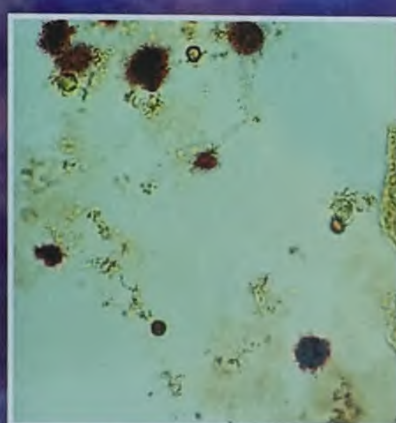
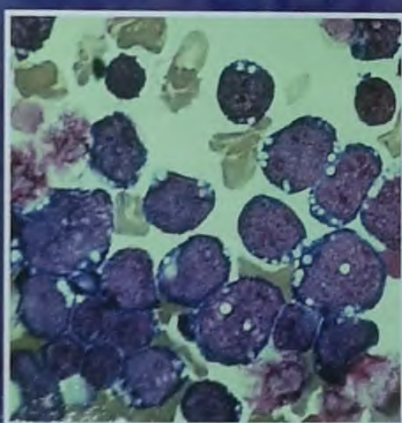
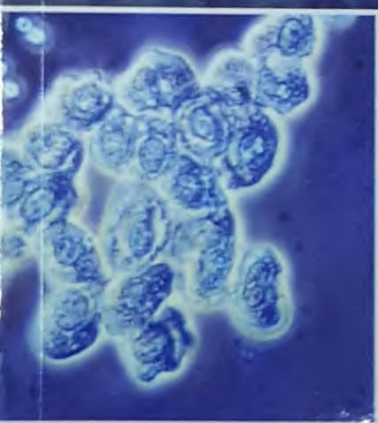



