Donor infection and the impact on transplantation

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THE INSTITUTE OF TRANSPLANTATION

NHS
The Newcastle upon Tyne Hospitals
NHS Foundation Trust

Donor derived infection

Organ transplant is a low risk but important route of transmission of infection from donor to recipient.

Agenda

1. Blood born Viruses
   - Hepatitis B
   - Hepatitis C
   - HIV
2. EBV & CMV virus
3. All the others
4. COVID 19

The most important resource for microbiology guidance in transplantation in the UK

SaBTO

Advisory Committee on the Safety of Blood, Tissues and Organs

MICROBIOLOGICAL SAFETY GUIDELINES

PREVIOUSLY KNOWN AS

GUIDANCE ON THE MICROBIOLOGICAL SAFETY OF HUMAN ORGANS, TISSUES AND CELLS USED IN TRANSPLANTATION

What are we dealing with ?

The degree of risk for transmission of infection carried with grafts, notably of viruses, is largely unknown and, for a specific organ, difficult to assess.

When will we see infection?

Days from Transplant to Recognition of Infection					
	0-30 days	31-90 days	91-180 days	>181 days	TOTAL
Viral	11	7	4	8	30
Bacterial	23	1	0	0	24
Fungal	20	5	2	1	27
Mycobacterial	2	2	2	0	6
Parasitic	7	4	6	1	18
TOTAL	63	19	14	10	106
	59%	18%	13%	9%	

Mandatory screening

Table 3– Mandatory and recommended screening of organ, tissue and cell donors

Infection	Serological Test	Organs*	Tissues**	Haematopoietic progenitor cells (HSPC), therapeutic cells (TC) and human embryonic stem cells**	Gametes and embryos***
HIV1/2	Anti-HIV1/2Ab/HIV Ag combo	M	M	M	M
HBV	HBsAg	M	M	M	M
	Anti-HBc	M	M	M	M
HCV	Anti-HCV IgG	M	M	M	M
HTLV1/2	Anti-HTLV1/2****	R	M	M	M
Syphilis	Anti-T. pallidum antibody	R	M	M	R
Toxoplasma gondii	Anti-T. gondii IgG	R	NR	R*****	NR
CMV	Anti-CMV IgG	R	NR	R	R
EBV	Anti-EBV IgG	R	NR	R	NR
HEV	HEV RNA	R	R	R	NR
Chlamydia trachomatis	n/a	NR	NR	NR	M
Neisseria gonorrhoea	n/a	NR	NR	NR	M

M = Mandatory Tests as required by EUODD and EUTCD

R = Recommended tests

NR. = not required; n/a = not applicable;

Transmission of Blood born virus

- **Human immunodeficiency virus (HIV)**
- **Hepatitis C virus (HCV)**
- **Hepatitis B virus (HBV)**
- **CMV and EBV**

Blood born virus (Hep B, C & HIV)

Exact rates of transmission are not well understood.

There are certain things from the history however that will give you indications for risk.

High Risk activity

Pathogens	Behavioral characteristics	Nonbehavioral characteristics
HIV	• MSM • IVDU • Noninjection illicit drug use • Multiple sex partners • Sex with partner known to be HIV-infected • Age ≤ 18 at first sexual intercourse	• STI • Marital status
HCV	• IVDU • Noninjection illicit drug use • Multiple sex partners • Sex worker • Inmates • Age ≤ 18 at first sexual intercourse • Sex with partner known to be HCV-infected • Sex with an injection drug user • Tattooing performed by a nonprofessional	• Hemodialysis • Receipt of blood transfusion • Signs and symptoms (eg, jaundice, elevated ALT) • STI • Marital status
HBV	• MSM • IVDU • Multiple sex partners	• Hemodialysis • STI • Marital status

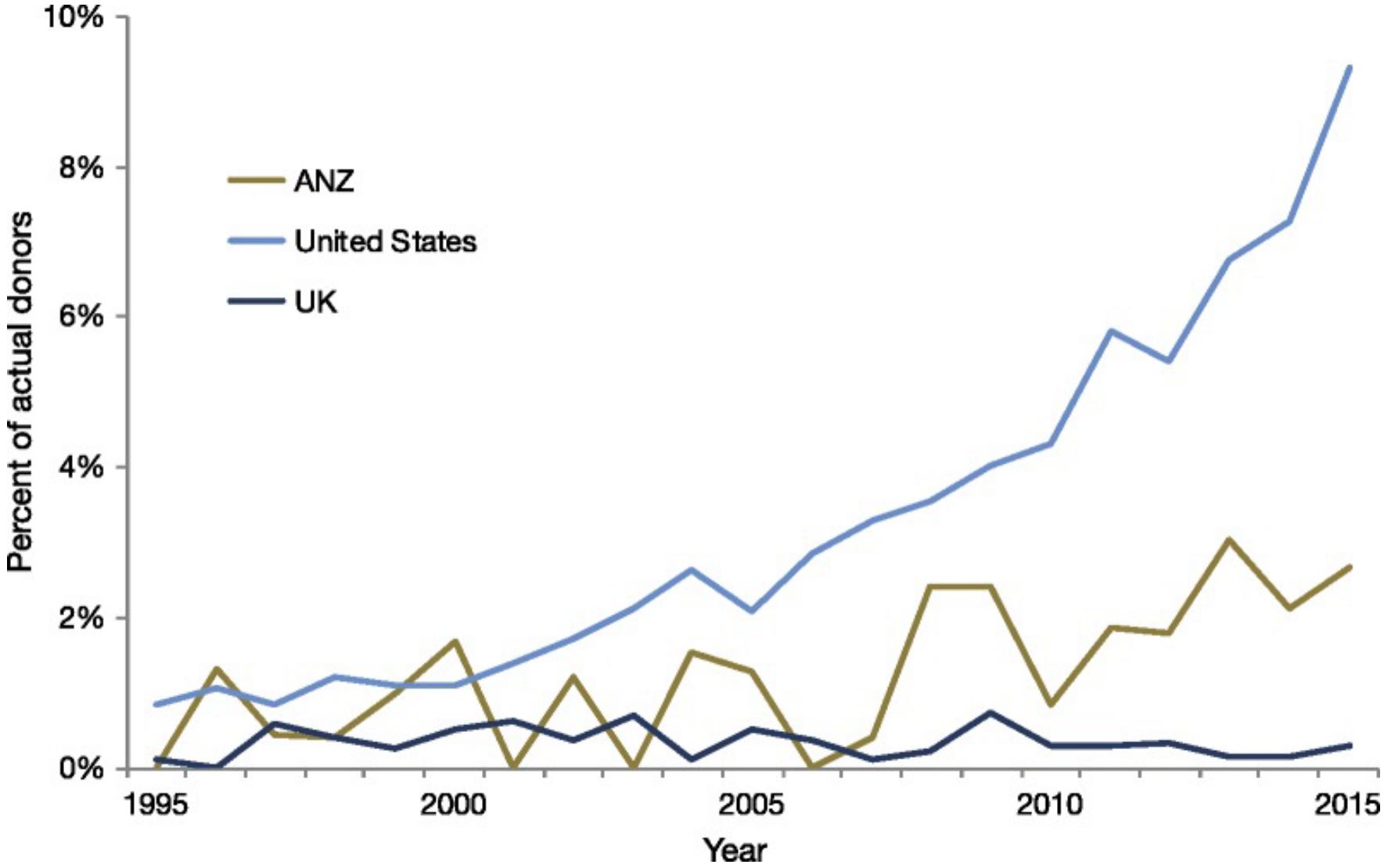
HIV, human immunodeficiency virus; HCV, hepatitis C virus; HBV, hepatitis B virus; MSM, men who have sex

Required Donor Information

- Treatment received in the illness before donation (including duration and dose of antimicrobial and other drug therapy)
- Vaccination history and immunisation status
- History of receipt of blood, blood components, blood products, tissue or organ graft.
- Previous or current immunosuppression (by disease or drugs) as this may affect the interpretation of test results or the donor's suitability.
- Travel History

Required Donor Information

- History of contact with animals and other vectors. Transplantation may transmit zoonotic infections.
- History that may have put the donor at increased risk of transmissible spongiform encephalopathies (TSEs).
- History of malignancy, recent infectious disease or exposure to an infectious disease.
- Behavioural history that could have put the donor at risk of transmissible pathogens This will include questions about risk behaviours such as recreational drug use, men who have sex with men (MSM), sex with commercial sex workers, sex with a partner know to have a sexually transmissible disease, acupuncture, tattooing and body piercing.
- Results of any recent microbiological tests should be reviewed.



