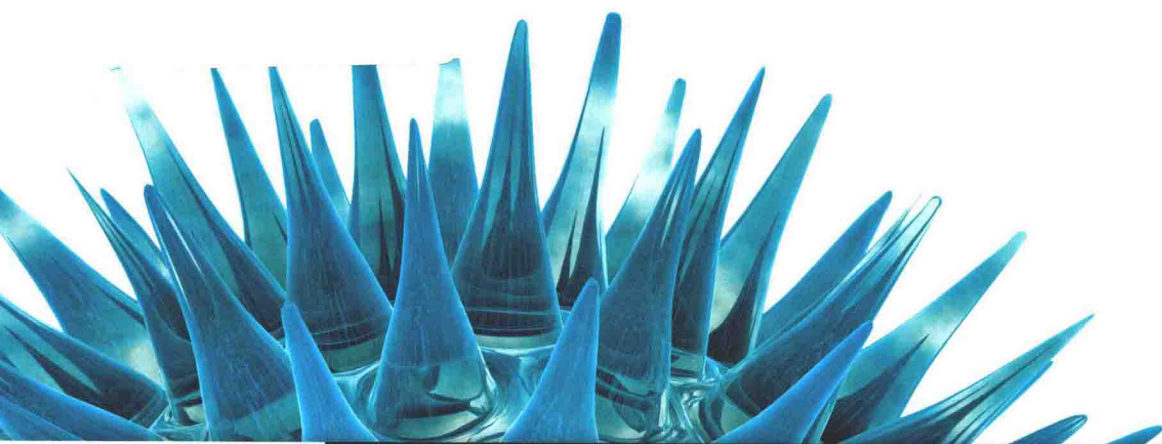




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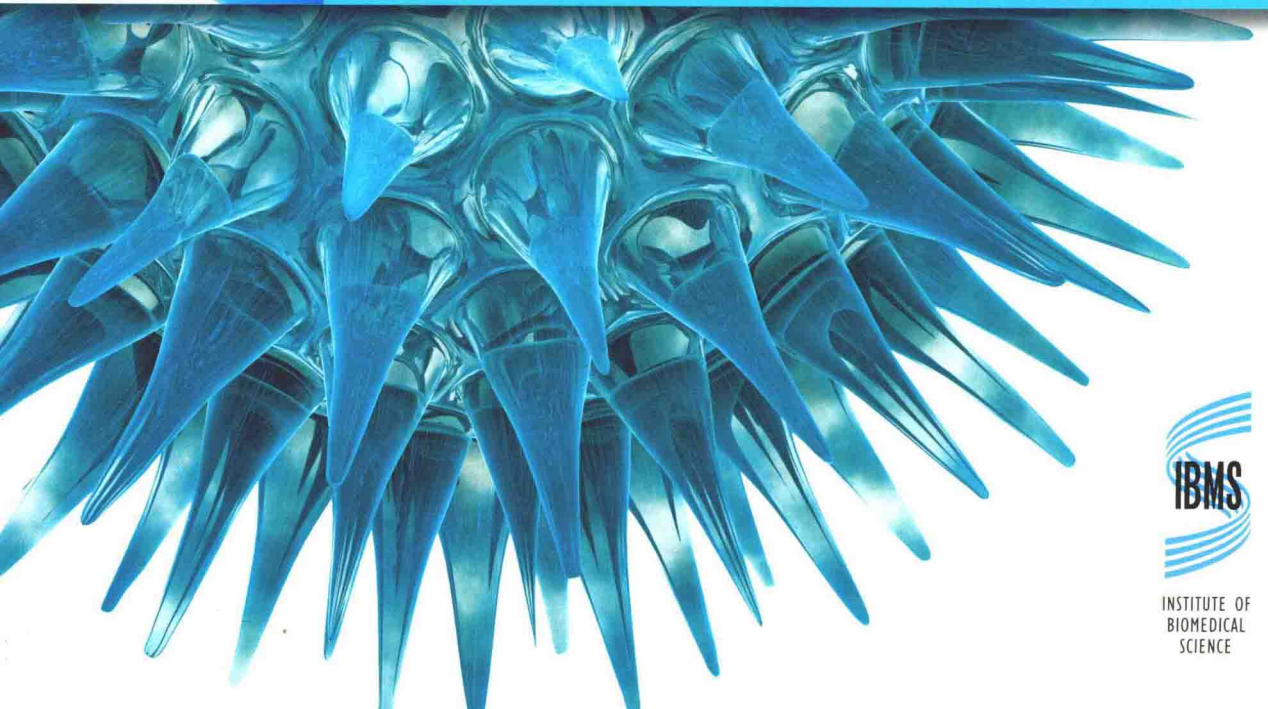
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EDITED BY Michael Ford