Susan King Strasinger  
Marjorie Schaub Di Lorenzo

# Urinalysis and Body Fluids

SEVENTH EDITION



 F.A. DAVIS

**ONLINE RESOURCES**  
Access code inside 

# Contents

Atlas of Images 1

## PART ONE: Basic Principles 48

### CHAPTER 1

Safety and Quality Management 49

Safety 50

Biological Hazards 50

Infectious Agent (Pathogen) 50

Reservoir 50

Portal of Exit 51

Means of Transmission 51

Portal of Entry 51

Susceptible Host 51

Standard Precautions 51

Sharp Hazards 56

Chemical Hazards 56

Chemical Spills and Exposure 56

Chemical Handling 57

Chemical Hygiene Plan 57

Chemical Labeling 57

Safety Data Sheets 57

The Globally Harmonized System  
of Classification and Labeling of Chemicals 58

Chemical Waste Disposal 58

Radioactive Hazards 58

Electrical Hazards 59

Fire/Explosive Hazards 60

Physical Hazards 61

Quality Management 61

Urinalysis Procedure Manual 62

Preexamination (Preanalytical) Variables 62

Examination (Analytical) Variables 64

Postexamination Variables 68

### CHAPTER 2

Urine and Body Fluid Analysis Automation 75

Urinalysis Automation 76

Reflectance Photometry 76

Analyzers 76

Fully Automated Urine Chemistry Analyzers 78

Automated Microscopy Analyzers 79

Automated Urinalysis Systems 86

Body Fluid Analysis Automation 87

### CHAPTER 3

Introduction to Urinalysis 91

History and Importance 92

Urine Formation 93

Urine Composition 93

Urine Volume 93

Specimen Collection 94

Containers 94

Labels 95

Requisition Form 95

Specimen Rejection 95

Specimen Handling 95

Specimen Integrity 95

Specimen Preservation 96

Types of Specimens 96

Random Specimen 96

First Morning Specimen 96

24-Hour (or Timed) Specimen 97

Catheterized Specimen 98

Midstream Clean-Catch Specimen 98

Suprapubic Aspiration 98

Prostatitis Specimen 98

Pediatric Specimens 100

Drug Specimen Collection 100

### CHAPTER 4

Renal Function 105

Introduction 106

Renal Physiology 106

Renal Blood Flow 106

Glomerular Filtration 106

Tubular Reabsorption 110

Tubular Secretion 111

Renal Function Tests 113

Glomerular Filtration Tests 113

Tubular Reabsorption Tests 116

Tubular Secretion and Renal Blood Flow Tests 119

**PART TWO: Urinalysis 124****CHAPTER 5****Physical Examination of Urine 125****Introduction 126****Color 126**

Normal Urine Color 126

Abnormal Urine Color 127

**Clarity 129**

Normal Clarity 129

Nonpathological Turbidity 129

Pathological Turbidity 130

**Specific Gravity 131**

Refractometer 131

Osmolality 132

Reagent Strip Specific Gravity 133

**Odor 134****CHAPTER 6****Chemical Examination of Urine 139****Introduction 140****Reagent Strips 140**

Reagent Strip Technique 140

Handling and Storing Reagent Strips 141

Quality Control of Reagent Strips 142

Confirmatory Testing 142

**pH 142**

Clinical Significance 143

Reagent Strip Reactions 143

**Protein 143**

Clinical Significance 144

Prerenal Proteinuria 144

Renal Proteinuria 144

Postrenal Proteinuria 145

Reagent Strip Reactions 146

Reaction Interference 146

**Glucose 148**

Clinical Significance 148

Reagent Strip (Glucose Oxidase) Reaction 149

Reaction Interference 150

Copper Reduction Test (Clinitest) 150

Clinical Significance of Clinitest 151

**Ketones 151**

Clinical Significance 151

Reagent Strip Reactions 152

Reaction Interference 152

**Blood 152**

Clinical Significance 153

Reagent Strip Reactions 153

Reaction Interference 154

**Bilirubin 154**

Bilirubin Production 154

Clinical Significance 155

Reagent Strip (Diazo) Reactions 155

Reaction Interference 156

**Urobilinogen 156**

Clinical Significance 157

Reagent Strip Reactions and Interference 157

Reaction Interference 157

**Nitrite 157**

Clinical Significance 157

Reagent Strip Reactions 158

Reaction Interference 158

**Leukocyte Esterase 159**

Clinical Significance 159

Reagent Strip Reaction 160

Reaction Interference 160

**Specific Gravity 160**

Reagent Strip Reaction 160

Reaction Interference 160

**CHAPTER 7****Microscopic Examination of Urine 167****Introduction 168****Macroscopic Screening 168**

Specimen Preparation 168

Specimen Volume 168

Centrifugation 168

Sediment Preparation 169

Volume of Sediment Examined 169

Commercial Systems 169

Examining the Sediment 169

Reporting the Microscopic Examination 170

Correlating Results 170

**Sediment Examination Techniques 170**

Sediment Stains 171

Cytodiagnostic Urine Testing 173

Microscopy 173

Types of Microscopy 176

**Urine Sediment Constituents 178**

Red Blood Cells 179

White Blood Cells 181

Epithelial Cells 182

Bacteria 187

Yeast 189

Parasites 189

Spermatozoa 189

Mucus 190

Casts 191

Urinary Crystals	199
Urinary Sediment Artifacts	209

## CHAPTER 8

<b>Renal Disease</b>	219
Introduction	220
<b>Glomerular Disorders</b>	220
Glomerulonephritis	220
Nephrotic Syndrome	222
<b>Tubular Disorders</b>	222
Acute Tubular Necrosis	222
Hereditary and Metabolic Tubular Disorders	225
<b>Interstitial Disorders</b>	226
Urinary Tract Infection	226
Acute Pyelonephritis	226
Chronic Pyelonephritis	227
Acute Interstitial Nephritis	228
Renal Failure	228
Renal Lithiasis	229

## CHAPTER 9

<b>Urine Screening for Metabolic Disorders</b>	235
Introduction	236
Overflow Versus Renal Disorders	236
Newborn Screening Tests	236
<b>Amino Acid Disorders</b>	236
Phenylalanine-Tyrosine Disorders	236
Branched-Chain Amino Acid Disorders	239
Tryptophan Disorders	241
Cystine Disorders	242
Porphyrin Disorders	243
<b>Mucopolysaccharide Disorders</b>	246
Purine Disorders	247
Carbohydrate Disorders	247

## PART THREE: Other Body Fluids 252

## CHAPTER 10

<b>Cerebrospinal Fluid</b>	253
Introduction	254
Formation and Physiology	254
Specimen Collection and Handling	254
Appearance	255
Traumatic Collection (Tap)	256
Uneven Blood Distribution	256
Clot Formation	257
Xanthochromic Supernatant	257
Cell Count	257
Methodology	257
Total Cell Count	258

WBC Count	258
Quality Control of CSF and Other Body Fluid Cell Counts	258

<b>Differential Count on a CSF Specimen</b>	258
Cytocentrifugation	259
CSF Cellular Constituents	259
<b>Chemistry Tests</b>	266
Cerebrospinal Protein	266
CSF Glucose	268
CSF Lactate	268
CSF Glutamine	268
<b>Microbiology Tests</b>	268
Gram Stain	269
Immunologic Assays	270
PCR Molecular Diagnostic Testing	270
<b>Serological Testing</b>	271