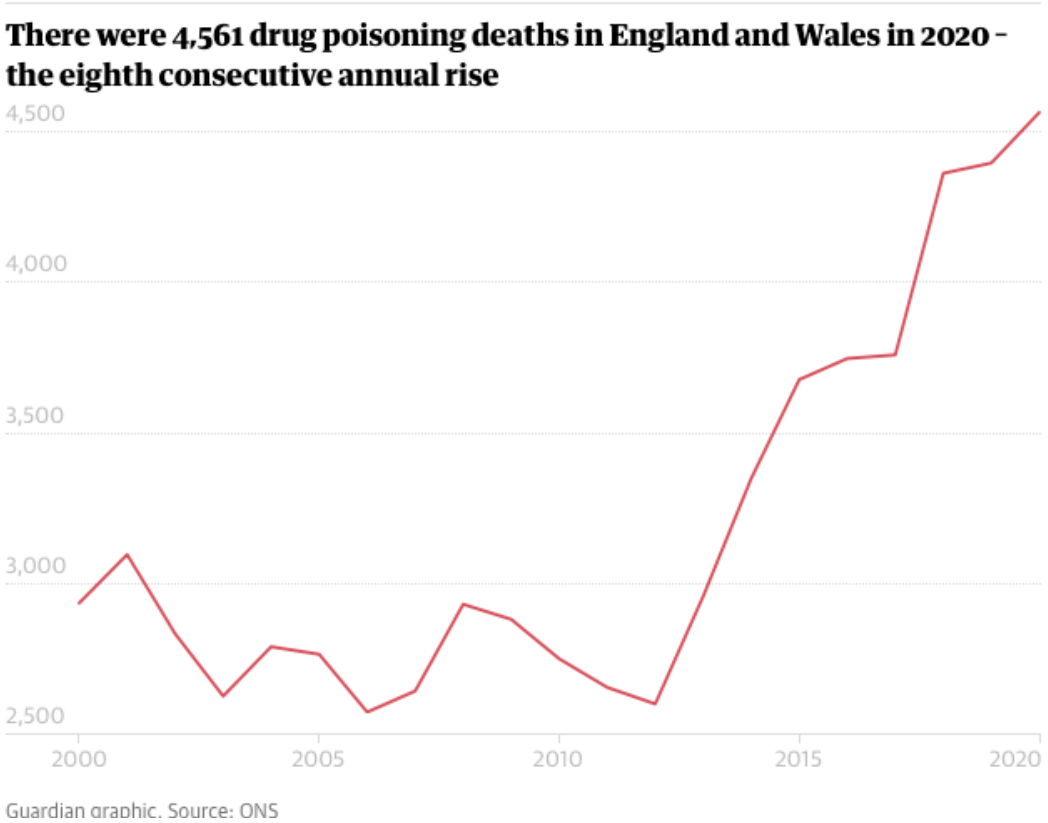
Twenty-year trends in the percentage of donors with drug overdose (intended or unintended) as a cause of death in Australia and New Zealand (ANZ) compared with the United Kingdom (UK) and United States (data sources: Australia and New Zealand Organ Donation Registry [ANZOD], Organ Procurement and Transplantation Network [OPTN], National Health Service Blood and Transplant [NHSBT]).

Drug poisonings in England and Wales

The rate of drug poisonings continues to increase

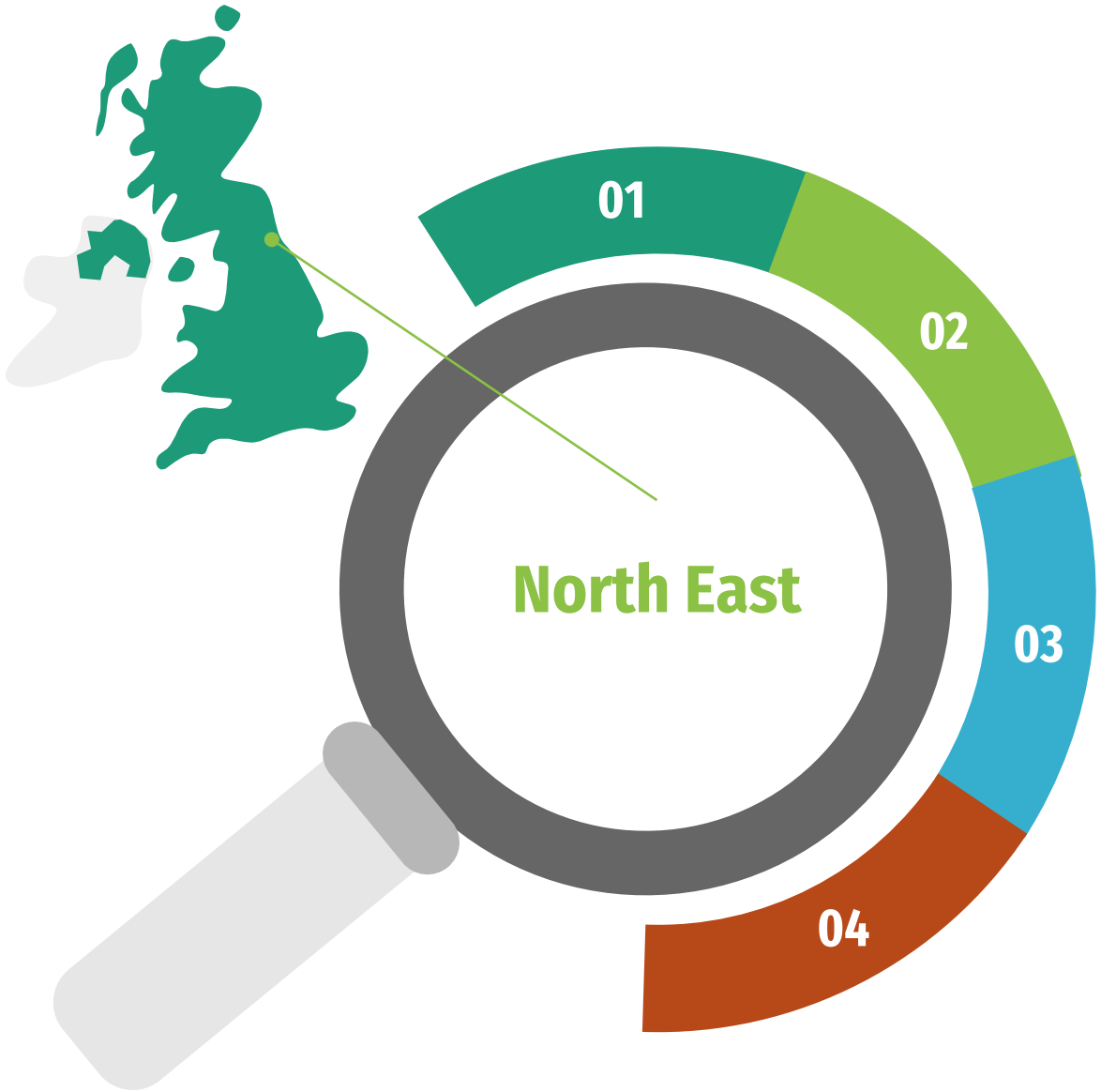
Rates of drug-related poisoning were 60.9% higher in 2020 (79.5 deaths per million) than they were in 2010 (49.4 per million).

The rate has increased every year since 2012



ONS:Deaths related to drug poisoning in England and Wales: 2020 registrations

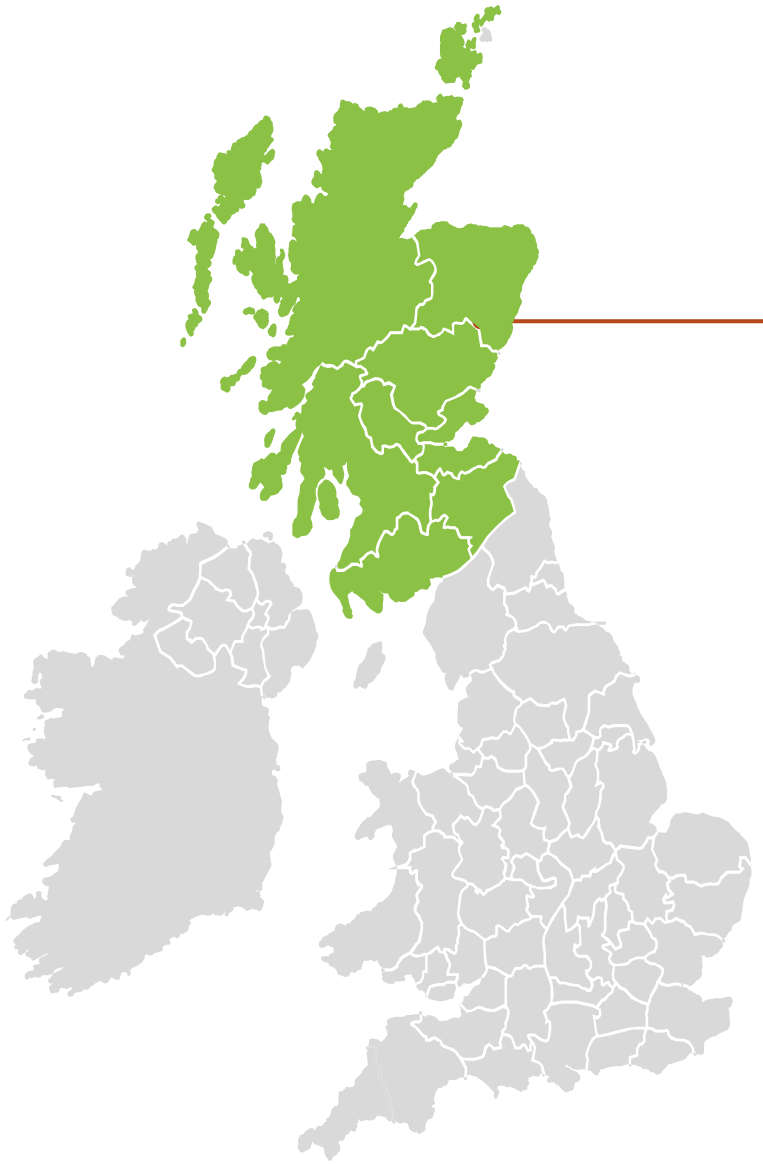
Regional Variation (England and Wales)