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INSTITUTE OF
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Medical Microbiology

Second edition



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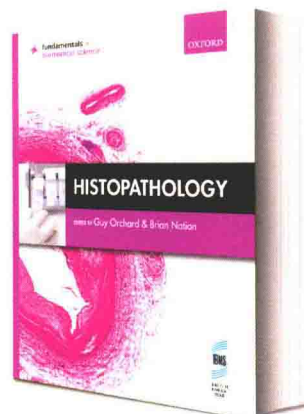
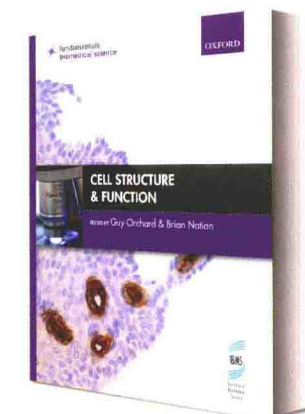
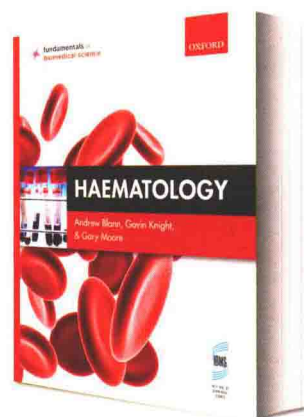
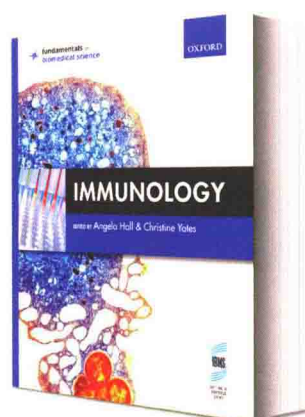
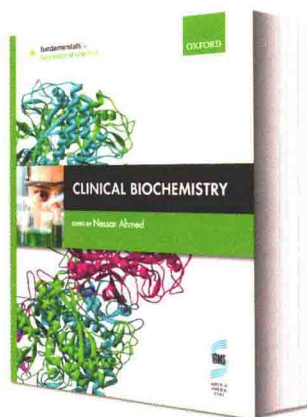
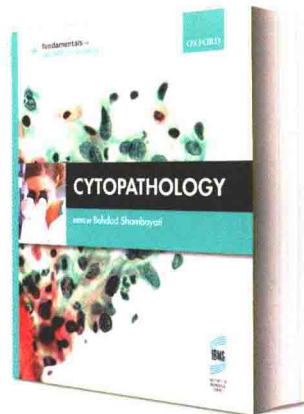
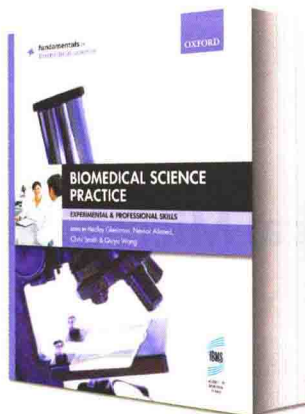
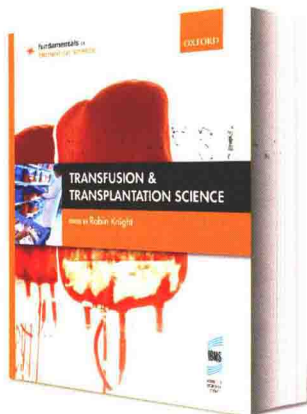
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Medical Microbiology



fundamentals OF
biomedical science

An introduction to the Fundamentals of Biomedical Science series


Biomedical scientists form the foundation of modern healthcare, from cancer screening to diagnosing HIV, from blood transfusion for surgery to infection control. Without biomedical scientists, the diagnosis of disease, the evaluation of the effectiveness of treatment, and research into the causes and cures of disease would not be possible. However, the path to becoming a biomedical scientist is a challenging one: trainees must not only assimilate knowledge from a range of disciplines, but must understand—and demonstrate—how to apply this knowledge in a practical, hands-on environment.

