, 382–5
 - verification and auditing 385
 - wastes management 388–9
- Microviridae 296 **298**, 292
- monitoring systems, matching critical control points 384–5
- monoclonal and polyclonal antibodies 300
- Monte Carlo simulation, risk assessment 166, 171–2
- most probable number (MPN) method 291–2
- multiple-tube fermentation (most probable number method) 291–2
- Myoviridae 296 **298**
- nematodes
 - cohort studies 143–4
 - standards 28
 - survival in different media **93**
 - see also* ascariasis
- Netherlands, *Campylobacter* infection, DALYs **55**
- null hypothesis 137
- opportunity cost, defined 213
- outbreak
 - defined 234
 - types 234–5
- pathogens
 - inactivation 108–9
 - pathogen–host properties **25**
 - survival in different media **93**
 - survival on soils and crops, warm climate **26**
- PCR (polymerase chain reaction) 301–2
- Peru, cholera epidemic, economic evaluation 343
- phages *see* bacteriophages; coliphages
- Philippines, diarrhoeal disease study 80
- Plesiomonas shigelloides* 127–8
- Podoviridae 296 **298**
- policy-making, epidemiology, risk assessment 242
- political resolution of risk issues 217–22
 - bargaining, models 218–19
 - pre-defined probability approach 208–10
 - public acceptance 214–17
 - satisficing 220
 - stakeholder inequality 220–2
 - inequality of health risks **221**
- political will, interventions in public health 246
- polyclonal antibodies 300
- population dose–response analysis 5
- population health measurement 44–7
 - see also* DALYs; risk, acceptable
- poverty, as determinant of disease 236
- preventive medical care, public health 245
- process adequacy (validation), critical control point, risk management 383–4
- process indicator, defined 288
- protozoan oocysts
 - drinking water ingestion case studies 166–73
 - see also* *Cryptosporidium*

- public health 227–54
 - acceptance of risk 214–17
 - see also* risk, acceptable
 - biological and physical sciences 243–4
 - defined 228
 - demography 244
 - and international/national guidelines 252–3
 - interventions 245–50
 - classification 245–6
 - control of environment 246
 - cultivating political will 246
 - health education and behavioral modification 246
 - preventive medical care 245
 - waterborne disease, cause-effect 248–9
 - metaphor for surveillance 229–30
 - nature and determinants of disease 230–7
 - acquired immunity 236–7
 - determinants of ill health 235–7
 - endemic/epidemic disease and outbreaks 234–5
 - environmental exposure 235–6
 - poverty 236
 - pre-existing health 236
 - routes of transmission 231–4
 - classification of water-related diseases **232**
 - practitioners' skills and tools 237–44
 - epidemiology, descriptive and analytical 238–42
 - mathematical modelling (quantitative risk assessment) 242–3
 - policy making 242
 - social and behavioural sciences 244
 - surveillance 240–1
 - risk acceptance, political resolution 15–16, 214–17
 - setting standards 223–4, 250–2
- public information, trusted sources **324**
- Quality Adjusted Life Years (QALYs), costs 213
- quality audit (QA) 185–206
 - applications 201–3
 - case study 201–3
 - stages, water supply pathway **202**
 - wastewater reuse, and ascariasis **203**
 - and international/national guidelines 204–5
 - outline QA, studies on drinking water consumption **200**
 - proposed framework **191**, 191–9
 - method 195
 - observation 194–5
 - outline **193–4**
 - output 196–7, 199–201
 - peer review 197
 - validity 197–8
 - science in risk estimates 189–90
 - uncertainty 187–9
 - Cryptosporidium* in tap water **189**
- quality indicators *see* microbiological water quality indicators
- quantitative microbiological risk assessment (QMRA) 162
- quantitative risk assessment (QRA), public health 242–3
- recreational water quality
 - bacterial probability density function 35–6
 - case studies 146–9
 - coliforms, faecal (FC) 146–9
 - epidemiology, risk assessment 146–9
 - hypothetical study of avoidance of acute GI infection
 - acceptable risk and health targets 403
 - assessment of environment exposure 402
 - microbiological data **402**