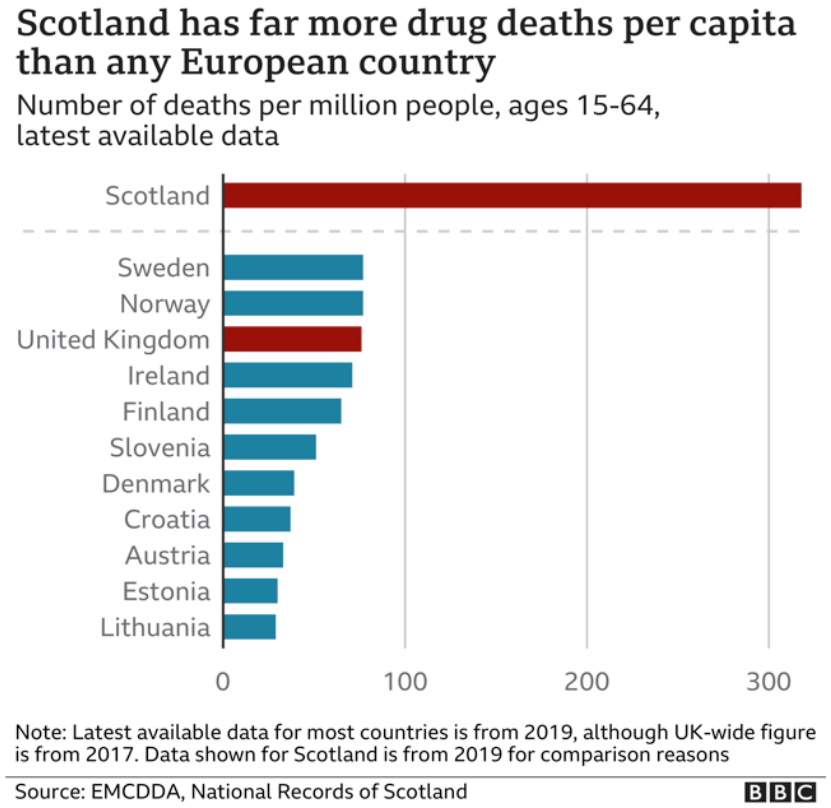


North - South Divide

In 2020, the highest rate of drug misuse deaths was observed in the North East (104.6 deaths per million; 258 registered deaths), while the lowest rate was in London (33.1 deaths per million; 296 deaths).

The North East has had the highest rate of drug misuse for the past eight years and has a statistically significantly higher rate than all other regions of England.

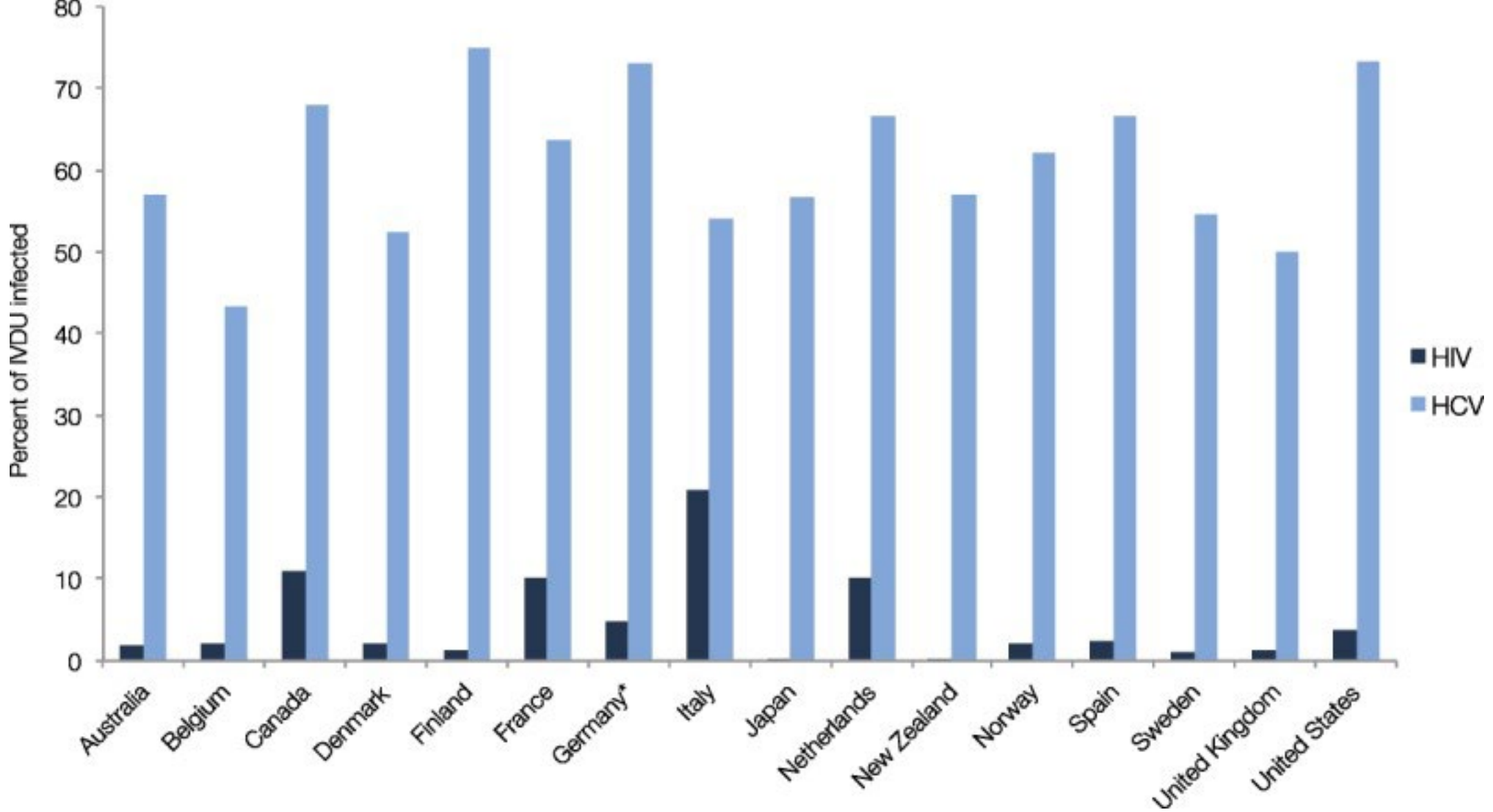




Scotland

It means Scotland continues to have by far the highest drug death rate recorded by any country in Europe.

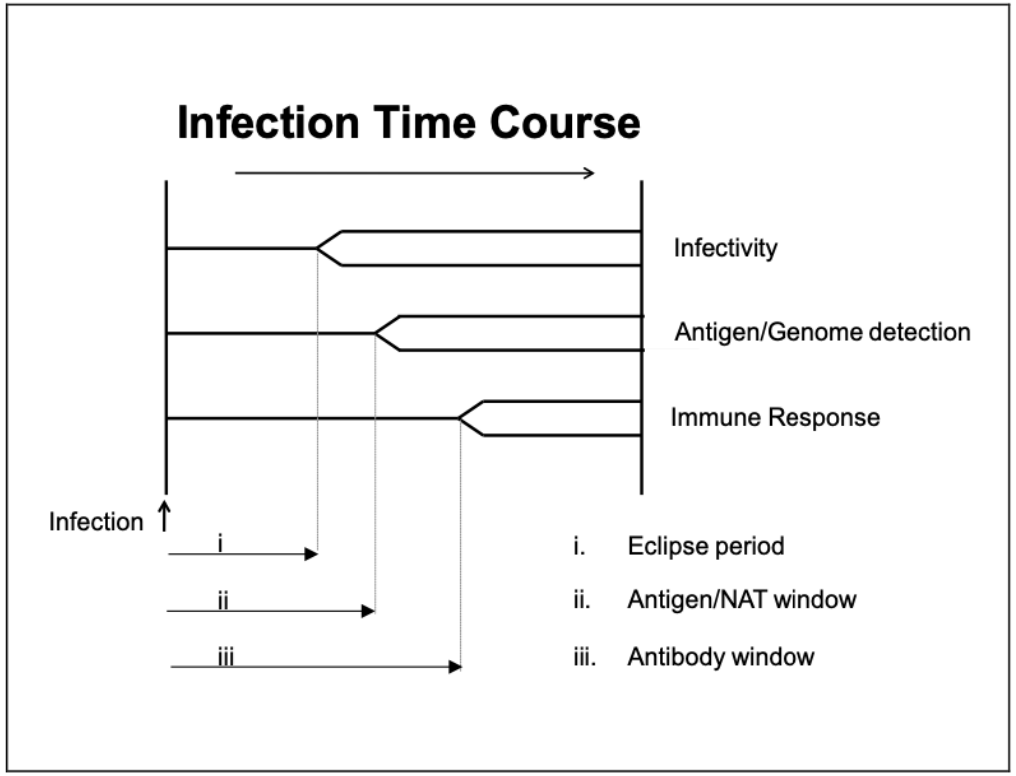
And its rate is more than three-and-a-half times that of England and Wales.