The *Fundamentals of Biomedical Science* series is written to reflect the challenges of biomedical science education and training today. It blends essential basic science with insights into laboratory practice to show how an understanding of the biology of disease is coupled to the analytical approaches that lead to diagnosis. Produced in collaboration with the Institute of Biomedical Science, the series provides coverage of the full range of disciplines to which a biomedical scientist may be exposed.

Learning from this series

The *Fundamentals of Biomedical Science* series draws on a range of learning features to help readers master both biomedical science theory, and biomedical science practice.

Case Studies illustrate how the biomedical science theory and practice presented throughout the series relate to situations that are likely to be encountered routinely in the biomedical science laboratory.




CASE STUDY 4.1 Multidrug-resistant *or*

A 70-year-old male admitted via the Emergency Department with symptoms of septicaemia has a blood culture and urine sample collected. After overnight incubation the positive blood culture showed Gram-negative bacilli. The positive bottle was subcultured to purity plates

1. What would you suspect of the organism?
2. How would you confirm you perform and why?

The organism was identified as *Acinetobacter baumannii*.

Method boxes walk through the key protocols that the reader is likely to come across in the laboratory.



METHOD Catalase test

- Using a plastic loop, sample a single colony and rub this inoculum onto a glass slide. The inoculum should be sufficiently large to be visible to the naked eye.
- Place a drop of 30% hydrogen peroxide onto a glass coverslip and place the coverslip onto the slide, exposing the bacterial inoculum to the hydrogen peroxide.

Health and Safety boxes raise awareness of key health and safety issues related to topics being discussed with which the reader should be familiar.

HEALTH & SAFETY

General requirements of Containment Level 3 are as follows.

Facilities:

1. Spacious, self-contained room.
2. Dedicated equipment.
3. Easily cleanable surfaces.
4. Negative air pressure.
5. Microbiological safety cabinet.

CLINICAL CORRELATION**Serious fungal infections**

Most serious fungal infections occur in patients with some other underlying illness which reduces immunity to infection. Common underlying conditions include AIDS, cytotoxic therapy, malignancy, the use of steroid therapy, immunosuppression for transplantation, diabetes and following abdominal surgery.

Clinical Correlation boxes emphasize at a glance how the material sits in a clinical context.

Further features are used to help consolidate and extend students' understanding of the subject

Key Point

Most fungi exist in one of two forms – a yeast for Certain fungi are dimorphic, i.e. they can exist in form depending on environmental conditions.

Key points reinforce the key concepts that the reader should master as they work through each chapter, while **Summary points** act as an end-of-chapter checklist for readers to verify that they have remembered the principal themes and ideas presented within the chapter.

prozone

Prozone is the phenomenon exhibited by some sera, in which agglutination or precipitation occurs at higher dilution ranges, but is not visible at lower dilutions or when undiluted.

adding the enzyme conjugate by washing (see antibodies in the serum. The method is simple, not **prozone** in the presence of high titre antibodies detecting low-affinity antibodies. If antibodies they block binding sites and prevent the hydrolysis of the substrate. This lack of colour change indicates a positive result.

Key terms in the margins provide instant definitions of terms with which the reader may not be familiar; in addition, each title in the series features a **glossary**, in which the key terms featured in that title are collated.

The role of cell culture in the diagnosis of viral infections is being increasingly challenged by rapid diagnostic methods. Therefore, the role of cell culture is expected to decline and is likely to be restricted to large central reference laboratories.

SELF-CHECK 13.7

Why is cell culture still used when there are so many more rapid diagnostic methods available?

Self-check questions throughout each chapter provide the reader with a ready means of checking that they have understood the material they have just encountered; answers to self-check questions are presented at the end of each volume.



Discussion questions

- 13.1** Discuss the provision of a diagnostic virology service to a district general hospital.
- 13.2** 'There is no longer a need for diagnostic laboratories to attempt isolation of viruses from tissue culture.' Comment on this statement.
- 13.3** What factors would you consider before selecting a commercially available diagnostic assay?