 - public health status **406**
 - risk management 403–5
 - trial study setting 401
- indicators **4**
- marine 280–1
- microbiological guideline design 33–8
 - acceptable risk 35–8
 - combining epidemiological and environmental data 35–7
 - current position 32–8
 - dose–response curve, faecal streptococci and gastroenteritis **35**
 - epidemiology 33–4
 - estimated disease burden **37**
 - probability density function of faecal streptococci **36**
 - water quality data 34–5
- monitoring and assessment
 - classes of health risk **277**
 - human faecal contamination 278–80
 - management strategies 276–84
 - microbiological quality 33, 280–1
 - new approach 276–8
 - principal sources of human faecal contamination 278–80
 - riverine discharges 279–80
 - sewage discharges 278–9, **279**

- monitoring and assessment (*cont'd*)
 - under-reporting of disease, outbreaks (1986–1996) **131**
 - and wastewater contamination 276–8
 - see also* bathing/beaches
- relative risk 238
- reverse-osmosis filters, in intervention studies 144–5, 155
- ribosomal RNA (16S rRNA), FISH 302
- risk
 - absolute, attributable, relative 238
 - defined 256
 - pathways, omission, examples 198
- risk, acceptable 10–13, 207–26
 - vs accepted 210–11
 - bargaining, Sobel–Takahashi multi-stage model 218
 - of cancer
 - 'essentially zero' level as gold standard 208
 - vs infection 56
 - and cultural theory 215–17
 - currently tolerated approach 210–11
 - definitions 56, 208–9
 - disease burden approach 35–8, 211
 - economic approach 211–14
 - 'framing effect' 215
 - and hazards, microbiological quality 378–9
 - hypothetical studies
 - drinking water, study of *Campylobacter* sp. 394–401
 - recreational water, study of avoidance of acute GI infection 401–6
 - wastewater reuse, study of hepatitis A infection 406–10
 - and international/national guidelines 225
 - political resolution of issues 217–22
 - pre-defined probability approach 208–10
 - public acceptance 214–17
 - setting standards 223–4, 250–2
 - uncertainty **186**, 187–9, 217
- risk assessment 161–83
 - background 161–2
 - chemical risk paradigm 162–6, 247
 - best-fit dose–response parameters **165**
 - dose–response analysis 163–5
 - exponential and beta-Poisson dose–response functions **164**
 - exposure assessment 162–3
 - hazard assessment 162
 - risk characterisation 165–6
 - risk management 166
 - classical framework 256–8
 - dose–response assessment 257
 - elements and implementation 9–16
 - hazard identification 256
 - risk characterisation 257–8
 - Cryptosporidium* case studies 55, 166–73
 - dynamic epidemiologically-based model 173–4
 - environmental exposure assessment 10
 - expanded framework **9**
 - Health & Safety Executive (HSE), UK 208–9
 - health targets, benefits **13**
 - and international/national guidelines 181
 - rotavirus disease process case study 174–80
 - summary/discussion 180–1
 - see also* quality audit; epidemiology
- risk characterisation
 - chemical risk paradigm 165–6, 247
 - management strategies 257–8
 - Monte Carlo approach 166, 171–2
 - rotavirus disease process case study 179–80
- risk communication 317–30
 - communication techniques 325–27
 - empathy 326
 - silence 327
 - uncertainty 326–7
 - education example 319
 - evaluation 327–8
 - functions 317–18
 - long term trust 324–5
 - media interest
 - cultural theory 216–17
 - triggers **321**
 - risk management cycle **317**
 - risk perception **323**
 - situation management 319–24
 - and WHO guidelines 328–9
- risk management 319–24, 255–86, 397–400
 - analytical verifications 399–400
 - anticipating concerns 323
 - approaches 380–1
 - assessment, recreational water quality 276–84
 - audience focused communication 321
 - audit measures 404
 - Australia 272–6
 - Melbourne 274–6
 - Sydney **267–8**, 272–4
 - basic control 397
 - chemical vs microbiological risk 258–9

- risk management (*cont'd*)
 - chemical risk paradigm 166, 247
 - classical risk assessment framework
 - dose–response assessment 257
 - exposure assessment 257
 - hazard identification 256