## CHAPTER 11

<b>Semen</b>	277
Introduction	278
Physiology	278
<b>Specimen Collection</b>	278
Specimen Handling	280
<b>Semen Analysis</b>	280
Appearance	280
Liquefaction	280
Volume	280
Viscosity	281
pH	281
Sperm Concentration and Sperm Count	281
Sperm Motility	283
Automated Semen Analysis Systems	283
Sperm Morphology	283
<b>Additional Testing</b>	285
Sperm Vitality	286
Seminal Fluid Fructose	286
Antisperm Antibodies	286
Microbial and Chemical Testing	287
Postvasectomy Semen Analysis	287
Sperm Function Tests	288
Semen Analysis Quality Control	288

## CHAPTER 12

<b>Synovial Fluid</b>	293
Physiology	294
Specimen Collection and Handling	294
Color and Clarity	295
Viscosity	296
Cell Counts	296
Differential Count	296

**Crystal Identification 297**

Types of Crystals 297

Slide Preparation 297

Crystal Polarization 298

**Chemistry Tests 300**

Glucose 300

Total Protein 300

Uric Acid 301

Lactate 301

Enzymes 301

**Microbiological Tests 301****Serological Tests 301****CHAPTER 13****Serous Fluid 305**

Introduction 306

Formation 306

Specimen Collection and Handling 306

Transudates and Exudates 307

General Laboratory Procedures 307

**Pleural Fluid 308**

Appearance 308

Hematology Tests 309

Chemistry Tests 310

Microbiological and Serological Tests 312

**Pericardial Fluid 312**

Appearance 312

Laboratory Tests 312

**Peritoneal Fluid 314**

Transudates Versus Exudates 314

Appearance 314

Laboratory Tests 314

**CHAPTER 14****Bronchoalveolar Lavage Fluid 321**

Clinical Significance 322

Specimen Collection 322

Specimen Handling and Transport 322

Color and Clarity 322

Cell Counts 322

Leukocytes 323

Macrophages 323

Lymphocytes 323

Neutrophils 323

Eosinophils 323

Mast Cells 324

Erythrocytes 324

Epithelial Cells 324

Microbiological Tests 324

Cytology 324

**CHAPTER 15****Amniotic Fluid 327**

Introduction 328

**Physiology 328**

Function 328

Volume 328

Chemical Composition 329

Differentiating Maternal  
Urine From Amniotic Fluid 329**Specimen Collection 329**

Indications for Amniocentesis 329

Collection 330

**Specimen Handling and Processing 330**

Color and Appearance 331

**Tests for Fetal Distress 331**Hemolytic Disease of the Fetus  
and Newborn 331

Neural Tube Defects 332

**Tests for Fetal Maturity 333**

Fetal Lung Maturity 333

Lecithin-Sphingomyelin Ratio 333

Phosphatidyl Glycerol 334

Foam Stability Index 334

Lamellar Bodies 334

**CHAPTER 16****Fecal Analysis 339**

Introduction 340

**Physiology 340****Diarrhea and Steatorrhea 341**

Diarrhea 341

Steatorrhea 342

**Specimen Collection 342****Macroscopic Screening 342**

Color 343

Appearance 343

**Microscopic Examination of Feces 343**

Fecal Leukocytes 343

Muscle Fibers 344

Qualitative Fecal Fats 344

**Chemical Testing of Feces 345**

Occult Blood 345

Quantitative Fecal Fat Testing 347

APT Test (Fetal Hemoglobin) 348

Fecal Enzymes 349

Carbohydrates 349

## CHAPTER 17

---

Vaginal Secretions	355	Desquamative Inflammatory Vaginitis	365
Introduction	356	Atrophic Vaginitis	365
Specimen Collection and Handling	357	Additional Procedures for Vaginal Secretion Associated With Pregnancy	365
Color and Appearance	357	Fetal Fibronectin Test	365
Diagnostic Tests	357	AmniSure Test	366
pH	357	Actim PROM	366
Microscopic Procedures	358	ROM Plus	366
Other Diagnostic Tests	363	Answers to Study Questions, Case Studies, and Clinical Situations	371
Vaginal Disorders	364	Abbreviations	381
Bacterial Vaginosis	364	Glossary	385
Trichomoniasis	364	Index	393
Candidiasis	364		