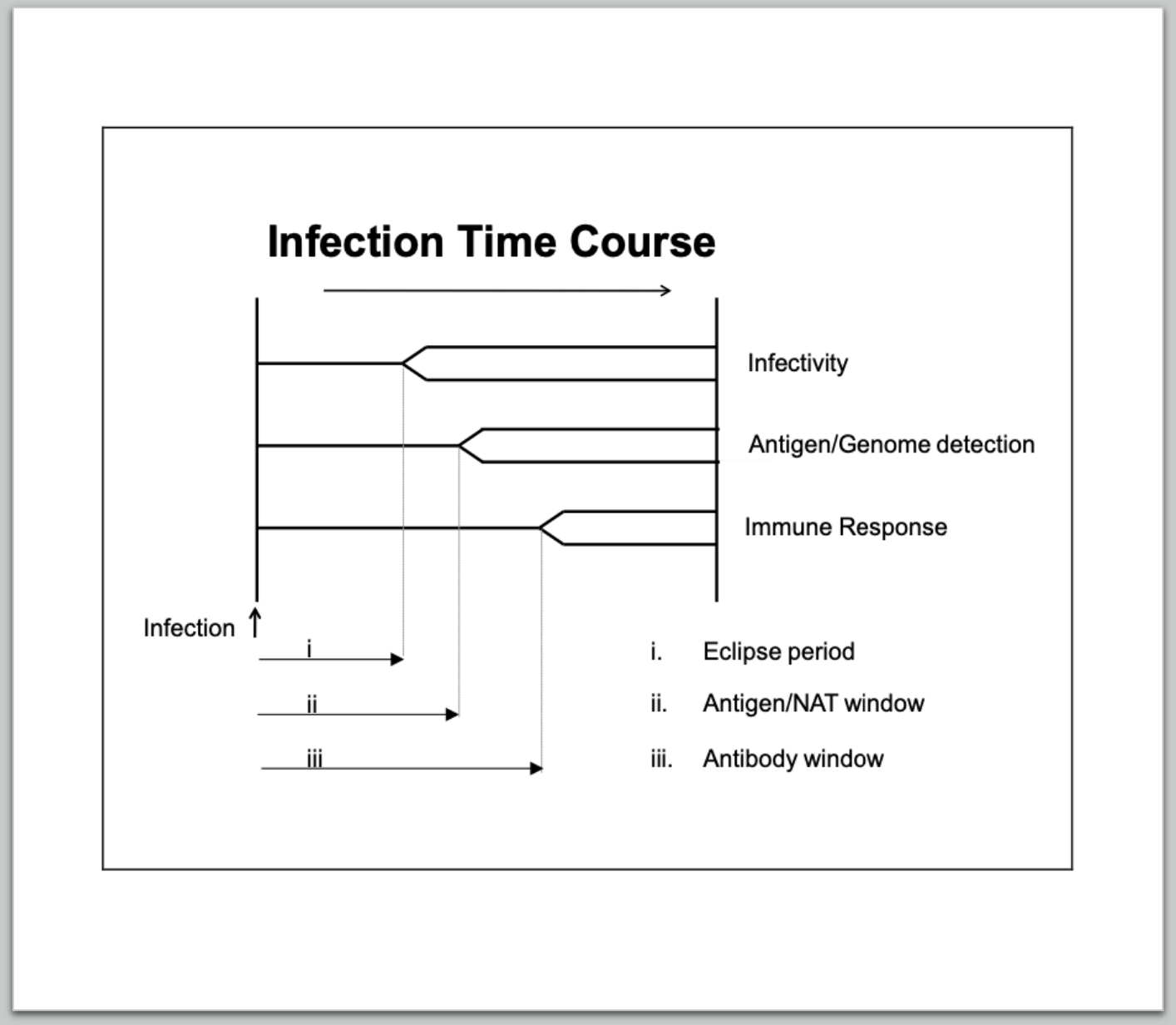
Estimated prevalence of human immunodeficiency virus (HIV) and hepatitis C virus (HCV) among people who inject drugs in selected high-income countries. HCV prevalence estimates represent mid-range estimates (source of HCV data: United Nations Office on Drugs and Crime http://unodc.org; source of HIV data: UNAIDS aidsinfo. unaids.org). *HCV estimate for Germany represents high range estimate for the year 2011. IVDU, intravenous drug users.

Interpreting donor test results

- Following exposure to, and infection by, a microbiological agent there is a period of time during which no microbe can be readily recovered from the host; this is classically called the eclipse period.
- Donations taken during this period are unlikely to be infectious but in practice this would not be safe and should be avoided.



- This period of infectivity which cannot be detected is colloquially called a “window” and represents the duration of undetectable infectivity.
- This “window” is shortest for genomic (nucleic acid technology testing, NAT) and antigen tests, and longest for antibody tests.



Window

Table 1: Estimates of window period length for different testing methods*

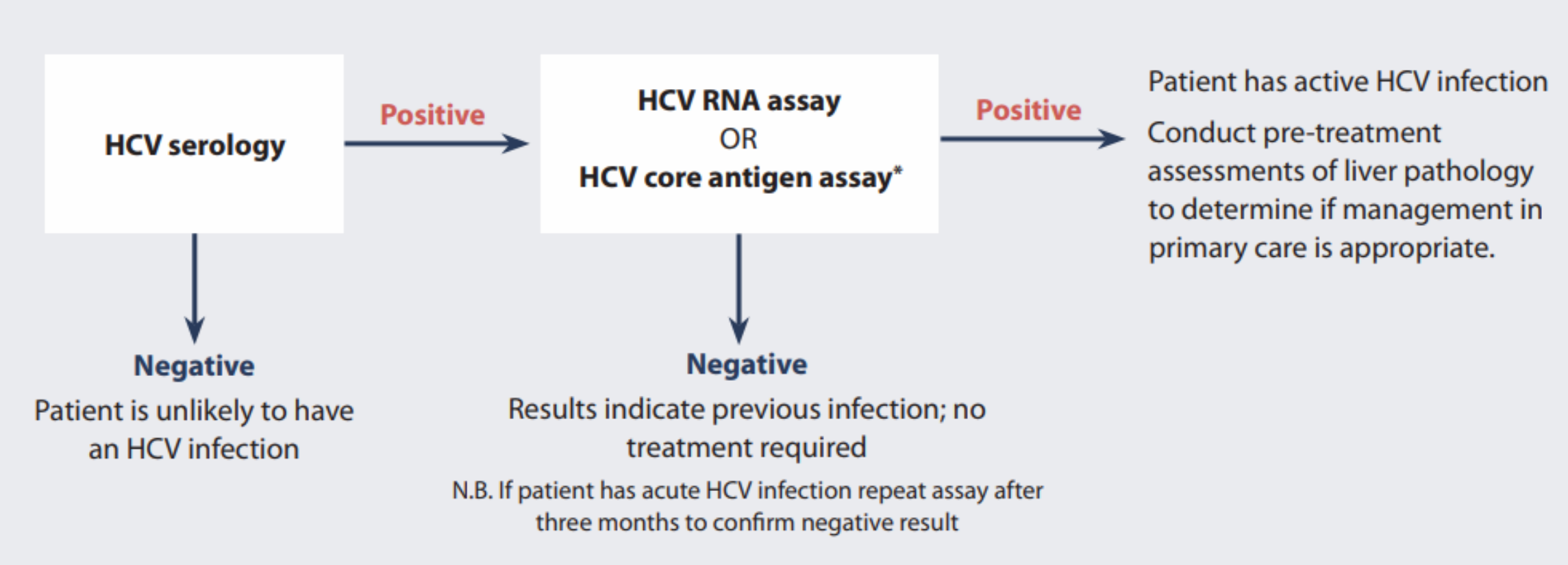
Pathogen	Standard serology	Enhanced serology (fourth generation or combined antibody-antigen tests)	Nucleic acid testing
HIV	17–22 days (5–8)	~7–16 days (9,10)	5–6 days (5,6)
HCV	~70 days (5,8,11)	~40–50 days (12–14)	3–5 days (5,11)
HBV	35–44 days (15,16)	Not applicable	20–22 days (8,15)

Interpreting Hepatitis B Blood Test Results

Interpretation & Action Needed	HBsAg Hepatitis B Surface Antigen	HBsAb (anti-HBs) Hepatitis B Surface Antibody	HBcAb (anti-HBc) Hepatitis B Core Antibody
Not Immune - Not Protected Has not been infected, but still at risk for possible hep B infection. Vaccine is needed.	–	–	–
***Immune Controlled - Protected** Surface antibodies present due to natural infection. Has recovered from a prior hep B infection. Cannot infect others. No vaccine is needed.	–	+	+
Immune - Protected Has been vaccinated. Does not have the virus and has never been infected. No vaccine is needed.	–	+	–
Infected Positive HBsAg indicates hep B virus is present. Virus can spread to others. Find a doctor who is knowledgeable about hep B for further evaluation. More Testing Needed.	+	–	+
***Could be Infected** Result unclear - possible past or current hep B infection. Find a doctor who is knowledgeable about hep B for further evaluation. More Testing Needed.	–	–	+

*Inform all doctors about a prior or current hepatitis B infection and include this information as part of your health history.
Talk to doctors before taking immune system suppressing medications to understand the risk for possible hep B reactivation.

Hepatitis C tests



HIV

- Screening for HIV infection must include a combined HIV antigen/antibody assay.
- Samples giving repeat reactivity in antibody or combined antigen/antibody assays must undergo additional testing to confirm HIV infection including nucleic acid tests (NAT) for HIV RNA.
- Confirmed detection of specific anti-HIV 1/2 antibodies and/or HIV RNA and/or HIV antigen indicates current infection.
- The use of organ and cells from HIV-infected individuals may be considered in the setting of HIV-infected recipients.