Discussion questions are provided at the end of each chapter, to encourage the reader to analyse and reflect on the material they have just read. Hints and tips for answering the discussion questions are provided at the end of each book.

Cross reference

Antimicrobial susceptibility testing methods are discussed in Chapter 4.

- The patient's age.
- Pregnancy.
- Drug allergies, e.g. penicillin.
- Local factors, e.g. known circulation of resistant strains.

As with other infections, patients with an LRTI will be treated with a broad-spectrum antibiotic, based on likely pathogens. Once the results are available, the antibiotic can be prescribed if appropriate.

Cross references help the reader to see biomedical science as a unified discipline, making connections between topics presented within each volume, and across all volumes in the series.

Online learning materials

Each title in the *Fundamentals of Biomedical Science* series is supported by an Online Resource Centre, which features additional materials for students, trainees, and lecturers.

www.oxfordtextbooks.co.uk/orc/fbs

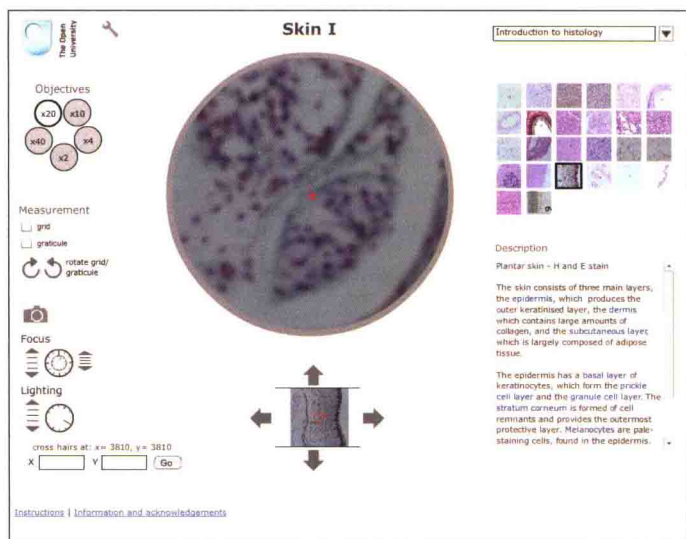


Guides to key experimental skills and methods

Video walk-throughs of key experimental skills are provided to help you master the essential skills that are the foundation of biomedical science practice.

Biomedical science in practice

Interviews with practicing biomedical scientists working in a range of disciplines give a valuable insight into the reality of work in a biomedical science laboratory.



Virtual microscope

Visit the library of microscopic images and investigate them with the powerful online microscope, to help gain a deeper appreciation of cell and tissue morphology.

Lecturer support materials

The Online Resource Centre for each title in the series also features figures from the book in electronic format, for registered adopters to download for use in lecture presentations, and other educational resources.

To register as an adopter visit www.oxfordtextbooks.co.uk/orc/fbs and follow the on-screen instructions.

Any comments?

We welcome comments and feedback about any aspect of this series. Just visit www.oxfordtextbooks.co.uk/orc/fbs and share your views.

