Contents

Chapter 1: Hospital-acquired Infection **1**

- Selected CDC Surveillance Definitions of Nosocomial Infection 6
- Simplified Criteria for Surveillance of Nosocomial Infections 11

Chapter 2: Epidemiology of Nosocomial Infections **14**

- Factors Affecting the Development of Hospital-acquired Infections 14
- Common Hospital-acquired Infections 16
- Microbiology of Hospital Infections 18
- Sources of Infection 19
- Modes of Transmission 21
- Etiological Agents 22
- Healthcare Workers and Transmission of Infection 24

Chapter 3: Control of Hospital-acquired Infections **27**

- Hospital-acquired Infection Control Committee 27
- Hospital-acquired Infection Control Team 28
- State Level Hospital-acquired Infection Control Board 28
- National Hospital-acquired Infection Control Central Board 29
- Role of Microbiology in Surveillance and Control 29
- Isolation Precaution Systems 30
- Limitations of Barrier Techniques 33
- Control of Epidemic Infections/Control of Outbreaks 33
- Investigations of Outbreaks 34
- Epidemiological Typing Techniques 35

Chapter 4: Prevention of Hospital Infections **41**

- Exclusion of Sources of Infection 41
- Breaking the Chain of Infection 42
- Enhancing the Host's Ability to Resist Infection by Boosting Immunity 43
- Appropriate Use of Antibiotics 44
- Care of Invasive Devices 44
- Reducing the Risks of Postoperative Infections 45

Chapter 5: Nosocomial Infection Surveillance **46**

- Methods of Surveillance 47
- Statistical Analysis of Data 48
- Health and Medical Surveillance 51
- Nosocomial Infection Rates 53

Chapter 6: Infection Control Responsibilities **55**

- Role of Hospital Management 55
- Role of the Physician 56
- Role of Microbiologist 56
- Role of Hospital Pharmacist 56
- Role of Nursing Staff 57
- Role of Central Sterilization Services 57
- Role of Food Services 58
- Role of the Laundry Services 58
- Role of Housekeeping Service 58
- Role of Maintenance 59
- Role of Infection Control Team (Hospital Hygiene Service) 59

Chapter 7: Sterilization **61**

- Steam Sterilization 63
- Low-temperature Sterilization Technologies 66
- Other Sterilization Methods 71
- Sterilizing Practices 74
- Recommendations for Disinfection and Sterilization in Healthcare Facilities 82
- Performance Indicators 94

Chapter 8: Disinfection **101**

- Definitions 102
- A Rational Approach to Disinfection and Sterilization 103
- Selection and Use of Disinfectants 105
- Changes Since 1981 106
- Problems with Disinfection and Sterilization of Healthcare Equipment 106
- Endoscopes 107
- Tonometers, Diaphragm Fitting Rings and Cryosurgical Instruments 109
- Dental Instruments 110
- Disinfection of Devices Contaminated with HBV, HIV, or *M. tuberculosis* 110
- Disinfection in Hemodialysis Unit 110
- Inactivation of *Clostridium difficile* 111
- Osha Blood-borne Pathogen Standard 111
- Emerging Pathogens 111
- Inactivation of Bioterrorist Agents 112
- Inactivation of Creutzfeldt-Jakob Disease Agent 113
- Toxicologic and Environmental Concerns 113

- Disinfection in Ambulatory Care and Home Care 114
- Susceptibility of Antibiotic Resistant Bacteria to Disinfectants 114
- Surface Disinfection: Is Surface Disinfection Necessary? 115
- Contact Times for Surface Disinfectants 117
- Air Disinfection 118
- Microbial Contamination of Disinfectants 118
- Factors Affecting the Efficacy of Disinfection and Sterilization 118
- Cleaning 121
- Disinfection 122
- Types of Chemical Disinfectants 123
- Formulation of a Disinfectant Policy 142
- Testing of Disinfectants 143

Chapter 9: Decontamination of the Environment, Equipment and the Skin **148**

- Infection Risks to Patients from Equipment, Materials and the Environment 149
- Hospital Environment 151
- Hospital Domestic Staff (Housekeeping Staff), their Duties and Responsibilities 151
- Decontamination 151
- Disinfection of Rooms 155
- Decontamination of Non-clinical Equipment 157
- Curtains 158
- Bed Cradles 158
- Decontamination of Instruments for Clinical Procedures 159
- Decontamination of Medical Equipment (High-risk Items) 160
- Intermediate High-risk Items 161
- Miscellaneous High-risk Items 163
- Decontamination of Respiratory Equipment 163
- Decontamination of Infant Incubators 165
- Decontamination of Vaginal and Other Specula and Sigmoidoscopes 166
- Decontamination of Tonometers 166
- Decontamination of Equipment Used on Patients with Creutzfeldt-Jacob Disease 166
- Cleaning and Disinfection of Skin and Mucous Membranes 167