CMV and EBV

- The majority of adult populations worldwide are latently infected with CMV and/or EBV,

- CMV: 20% to 100%
- EBV: 50% to 90%

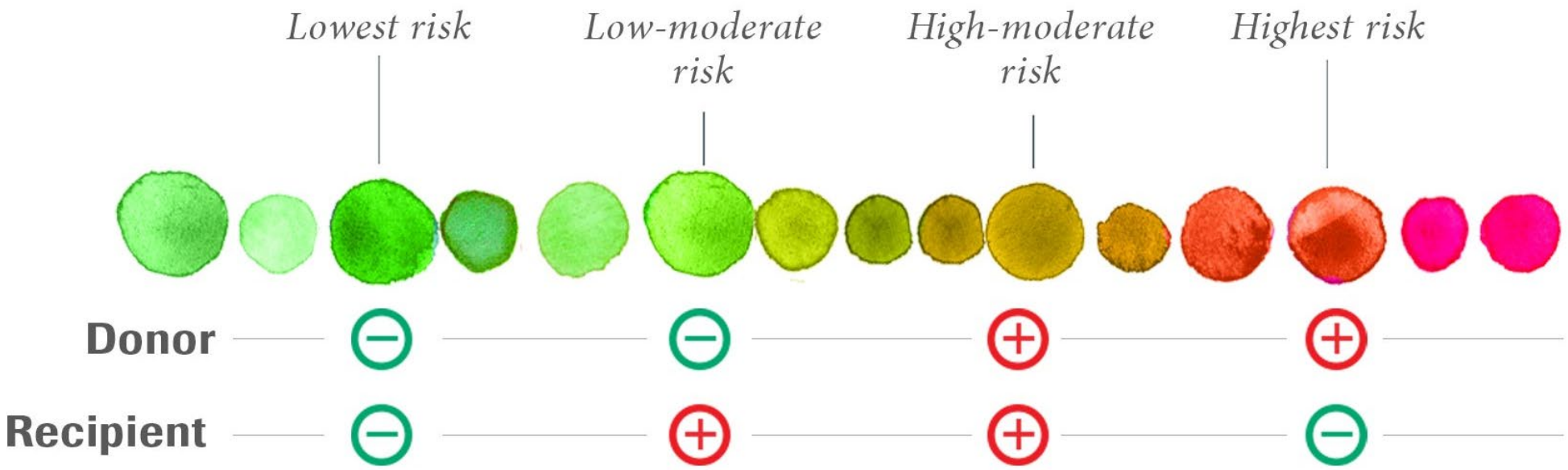
of populations older than 18 years, respectively

CMV and EBV

- CMV and EBV cause lifelong infection, and organs from seropositive donors may transmit infection, potentially causing severe disease in a seronegative recipient.

- Latent CMV and EBV may also reactivate in immunosuppressed seropositive patients post transplantation. No contraindications exist for organ donation in the case of donors with latent CMV infection, although recipient morbidity increases in the case of D+/R− combinations.

CMV


Lowest risk
Low-moderate risk
High-moderate risk
Highest risk
Donor
Recipient

EBV - *Epstein-Barr virus*

- Epstein-Barr virus (EBV) infection is associated with the development of post-transplant lymphoproliferative disorders (PTLDs).
- EBV transmission to a seronegative recipient is the greatest risk factor for PTLD
- EBV positive donors does not prevent transplant but monitoring is recommended

Human T cell Lymphotropic Virus (HTLV)

- The Human T-cell lymphocytic virus-1 (HTLV-1) is an oncogenic retrovirus that preferentially infects CD4+ T-cells.
- Transmission may occur as a result of breast feeding, IV drug use, sexual intercourse or blood transfusion.
- Although infection is usually asymptomatic in most individuals, approximately 2% to 5% of infected individuals will subsequently develop acute T-cell leukaemia/lymphoma (ATL) around 20 to 30 years after infection.
- A smaller proportion (0.25–4%) will develop HTLV-1–associated myelopathy/tropical spastic paraparesis (HAM/TSP) soon after the initial infection.

Human T cell Lymphotropic Virus (HTLV)

- **The majority of HTLV-1–infected individuals will not develop clinical manifestations of ATL or HAM/TSP in their lifetime.**
- However, infection with HTLV-1 suppresses immune surveillance and increases susceptibility to other infections including parasitic infection with *Strongyloides stercoralis* and scabies, bacterial infections including *Mycobacterium tuberculosis*, *Mycobacterium leprae*, and infectious dermatitis, and viral infections including HIV, HCV, and HBV.

HTLV

- HTLV is not mandatory for all donors of tissues and cells but is for donors living in, or originating from high-prevalence areas, or with sexual partners originating from those areas or where the donor's parents originate from those areas. There are also requirements for the repeat testing after at least 180 days for those donors at risk of HTLV infection
- Confirmation of specific anti-HTLV antibodies indicates current infection
- The decision to proceed with solid organ transplantation following an initial reactive HTLV antibody test is dependent on an assessment of the net benefit of receiving that transplant when compared to the risk of not receiving that specific transplant.

(A.

Toxoplasma gondii

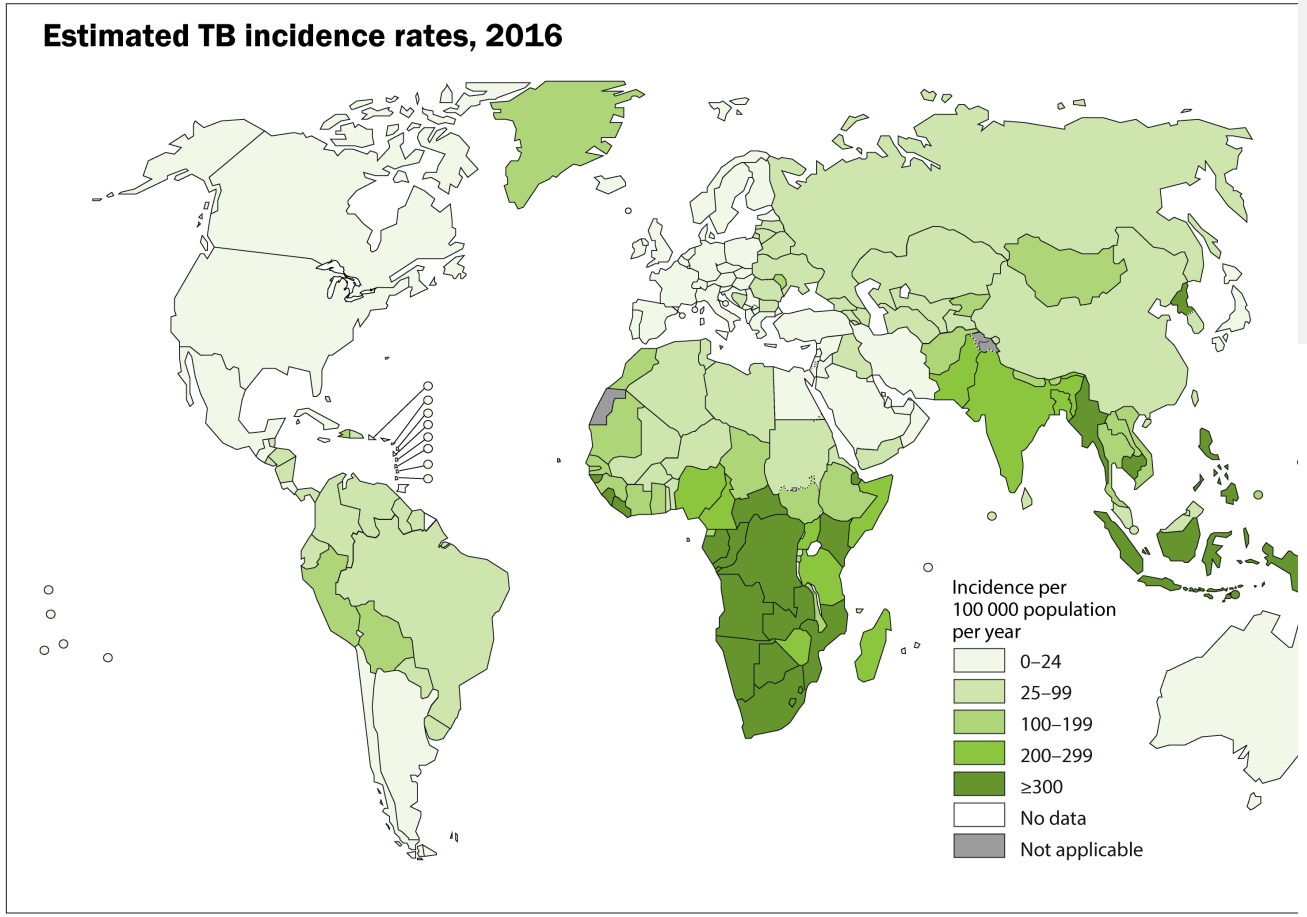
- Transmission of an infection with *T. gondii* occurs most commonly when a seronegative recipient receives an organ from a seropositive donor. Whereas the occurrence of toxoplasmosis following non-cardiac organ transplantation is low, the reported prevalence in serologically mismatched (D+/R–) heart and heart-lung recipients in the absence of antimicrobial prophylaxis can be as high as 75% due to the transmission of *T. gondii* cysts present within cardiac tissue.
- Less commonly, seropositive recipients may manifest reactivation of latent infection.

If positive

- Donation permitted
- Informs need for prophylaxis in heart recipients

TB - Tuberculosis

- Donation of organs and tissues is contraindicated from donors with active disease or within the first six months of anti-tuberculosis treatment.
- Previous disease or from a risk area - requires donor prophylaxis.



The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

Data Source: *Global Tuberculosis Report 2017*. WHO, 2017.