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Abbreviations

4-MeU	4-methylumbelliferone	CF	cystic fibrosis
7-AMC	7-amido-4-methylcoumarin	CFT	complement fixation test
AAFB	acid-alcohol-fast bacilli	CFTR	cystic fibrosis transmembrane conductance regulator
ABHG	alcohol-based hand gels	CFU	colony forming units
ABPA	allergic bronchopulmonary aspergillosis	cGMP	cyclic guanosine monophosphate
ACDP	Advisory Committee on Dangerous Pathogens	CLED	cysteine lactose electrolyte deficient
ACV	acyclovir	CLSI	Clinical Laboratory Standards Institute
ADH	arginine dihydrolyase	CMV	cytomegalovirus
ADPR	adenosine diphosphate	CNS	coagulase-negative <i>Staphylococcus</i>
ADPR	ADP-ribose	COSHH	Control of Substances Hazardous to Health
A/E	attaching and effacing	CPE	cytopathic effect
AFB	acid-fast bacilli	CRP	C-reactive protein
AIDS	acquired immune deficiency syndrome	CSF	cerebrospinal fluid
API	analytical profile index	CSU	catheter stream urine
ASO	antistreptolysin O	CT	computed tomography
ATCC	American Type Culture Collection	CV	coefficient of variation
ATP	adenosine triphosphate	CVA	cerebrovascular accident
AUC	area under curve	DAEC	diffusely adherent <i>E. coli</i>
AZT	azidothymidine	DAG	diacylglycerol
β-HS	β-haemolytic streptococci	dATP	deoxyadenosine triphosphate
BAL	bronchoalveolar lavage	DCA	deoxycholate citrate agar
Bcc	<i>Burkholderia cepacia</i> complex	DFA	direct fluorescent antibody
BCG	Bacille Calmette-Guérin	DGI	disseminated gonococcal infection
BCR	B-cell receptor	dGTP	deoxyguanosine triphosphate
BCYE	buffered charcoal yeast extract	DNA	deoxyribonucleic acid
bdNA	branched DNA	DNase	deoxyribonuclease
BEAV	bile esculin azide vancomycin	dNTP	deoxyribonucleotide triphosphate
BEB	bile esculin broth	DTT	dithiothreitol
BHI	brain heart infusion	dTTP	deoxythymidine triphosphate
BSAC	British Society for Antimicrobial Chemotherapy	EAEC	enteroaggregative <i>E. coli</i>
BV	bacterial vaginosis	EBV	Epstein-Barr virus
C390	9-chloro-9-(4-diethylaminophenyl)-10-phenylacridan	ECM	extracellular matrix
cAMP	cyclic adenosine monophosphate	EDTA	ethylenediaminetetraacetic acid
CAPD	continuous ambulatory peritoneal dialysis	EF-2	elongation factor 2
CAT	chloramphenicol acetyltransferase	EHEC	enterohaemorrhagic <i>E. coli</i>
cCTP	deoxycytidine triphosphate	EHO	Environmental Health Officer
CDC	Centers for Disease Control	EIA	enzyme immunoassay
CDC	cholesterol-dependent cytolysin	EIEC	enteroinvasive <i>E. coli</i>

ELISA	enzyme-linked immunosorbent assay	IE	infective endocarditis
EM	electron microscopy	IFAT	indirect fluorescent antibody test
EPEC	enteropathogenic <i>E. coli</i>	IgA	immunoglobulin A
EPS	exopolysaccharide	IgG	immunoglobulin G
EPU	eyepiece units	IgM	immunoglobulin M
ESBL	extended spectrum β -lactamase	I3P	inositol trisphosphate
ETEC	enterotoxigenic <i>E. coli</i>	INF	interferon
E-Test	epsilometer test	IL	interleukin
EUCAST	European Committee on Antimicrobial Susceptibility Testing	ISTB	Iso-Sensitest broth
FEC	formalin-ether concentration	IUCD	intrauterine contraceptive device
FIC	fractional inhibitory concentration	KES	<i>Klebsiella-Enterobacter-Serratia</i>
FPIA	fluorescence polarization immunoassay	KOH	potassium hydroxide
GAP	GTPase activating protein	LAP	leucyl aminopeptidase
GC	guanylate cyclase	LCR	ligase chain reaction
GDI	guanine nucleotide dissociation inhibitor	LD50	median lethal dose
GDP	guanosine diphosphate	LD50	median time to death
GEF	guanine nucleotide exchange factor	LEE	locus of enterocyte effacement
GI	gastrointestinal	LJ	Löwenstein-Jensen
G6PD	glucose-6-phosphate dehydrogenase	LOS	lipooligosaccharide
GP	General Practitioner	LRTI	lower respiratory tract infection
GTP	guanosine triphosphate	LV-PVA	low viscosity polyvinyl alcohol
GU	genitourinary	MAC	<i>Mycobacterium avium</i> complex
GUM	genitourinary medicine	MAC	membrane attack complex
HA	haemagglutination	MAMP	microbial associated molecular pattern
HACEK	group of CO ₂ -dependent organisms – <i>Haemophilus</i> spp., <i>Aggregatibacter actinomycetemcomitans</i> (previously named <i>Actinobacillus</i>), <i>Cardiobacterium hominis</i> , <i>Eikenella corrodens</i> , and <i>Kingella</i> spp.	MAPK	mitogen-activated protein kinase
HAI	health-care-acquired infection	MBC	minimum bactericidal concentration
HAV	hepatitis A virus	MDR	multidrug resistant
HBV	hepatitis B virus	MHB	Mueller-Hinton broth
HCAI	health-care-acquired infection	MHC	major histocompatibility complex
HCV	hepatitis C virus	MIC	minimum inhibitory concentration
HEPA	high efficiency particulate absorption	MICE	minimum inhibitory concentration evaluation
Hib	<i>Haemophilus influenzae</i> type b	MIRU-VNTR	mycobacterial interspersed repetitive units variable number tandem repeats
HIV	human immunodeficiency virus	MRSA	methicillin-resistant <i>Staphylococcus aureus</i>
HPLC	high-performance liquid chromatography	MSA	mannitol salt agar
HPU	Health Protection Unit	MSCRAMM	microbial surface components recognizing adhesive matrix molecules
HSV	herpes simplex virus	MSU	midstream urine
HVS	high vaginal swab	MSM	men who have sex with men
IA	invasive aspergillosis	MTB	<i>Mycobacterium tuberculosis</i>
IATA	International Air Transport Authority	NAAT	nucleic acid amplification test
ICU	Intensive Care Unit	NAC	N-acetyl-L-cysteine
		NAD	nicotinamide adenine dinucleotide
		NCTC	National Collection of Type Cultures