Chapter 10: Surgical Site Infections **186**

- Microbiology of Hospital-acquired Surgical Infection 187
- Classification of Surgical Site Infections 188
- Recording of Data 190
- Operations, and Likely Surgical Site Infection Pathogens 191
- Risk Factors 192
- Surveillance of Surgical Site Infection 203
- Special Problems of Infections due to *Clostridium perfringens* and Other Gas Gangrene Bacilli 204
- Microbiologic Sampling 204

- Disinfection of Operation Theater 205
- Fumigation/Fogging 206
- Conventional Sterilization of Surgical Instruments 206
- Flash Sterilization of Surgical Instruments 206

Practical Aspects 207

- Risk Factors for SSI and General Guidelines for Prevention of SSI 207
- Methods of Cleaning Operation Theater and Equipment Inside Operation Theater 212
- Fumigation of Operation Theaters 212
- Use of Machines for Fumigation/Fogging 214
- Cold Fogging of Operation Theaters 214
- Biological Test for Monitoring Autoclaves 215
- Recommendations for Prevention of Surgical Site Infection 216
- Summary of SSI Prevention (Including SSI Bundle) 220

Chapter 11: Urinary Tract Infections (Catheter-associated Urinary Tract Infections) **225**

- Definitions 226
- Criteria for CAUTI 226
- Specific Problems 227
- Pathogens Associated with UTI 228
- Diagnosis of UTI 229
- Epidemiology of UTI 229
- Mechanism of Infection 230
- Control Measures 232
- Recommendations 233
- Use of New Types of Catheters 238
- Practical Approach to Prevention of Urinary Tract Infection 239
- Summary of CAUTI Prevention (Including CAUTI Bundle) 241

Chapter 12: Dialysis Unit **245**

- Methods of Dialysis 247
- Special Hazards in Dialysis Unit 247
- Prevention of Infections 247
- Subcutaneous Arteriovenous Fistula 248
- External Arteriovenous Fistula 248
- Routine Care of Access Site 248
- Training for Home Dialysis 249
- Infection in the Access Site 249
- Acute and Intermittent Dialysis: Precautions 249
- Continuous Ambulatory Peritoneal Dialysis 249
- Disinfection 250
- Infection Control Precautions for Outpatient Hemodialysis Settings Compared with Inpatient Hospital Settings 251

- Hepatitis B Infection 252
- Hepatitis C Infection 257
- Hepatitis Delta Virus Infection 260
- Human Immunodeficiency Virus Infection 260
- Bacterial Infections 260
- Recommendations 262
- Practical Approach to Control of HAI in the Dialysis Unit 273
- Microbial Testing of Dialysate 277

Chapter 13: Infections in Obstetrics and Gynecology **281**

- Common Infection in Obstetrics and Gynecology 281
- Neonatal Infections 283
- Control Measures 287
- Preparation of Infant Feeds and Use of Milk Kitchens 290
- Practical Procedures for Prevention of HAI in Gynecology and Obstetrics 293

Chapter 14: Intensive Care Unit—Problems and Management.....**299**

- General Problems and Management in ICU 299
- Control of Infection 301
- Transmission-based (Isolation) Precautions 302
- Antibiotic Utilization Policies 302
- Surveillance 303
- Prevention of Specific Infection Sites 303
- *Clostridium difficile* Infections 305
- Nosocomial Sinusitis 305
- Decolonization 305
- Design of the Unit 306
- Furniture and Fitting 306
- Cleaning of Environment 307
- Handling of Patients 307
- Procedures in ICU 307
- Equipment in ICU 308
- Antibiotic Prophylaxis 308
- Administrative Aspects 308
- Visitor Policy and Use of Protective Shoe Covers 309
- Practical Aspects for Infection Control in Intensive Care Areas 310

Chapter 15: Intravenous Catheter/Cannulation-associated Infection.....**312**

- Terminology and Estimates of Risk 313
- Pathogenesis 314
- Epidemiology and Microbiology in Adult and Pediatric Patients 315
- Strategies for Prevention of Catheter-related Infections in Adult and Pediatric Patients 316

- Practical Approach for Prevention of Catheter-associated Infection 323
- CRBSI Summary (Including CRBSI Bundle) 328

Chapter 16: Respiratory Infections.....**334**

- Pathogenesis 335
- Etiological Agents 336
- Treatment 338
- Risk Factors 338
- Prevention and Control Measures 348
- Summary of Ventilator-associated Pneumonia (VAP) Including VAP Bundle 356