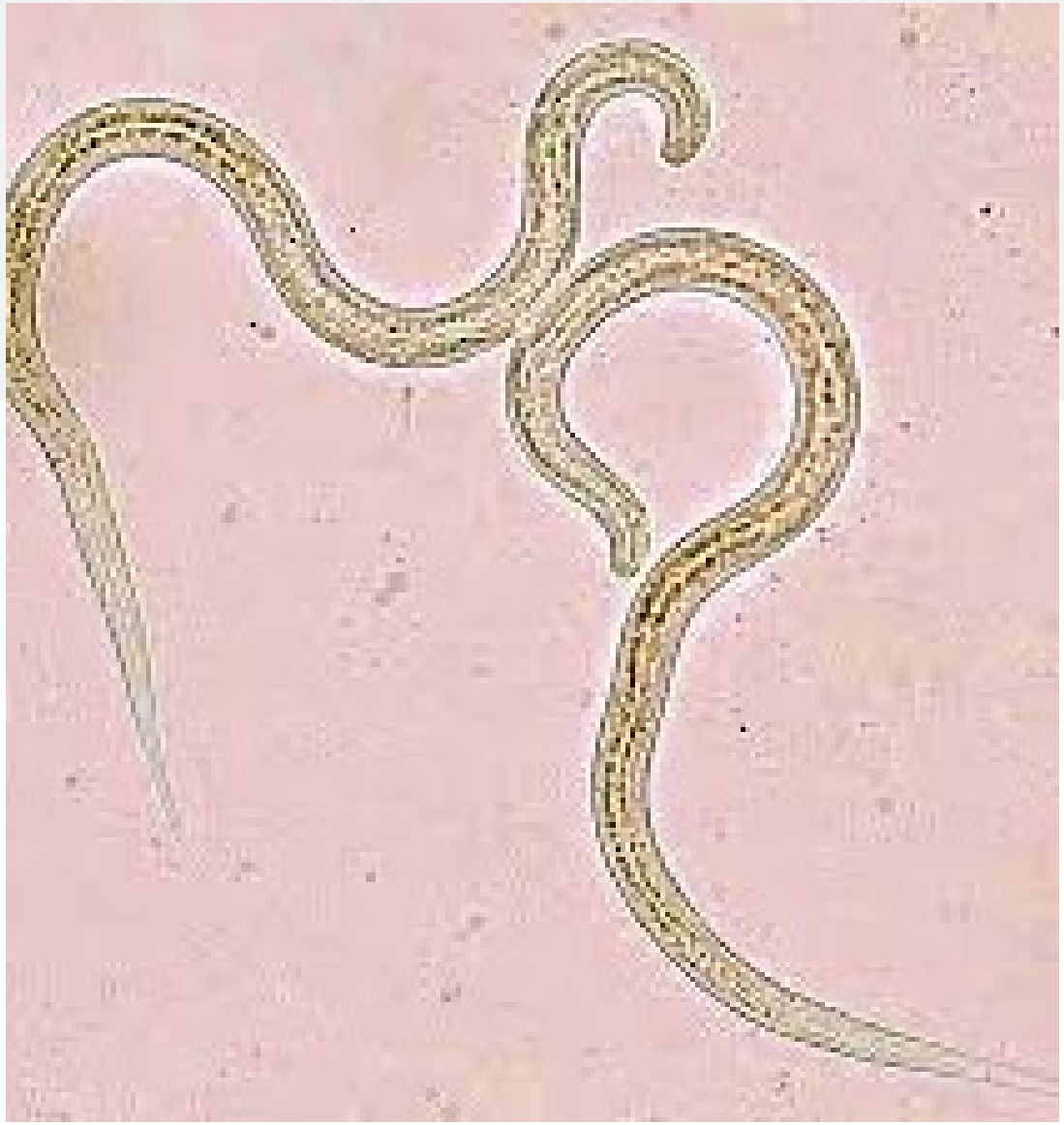
Hepatitis E Virus

- Hepatitis E virus (HEV) is overall the world's most common cause of acute viral hepatitis.

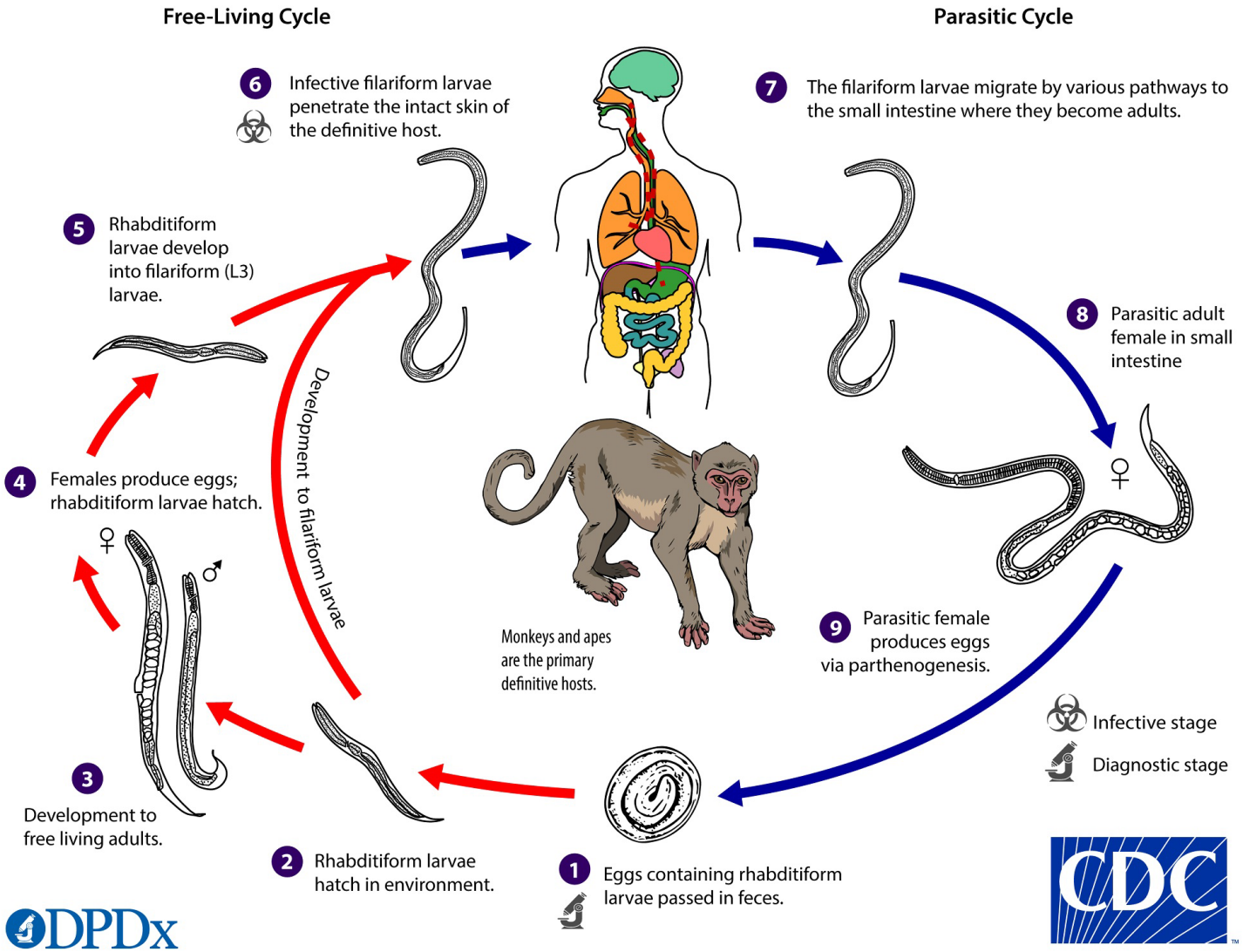
- If positive
- Donation permitted. Informs post transplant management

Strongyloides stercoralis

- Asymptomatic carriage with strongyloides stercoralis has been reported most often in donors who were both born in and lived for some while in endemic areas which include most of the Tropics and Sub-tropics.
- An Eosinophilia may or may not be present. Transmission to immuno-compromised recipients is often associated with significant morbidity and a high mortality rate.
- Pre-donation identification from stool sampling and serology, most practicable for a live donor allows for effective recipient prophylaxis.