 - risk characterisation 257–8
 - critical control point 382–5
 - corrective actions 385
 - identification 382–3
 - monitoring 384–5
 - process adequacy (validation) 383–4
 - verification and auditing 385
 - Cryptosporidium* case study 166–73
 - current condition 398
 - cycle, risk communication **317**
 - definitions 256–8
 - harmonised assessment 13–14
 - and international/national guidelines 284
 - intervention measures 404–5
 - key risk points and audit procedures 398–9
 - long term trust 324–5
 - managing people and processes 271–2
 - media triggers **321**
 - microbiological quality regulation 380–5
 - microbiological risk 259–64
 - negative feedback and outrage 322–3
 - risk perception **323**
 - objectives 404
 - origins 258–64
 - public information sources 324
 - trusted sources of impartial advice in UK **324**
 - recreational water quality assessment
 - classes of health risk **277**
 - microbiological quality 280–1
 - primary classification of beaches 281–2, **282**
 - principal sources of human faecal contamination 278–80
 - systems approach 265–71
 - critical control points 268–9
 - critical limits 269–70
 - flow chart and flow chart verification 266
 - hazard analysis **265**, 267–8
 - monitoring and corrective actions 270–1
 - record keeping, validation and verification 271
 - team skills and resources 266
 - water description and use 266–7
 - theory/reality 264–5
 - verification information 405
 - water quality objectives 397–8
 - see also* Hazard Analysis and Critical Control Points; risk communication
 - riverine discharges, and recreational water quality 279–80
 - rotavirus disease process case study 174–80, 372
 - average daily prevalence, children exposed to drinking water contamination **180**
 - conceptual model **176**
 - implementation 177–80
 - International Life Sciences Institute (ILSI) 177–8
 - problem formulation and analysis 178
 - risk characterisation 179–80
 - schematic application of ILSI framework **178**
- Salmonella* infection
 - case study in wastewater irrigation 372
 - detection 300
 - disease outbreak causes, UK 263
- saltwater, pathogen and indicator survival **93**
- sanitation 96–111
 - containment 109–11
 - selected excreta management and treatment options **110–11**
 - diarrhoeal disease, water and sanitation improvements **98**
 - global coverage (in 1990 and 2000) and Africa **99**
 - health and poor sanitation 96–8
 - pathogen inactivation 108–9
 - organism survival in faecal sludge **109**
 - sanitation coverage 98–100
 - scenario, low-income neighbourhood 99–100
 - sewerage system, costs 107
 - technical options 102–8
 - containment efficiency **109**
 - conventional waterborne, disadvantages 107
 - faecal sludge treatment 106
 - groundwater pollution risks from on-site sanitation 105
 - off site (sewered) sanitation 106–7
 - on-site installations 102–4
 - septic tanks **104**
 - VIP latrine and double vault no-mix latrine **103**
 - wastewater treatment 107–8
- satisficing, political resolution of risk issues 220
- selection bias 137
- seroprevalence, selected enteric pathogens, French–Canadian population **68**

- sewage discharges, recreational water quality 278–9, **279**
- sewage treatment *see* wastewater treatment
- shellfish, faecal–oral pathogen transmission routes **95**
- small round structure virus (SRSV) 128
- Snow, John, cholera in London 228
- Sobel–Takahashi multi-stage model, bargaining 218
- soils, pathogen and indicator survival **93**
- soils and crops, pathogens **26**
- stakeholder inequality, political resolution of risk issues 220–2
- sterol biomarkers 297
- storm run-off, microbiological risk **260**
- streptococci, faecal (FS) 290
 - absolute numbers 37
 - defined 290
 - and enterococci 281–2
 - gastroenteritis **35–6**
 - thermotolerant/faecal streptococci ratio 294
- study design, BMJ **334**
- sulphite-reducing clostridia, indicator development 281, 290, 294–5
- surveillance systems
 - epidemiological, public health 240–1
 - waterborne infections (general) 117–34
- Sweden 118–24
 - clinical and laboratory surveillance 121–4