Chapter 17: Burns and Open Traumatic Wounds.....**361**

- Etiological Agents 361
- Trasmission of Infection 362
- Outbreaks in Burn Units 362
- Other Infections in Burns Patient 363
- Open Wounds 363
- Culturing and Surveillance 363
- Design of Units 364
- Prevention of Infection 364
- Category-specific Precautions 367
- Environmental Issues 367
- Special Problems of Sterilization and Immunization 368
- Methicillin-resistant *Staphylococcus aureus* 369
- Homografts as Vectors of Infection 369
- Silver-based Applications 369

Chapter 18: Human Immunodeficiency Virus.....**371**

- Transmission and Prevalence 372
- Diagnosis 372
- HIV-2 Infections 372
- Prevention of Spread of Blood-borne Viral Infections in Hospitals 373
- Contaminated Sharps 373
- Determination of PEP Recommendation 375
- Drug Regimen 375
- Testing and Counseling 375
- Duration of PEP 375
- Side Effects of these Drugs 376
- Pregnancies and PEP 376
- Steps to be Undertaken by the Infection Control Officer on Receiving Information About Exposure 376
- Primary Side Effects Associated with Antiretroviral Agents 377
- Occupational Transmission of HIV 377
- Monitoring and Management of PEP Toxicity 377
- Counseling and Education 378

Chapter 19: Control of Hepatitis Virus Infections in Healthcare Settings **382**

Control of Hepatitis A Virus Infection 383

- Diagnosis and Transmission of Hepatitis A Virus Infection 383
- Prophylaxis for HAV Infection 383
- Postexposure Prophylaxis 384

Control of Hepatitis B Virus Infection 384

- Hepatitis B Markers and their Implication 384
- Incidence of Hepatitis B 385
- Needlestick Injury from HbeAg Positive Blood and Transmission of Infection 385
- Treatment 386
- Prevention Strategies 387
- HBV Vaccination of Healthcare Workers 387
- Candidates for Hepatitis B Vaccination 388
- Side Effects (or Adverse Reactions) of Vaccine 389

Control of Hepatitis C Virus Infection 391

- Introduction (Source and Transmission) 391
- Diagnosis of Hepatitis C Virus Infection 391
- Treatment and Vaccine 391
- Risk of Occupational Transmission of HCV 391
- Management of Exposures to HCV 392

Control of Hepatitis D Virus Infection 393

- Introduction 393
- Diagnosis 394
- Treatment and Prevention 394

Control of Hepatitis E Virus Infection 395

- Introduction 395
- Diagnosis 396
- Vaccines 396

Chapter 20: Infection Control in Specialty Clinics **399**

Ophthalmic Department 400

- Control of Infection 400
- Wards 401
- Care of Contact Lenses 401
- Postoperative Endophthalmitis 401
- Use of Vancomycin for Prophylaxis 401
- Control of Infection in Ophthalmic Practice 402

Ear, Nose and Throat (ENT) Department 403

- Prevention of Infection 403
- Care During Operative Procedures 404

Pediatric Department 404

- Special Problems of Infection in Pediatric Department 404
- Prevention of Infection 408
- Surveillance System 409

Dermatological Words 409

- Introduction, Sources and Transmission of Infection 409
- Control of Infection 410
- Dressing Techniques 412
- Antibiotic Treatment 413
- Ointments and Other Medicaments 413

Neurosurgery Department 413

- Introduction 413
- Causes of Infection in Neurosurgery 413
- Risk Factors in Neurosurgery 414
- Prevention of Infection 414

Chapter 21: Infection Control in Ancillary Units.....**416**

Microbiology and Pathology Laboratories 416

- Introduction 416
- Special Risks of Infection 417
- Prevention of Infection 417
- Transport of Specimens 418
- Procedures within the Laboratory 418
- Immunization of Laboratory Staff 418
- Training and Instructions for Staff 418
- Precautions Against Laboratory Infections 419
- Infections in Containment Category 3 Laboratories 420
- Fungi 420

Radiology and Radiotherapy 420

- Introduction and Principles of Control 420
- Care and Control of Infection in Radiotherapy 421

Postmortem Room and Mortuary 421

- Introduction and Causes of Infection 421
- Prevention of Infection 422

Chapter 22: Laundry **424**

- Types of Laundry 424
- Precautions for the Laundry Staff 426
- Decontamination and Washing of Blankets 427
- Decontamination and Washing of Mattresses 427
- Practical Aspects of Laundry 427