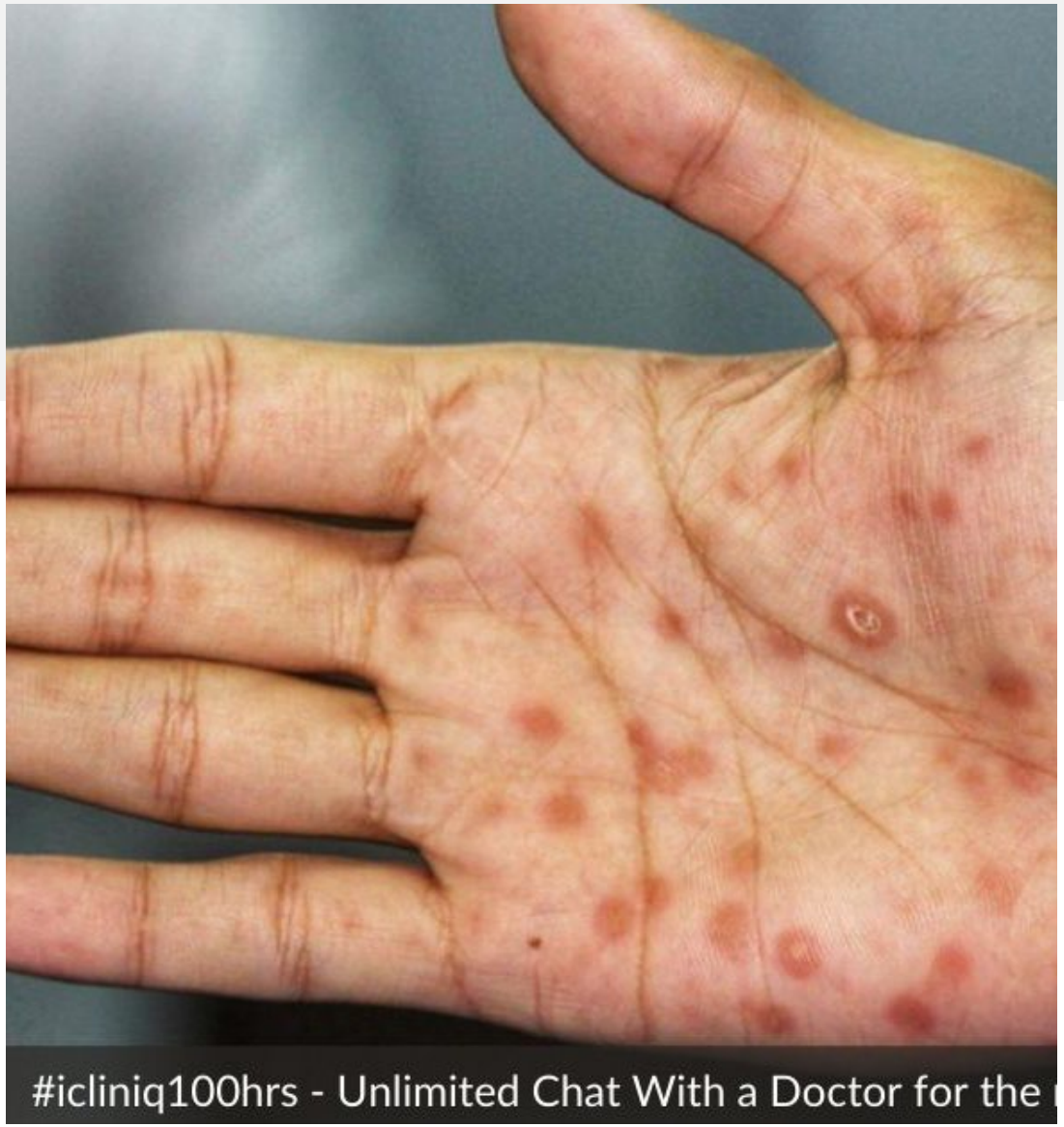


Strongyloides fuelleborni



Treponema pallidum (Syphilis)

- Syphilis is never a contraindication for using organs
- Penicillin should be administered to recipients of serologically reactive donors.



Drug resistant bacteria e.g. methicillin resistant Staphylococcus aureus (MRSA), vancomycin resistant Enterococcus (VRE), carbapenemase-producing Enterobacteriaceae (CPE)

Drug resistant bacteria can be transmitted from donor to recipient. Transmitted infections are difficult to treat and are associated with poorer outcome in the recipient.

- The presence of drug resistant bacteria in the donor is a relative contraindication to solid organ transplantation.
- Specialist microbiological advice must be sought.
- Careful consideration of benefits from transplant is required.

Yearly Epidemic Influenza

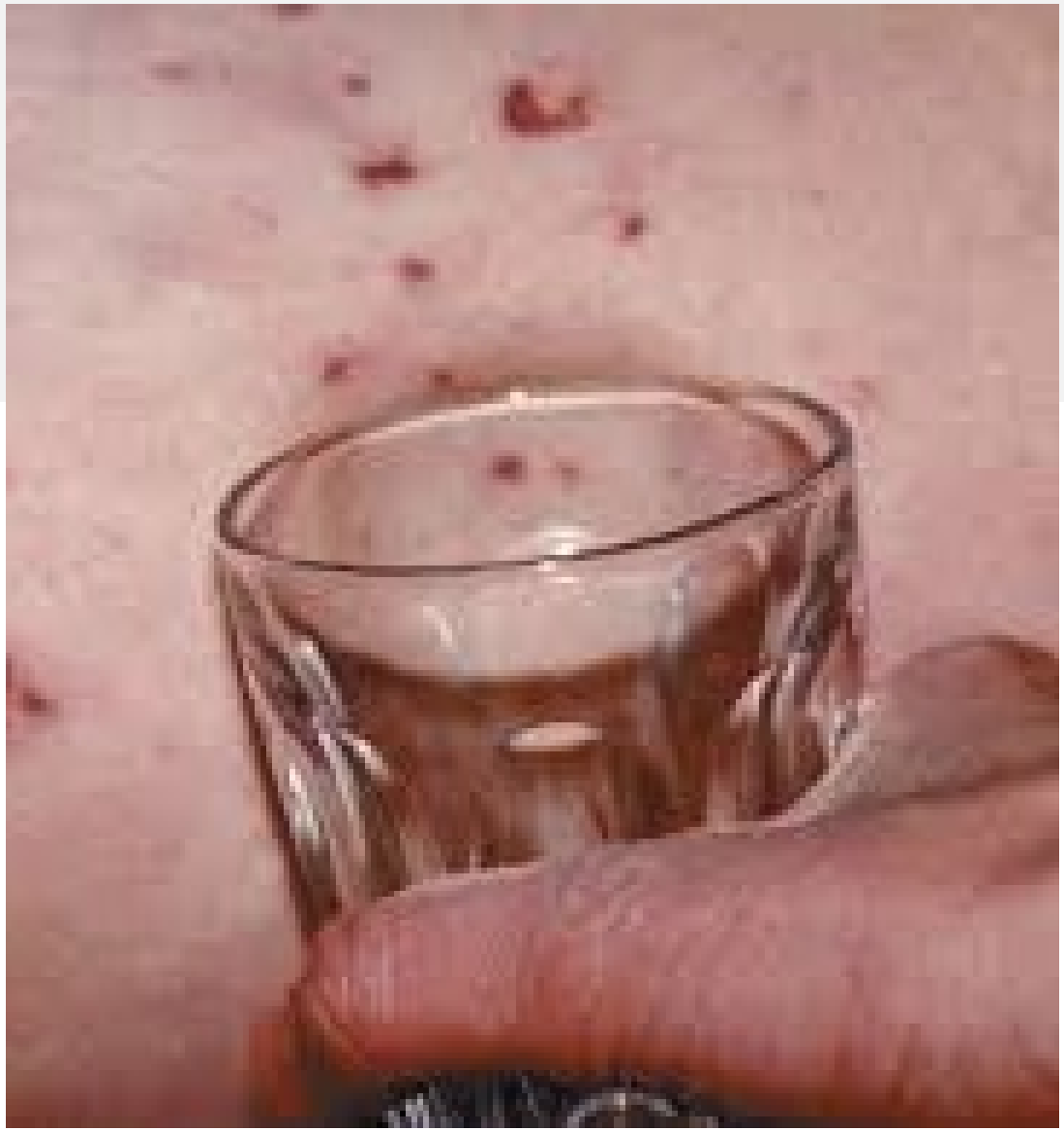
- UK guidelines state that lungs and bowel should not be used from donors with confirmed influenza infection. Other organs may be offered, and the final decision lies with the transplanting surgeon, weighing the balance of risks for the recipient and noting that pathogenicity of some strains of virus may be enhanced by immunosuppression.

Meningoencephalitis of unknown cause

- Donors with undiagnosed meningoencephalitis are an uncommon but potentially lethal source of donor-derived infection.
- Transmission of rabies, LCMV, WNV, *Mycobacterium tuberculosis*, *Cryptococcus*, *Coccidiodes immitis*, *Aspergillums,* and *Balamuthia* have occurred when donors with meningitis or encephalitis of unknown cause have been used as organ donors.
- For this reason, any meningitis or encephalitis without a proven cause should be an absolute contraindication to transplantation, according to the international guidelines

Bacterial meningitis

- If bacterial meningitis has been confirmed, and there is no visible damage or local infection in the organ or tissues required at retrieval, the donation of the organs, tissues and cells are acceptable provided appropriate treatment has been administered to the donor.



Transmissible Spongiform Encephalopathies (TSEs) (Prion)

TSEs (otherwise known as prion diseases) are a group of fatal transmissible neurodegenerative disorders that in humans occur in sporadic, genetic and acquired forms.