 - diagnosis **122**
 - initially reported and actual numbers **123**
 - risk factors identified **124**
 - recognition of outbreaks 120–1
 - water sampling 121
 - waterborne disease 1980–99 118–20, **119**
- Siphoviridae 296, **298**, 292
- tap water *see* drinking water
- tolerable daily intake (TDI), chemical pollutants 19
- tourism
 - developing countries 379
 - travellers' diarrhoea **78**
- transmission routes
 - GI infections 231–4
 - giardiasis 173
- travellers' diarrhoea, developing countries **78**
- turbidity
 - bacterial, endemic waterborne disease, industrialized countries 72
 - Milwaukee, USA 72
- UK
 - GI disease, studies 64
 - Health & Safety Executive (HSE), risk assessment 208–9
- uncertainty **186**, 187–9
 - extrapolation uncertainty 218
 - risk communication 326–7
 - types 217
- urine as crop fertilizer 102
- USA
 - drinking water quality, (1995–1996) **127**
 - FoodNet site 65–6
 - recreational water quality, microbiological guideline design 33
- USA disease outbreaks
 - Cleveland study of GI disease 63–4
 - Cryptosporidium*
 - Milwaukee (1993) 67, 72
 - New York 166–73
 - drinking water (1995–1996) 132–3
 - management 128–30
 - Minnesota study 127
 - Philadelphia study 73
 - Tecumseh study of GI disease 63–4
 - waterborne outbreaks (WBDOs) 124–8, **127**
- USEPA (Environmental Protection Agency)
 - standards 199, 208, 210
 - and World Bank
 - case study in wastewater irrigation 370–3
 - recommendations 372
- utility, defined 213
- validation, critical control point, risk management 383–4
- Vibrio cholerae*, case study in wastewater irrigation 372
- viruses
 - enteric 67–8
 - human enteric 297–9
 - seroprevalence, French–Canadian population **68**
 - small round structure virus (SRSV) 128
- wastewater and excreta in agriculture and aquaculture 22–32
 - as benefit 24–5

- wastewater and excreta in agriculture and aquaculture (*cont'd*)
 - case studies
 - epidemiology 149–55
 - Mexico 149–55, 201
 - community management, application of framework 388–9
 - derivation of WHO (1989) guidelines 27–32
 - controversy on wastewater reuse 32
 - incorporation into standards 31–2
 - main features 30–1
 - model of reducing health risks **30**
 - recommended microbiological quality **28**
 - effect of exposure and degree of storage **152**
 - indicators **4**
 - irrigation, World Bank and WHO, case study 370–3
 - pathogen–host properties **25**
 - and recreational water quality 276–8
 - reuse case studies, epidemiology, risk assessment 149–55
 - WHO, reuse guidelines, history 23–7
 - see also* quality audit (QA); wastewater treatment
- wastewater reuse, hypothetical study of hepatitis A infection
 - acceptable risk and health targets 408
 - assessment of environmental exposure and risk 407–8
 - assumptions and data inputs **407–8**
 - drip irrigation 409
 - public health status 409–10
 - risk management 408–9
 - trial study setting 407
- wastewater treatment 107–8, 409, 278–9, **279**
 - systems, developed vs developing countries **362**
- waste stabilization ponds (WSP) 24, 27
 - organism survival periods **109**
 - recommended microbiological quality guidelines 24, 27
 - see also* wastewater and excreta in agriculture and aquaculture
- Water Decade 5
- water quality indicators *see* microbiological water quality indicators
- water source committee, community-managed drinking water supplies 387
- waterborne outbreaks (WBDOs) *see* USA
- WHO
 - carcinogens, acceptable risk defined 208
 - drinking water quality guidelines (GDWQ) 18–22
 - estimates of world disease (1996) 62
 - health, defined 230
 - Health Guidelines for the Use of Wastewater* 370–3
 - Stockholm, hypothetical studies, harmonised framework for guideline development 393–410
 - wastewater reuse guidelines 23–7
 - water quality, harmonised assessment **2** and World Bank, case study in wastewater irrigation 370–3
 - willingness-to-pay, studies 336–7, **338–9**
 - World Bank, and WHO, case study in wastewater irrigation 370–3
 - years of life lost (YLL), definitions of DALYs 45
 - years lived with disability (YLD) 45–6