NEQAS	National External Quality Assurance Schemes	SDA	strand displacement amplification
NHS	National Health Service	SIC	streptococcal inhibitor of complement
NNT	number needed to treat	SM-ID	<i>Salmonella</i> identification
NOD	nucleotide oligomerization domain	SPA	suprapubic aspirate
NPA	nasopharyngeal aspirate	SPS	sodium polyethanol sulphonate
NSU	non-specific urethritis	STI	sexually transmitted infection
O129	2,4-diamino-6,7-diisopropylpteridine phosphate	SU	stage unit
ONPG	o-nitrophenyl- β -d-galactopyranoside	TAA	trimeric autotransporter adhesin
PABA	<i>para</i> -aminobenzoic acid	TB	tuberculosis
PBP	penicillin-binding protein	TCBS	thiosulphate citrate bile salt sucrose agar
PCP	<i>Pneumocystis jirovecii</i> pneumonia	TCR	T-cell receptor
PCR	polymerase chain reaction	TLR	Toll-like receptor
PID	pelvic inflammatory disease	TPHA	<i>Treponema pallidum</i> haemagglutination
PIP2	phosphatidylinositol-4,5-bisphosphate	TPPA	<i>Treponema pallidum</i> particle agglutination
PK	protein kinase	T3SS	type III secretion system
PMC	pseudomembranous colitis	TSS	toxic shock syndrome
p-NA	<i>para</i> -nitroaniline	TSST	toxic shock syndrome toxin
POC	products of conception	TST	tuberculin skin test
PPE	personal protective equipment	TV	<i>Trichomonas vaginalis</i>
PRR	pattern recognition receptor	UBA	urine bacterial analysis
PUO	pyrexia of unknown origin	UCP	urine collection pad
PVC	polyvinyl chloride	UPEC	uropathogenic <i>E. coli</i>
PVE	prosthetic valve endocarditis	UTI	urinary tract infection
PVL	Panton-Valentine leukocidin	UV	ultraviolet
RAPD	random amplified polymorphic DNA	VDRL	Venereal Disease Reference Laboratory
RBC	red blood cell	VHF	viral haemorrhagic fever
RCA	regulators of complement activation	VP	Voges-Proskauer
RFLP	amplified fragment length polymorphism	VRE	vancomycin-resistant <i>Enterococcus</i>
RNA	ribonucleic acid	VTEC	verocytotoxin-producing <i>E. coli</i>
RPR	rapid plasma reagin	VZV	varicella zoster virus
RSV	respiratory syncytial virus	WBC	white blood cell
RT-PCR	real-time PCR	WHO	World Health Organization
SAF	sodium acetate-acetic acid-formalin	WD	washer disinfectant
SAH	subarachnoid haemorrhage	XLD	xylose lysine deoxycholate
SCBU	Special Care Baby Unit	ZN	Ziehl-Neelsen

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