The commonest human TSE, Creutzfeldt-Jakob disease, occurs in all three forms:

1. Genetic (gCJD),
2. Sporadic (sCJD)
3. Acquired (Variant CJD,vCJD, and iatrogenic CJD,iCJD).

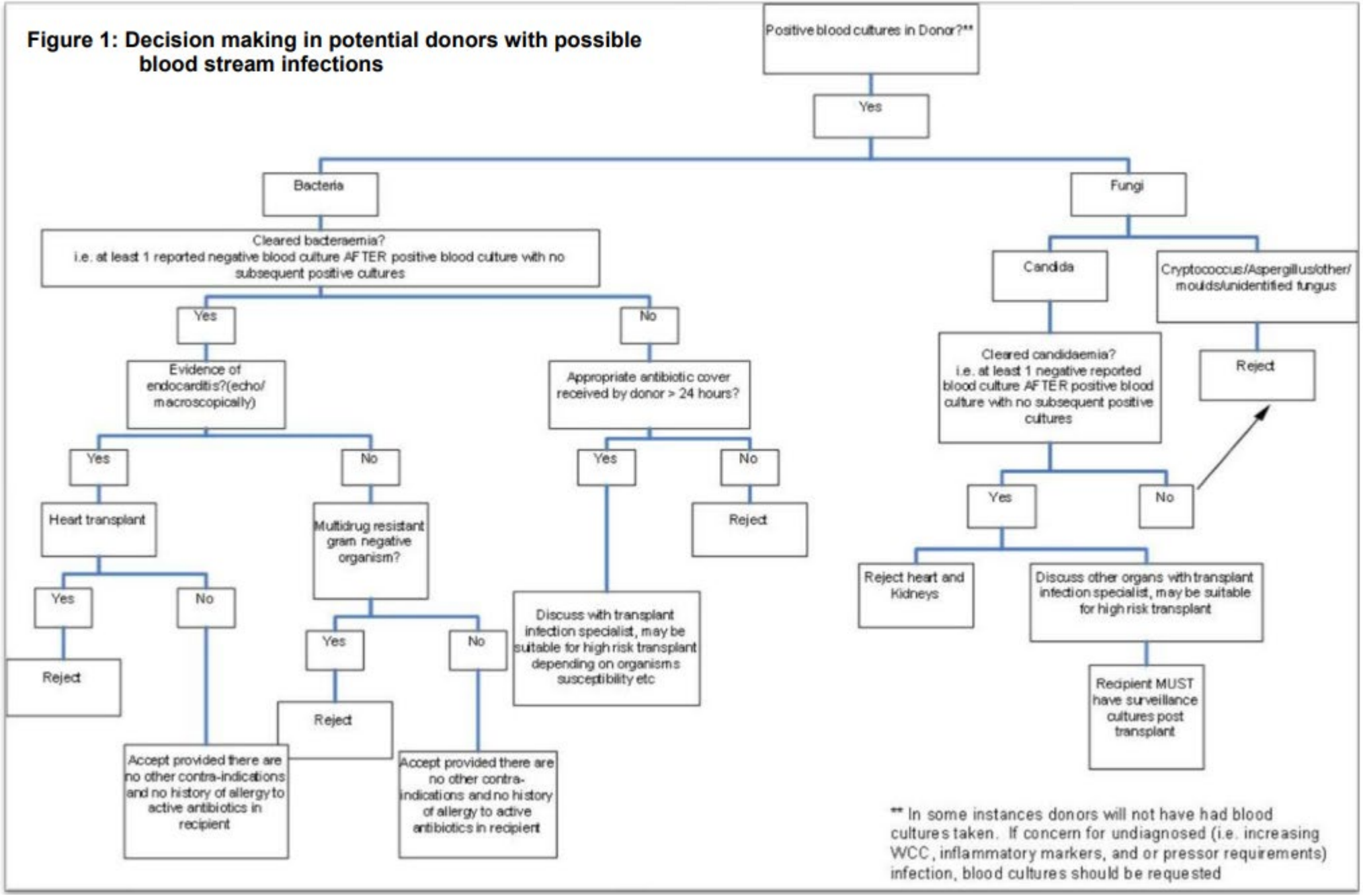
Exclusions from organ and/or tissue donation based on possible TSE exposure

	Solid Organ Donors
Definite, probable or possible case of human TSE, including CJD and vCJD	Absolute contra-indication
Individual with a neurological disease of unknown aetiology	Absolute contra-indication
Individual whose blood relatives have had familial CJD [1]	Absolute contra-indication
Individual "presumed infected" with vCJD[2]	Absolute contra-indication
Individual "at increased risk of CJD/vCJD" (for public health purposes)[3]	**Individual assessment required [4]**
History of definite [5] or probable [6] blood transfusion since 1980	**Individual assessment required [4]**
History of receipt of *dura mater* graft	**Individual assessment required [4]**
History of definite receipt of tissue since 1980	**Individual assessment required [4]**
History of receipt of pituitary derived growth hormone and/or gonadotrophin	**Individual assessment required [4]**
History of receipt of organ	**Individual assessment required [4]**

Bacterial infection tests

Tests for bacterial infection	
Rapid plasma reagin (RPR) or other serological test for syphilis	Not contraindicated but treat the recipient
Tuberculin skin test	(test recommended only for recipient)
Blood cultures	Not contraindicated but treat the recipient. Individual decision in the case of MDR bacteria.

Figure 1: Decision making in potential donors with possible blood stream infections



Viral infection Tests

Tests for viral infection	
HIV 1/2 antibody	Contraindicated but considered for HIV-positive recipient
Cytomegalovirus IgG antibody	Not contraindicated but essential to define prophylactic strategy after procedure depending on recipient serology
EBV IgG antibody	Not contraindicated but essential to monitor EBV-negative recipients, especially children
HBsAg	Contraindicated but considered for HBsAg+ recipients or HBV protective immunity
HBcAc/'HBc alone'	Not contraindicated but consider antiviral prophylaxis for liver and HBV non-immune recipients
HCV antibody	Contraindicated but considered for HCV+ recipients

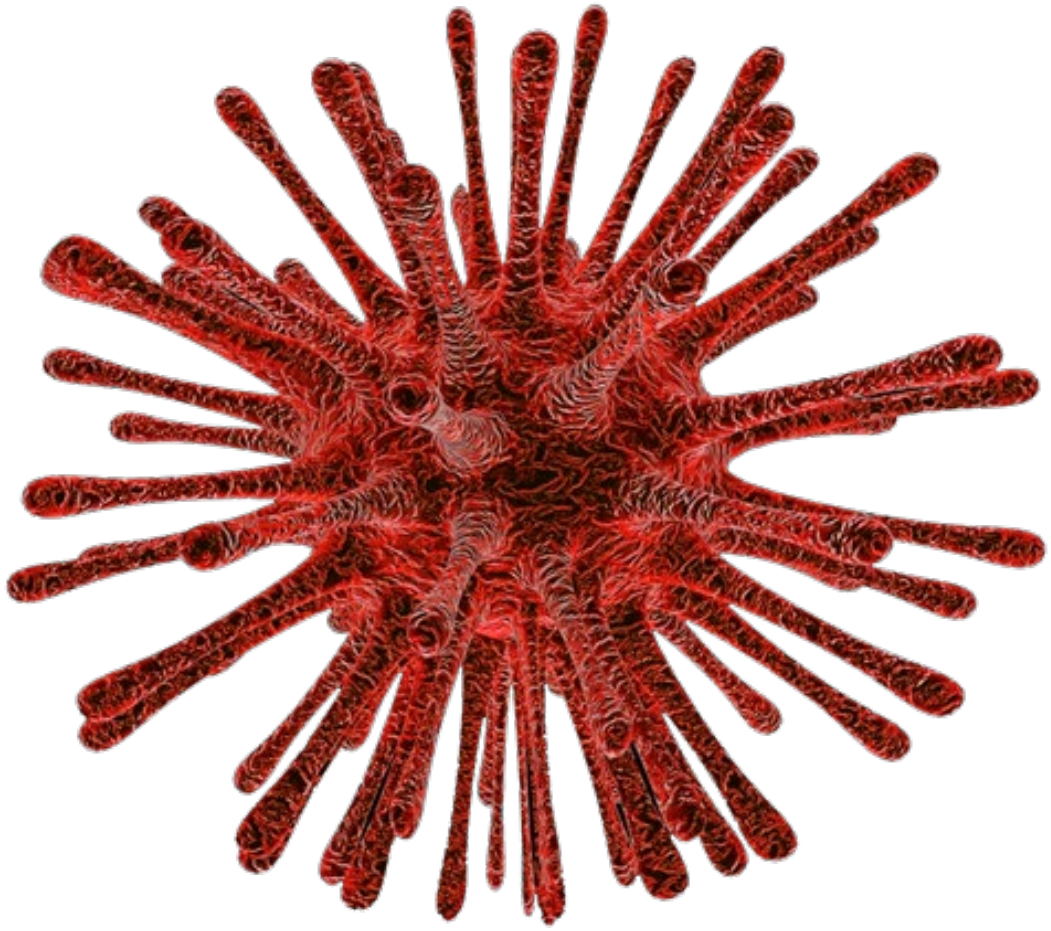
Hep C organs are now being excepted into negative recipients by some units who are pre-consenting recipients given how effective treatment for HEP C has become

Tests for parasitic infection

Tests for parasitic infection	
Toxoplasma IgG antibody	Not contraindicated but consider prophylaxis for heart transplant

COVID 19

SARS-CoV-2



SARS-CoV-2

There is growing experience in the US and Europe with the transplantation of organs (other than lungs) from selected donors that were positive for SARS-CoV-2 ribonucleic acid (RNA) in respiratory tract samples, without apparent transmission to recipients.

Transmission has only been described through transplantation of lungs where a lower respiratory tract sample was not tested during donor screening and was subsequently shown to be strongly positive for SARS-CoV-2 RNA, denoting infection at the time of donation.

POL304/3 – SARS-CoV-2 Assessment and Screening in Organ Donors and Recipients Copy No: Effective date: 30/03/2022

- If donor is positive: a period of at least 10- 14 days from onset of symptoms or from first testing positive for SARS-CoV-2 RNA (if asymptomatic) needs to be observed
- Where ongoing SARS-CoV-2 RNA positivity : seek virologist advice
- Decisions on when a potential living donor donates after recovering from COVID-19 must involve discussion with the wider multi-disciplinary team (including an anaesthetist) and the potential donor.