Chapter 23: Kitchen Hygiene **429**

Infection Control in Hospital Kitchen 429

- Introduction 429
- Medical Examination of Staff 431
- Training 432
- Hazard Analysis Control Points 435
- Responsibility 435
- Pests—Eradication and Control 436
- Questionnaire for Catering Staff 436
- Catering Staff Agreement to Report Infection 437

Practical Aspects Regarding Kitchen 437

- Kitchen Architecture and Facilities 438
- Health Check-up for Food Handlers 438
- Personal Hygiene 439
- Washing of Crockery and Cutlery 439
- Disposal of Refuse 439
- Cleaning 439
- Education and Training of Food Handlers 439

Chapter 24: Waste Disposal 441

- Classification of Biomedical Waste (Hospital Waste) 443
- General Waste 443
- Infectous Waste 443
- Communicable Disease Transmitted Through Biomedical Waste 445
- Injuries to Waste Handlers During Procedures 445
- Objectives of Biomedical Waste Management 445
- Biomedical Waste Categories and their Segregation, Collection, Treatment and Processing, and Disposal Options 446
- Biomedical Waste Categories, Color Coding, Type of Container and Treatment Options 448
- Waste Management Policy 449
- Hospital Waste Contract 464
- Landfills 465
- Occupational Hazards 468
- Safety Measures for the Medical and Paramedical Staff 469
- Safety Measures for Cleaning and Transportation Staff 469
- Training and Motivation 469
- Training Modules for Different Levels of Staff 469
- Training for Medical and Laboratory Personnel 469
- Administrative and Management Staff 470
- Incentives and Motivation 471
- Awareness 471
- Standard Operative Procedures for Waste Disposal 471

Chapter 25: Use of Antibiotics and Chemotherapeutic Agents **475**

- Changes in Character of Nosocomial Infections 475
- Indiscriminate Use of Antibiotics 476
- Aim of Chemotherapy and Proper Choice 476
- Development of Resistance to Antibiotics 476
- Virulence of Antibiotic-resistant Bacteria 477
- Factors Indicating a Link Between Hospital Use of Antimicrobials and Development of Antimicrobial Drug Resistance 477
- Classifications of Antibiotics 477
- Use of Broad-spectrum Antibiotics 478
- Antibiotic Combinations 478
- When is a Combination Therapy Superior to Single Agent? 479
- Selection of an Antibiotic 479
- Indications for Prophylaxis with Antibiotics 480
- Formulation of Antibiotic Policy 494
- Identification of Identical Strains Disseminated in the Hospital 496

Chapter 26: Hospital Antibiotic Policy and Standard Treatment Guidelines **498**

- Antibiotic Policy 499
- Surveillance of Antimicrobial Resistance 503
- Cumulative Antibiogram 505
- Development of Standard Treatment Guidelines 507
- Strategies for Promoting Rational Antibiotic Prescription 509
- A Model Standard Treatment Guideline for Community-acquired Pneumonia at the Hospital Level 510
- Antimicrobial Stewardship 513
- Summary of Antibiotic Policy and Standard Treatment Guidelines 515

Chapter 27: Infection Control in Cardiac Catheterization Laboratory **518**

Patient Preparation and Protection 519

- Hair Removal 519
- Skin Cleaning 520
- Drapes 520
- Antibiotics 520
- Catheterization Technique 521
- Sheath Removal and Vascular Closure Devices 521
- Wound Dressings 522

Laboratory Personnel—the Primary Operator and Staff 522

- Hand Scrub and Gloves 522
- Gowns and Shoe Covers 523
- Caps, Masks, and Eye Protection 524

- Ancillary Personnel 524
- High-risk Patients (For Staff Exposure) 524
- Skin Puncture or Laceration 525
- Vaccination 525

Laboratory Environment 525

- Cleaning 525
- Air Vents 525
- Maintenance of Environment 526
- Fixed and Disposable Laboratory Equipment 526
- Disposal of Waste 526

Chapter 28: Central Sterile Supply Department **529**

- Decontamination, Cleaning, Drying and Transportation 532
- Inspection and Tray Assembly 537
- Packaging and Packaging Material 538
- Storage 543
- Sterile Linen for Use in Operation Theaters 544
- High-temperature Sterilization 544
- Low-temperature Sterilization 546
- Quality Assurance and Monitoring of the Sterilization 548
- Documentation 550
- Sterile Area—Maintenance and Handling of Sterile Supply Storage 550
- Shelf Life 551
- Expiry Date 551
- Checks Before Issue 551
- Housekeeping Practices 551
- Transportation 552
- Handling 552
- Training of Staff and Standard Operating Protocols 552

Index *553*