

THE IN A HURRY SERIES

Transplants

in a Hurry

Moving parts between people

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The Whole Thing in One Page

The public picture of a transplant is a surgeon lifting one failed part out of a body and sewing in a working replacement. It looks like the most literal form of repair medicine has devised. A kidney takes over filtration. A liver resumes chemistry. A heart supplies flow. A cornea restores a clear path for light. Blood-forming stem cells rebuild a marrow system. One person has what another person needs, and medicine moves it across.

The operation is only the middle.

A vascularised donor organ is living tissue that has lost its circulation. From that moment, cells run down stored energy, membranes lose control of ions, acidity rises and injury accumulates. Cooling slows the process without stopping it. Retrieval teams, preservation fluid, transport, allocation and two operating theatres must therefore behave as one timed machine. The recipient cannot receive the organ until the donor has been identified, death has been confirmed where relevant, lawful consent has been established, infection and cancer risks have been assessed, blood vessels have been prepared and a compatible candidate has been found.

Compatibility does not mean sameness. Another person's cells carry molecular labels that an immune system is built to inspect. Blood groups, human leucocyte antigens, previous pregnancies, transfusions and transplants can all shape the danger. A crossmatch may expose an immediate collision before surgery. Drugs can suppress the response afterwards, but suppression is a bargain, not a victory. Reduce immunity enough to protect the graft and infection, cancer, metabolic disease and drug toxicity gain room. Reduce it too little and rejection can damage the organ. The patient and the graft can survive on different timetables, which is why transplant medicine never has one outcome number.

The word part also hides several different operations. A cornea can be stored and placed without joining major vessels. Donor stem cells can enter through a vein, settle in marrow and build blood and immunity. A kidney or heart must be reconnected to circulation. In a stem-cell graft, donor

immunity may attack the recipient rather than the recipient attacking one shaped organ.

Scarcity turns this biology into public ethics. Organs cannot be stored like ordinary equipment, and far more people could benefit than receive them. Allocation systems must trade urgency, compatibility, likely benefit, waiting time, size, geography, transport and fairness. They are not queues with a receptionist at the front. They are changing moral choices written as algorithms.

Donation carries its own risks and meanings. A living donor accepts an intervention whose intended clinical benefit belongs to somebody else. A deceased donor can give only after treatment decisions and death confirmation have been kept separate from retrieval. Consent laws differ, families remain central in many systems, and trust cannot be manufactured by legislation. A service that loses legitimacy loses donors as well as confidence.

The field keeps trying to widen what counts as usable: paired kidney exchanges, split livers, donation after circulatory death, machine perfusion, organ repair and gene-edited pig kidneys. Each advance buys time or crosses a barrier. None produces free supply. It moves risk, uncertainty, cost and responsibility to a new place in the chain.

That is the book.

Why You Should Care

In the United Kingdom during the year to 31 March 2026, 4,666 organ transplants were recorded. At that date, 8,296 people were active on a waiting list and another 4,139 were temporarily suspended. During the year, 434 patients died while active on a list and 899 were removed, mostly because deteriorating health or ineligibility made transplantation impossible. Those figures describe a service large enough to feel established and a shortage large enough to shape every decision inside it. They also hide the stranger fact: each solid-organ transplant required a part of one body to become a temporary patient in its own right.

Consider a kidney leaving a donor hospital. It is flushed, cooled, labelled, packaged and sent into a transport network while teams elsewhere compare blood group, antibodies, size, urgency and expected benefit. A recipient may be called at night, told not to eat, travel to a centre, undergo tests and still go home without surgery because the organ proves unsuitable. A theatre may be prepared before the final answer exists. The organ cannot complain, yet every minute and every handling decision alters its future.

The headline numbers cover only solid organs. Corneas, skin, bone, tendons, heart valves and blood-forming stem cells move through different banks and clinical services, often without the theatre drama attached to a heart or liver. They restore sight, cover wounds, rebuild joints or reconstruct blood formation. The field is broader than the organs that appear in appeals.

This changes how medicine looks. Most treatment is delivered to one person at a time. Transplantation joins at least two bodies, several clinical teams, laboratories, couriers, regulators and a waiting population that is absent from the operating room but affected by what happens there. The donor and recipient may never meet. Their risks remain connected. A living donor can be healthy before an operation and less healthy afterwards so that somebody else may recover. A deceased donor's family can face a donation conversation during the worst hours of their lives. A recipient may feel gratitude, guilt, relief and fear while taking tablets that protect the graft

by weakening the system that protects the rest of the body.

The science matters because it corrects a common fantasy about identity. A heart does not carry a personality into its new owner. Yet bodies do recognise biological belonging with extraordinary force. The immune system has no concept of generosity. It sees molecular difference, damaged tissue and danger signals. Transplant medicine succeeds by making that response less destructive without removing it altogether. The result is neither natural acceptance nor permanent mechanical replacement. It is a negotiated coexistence, maintained by drugs, tests, appointments and behaviour.

The politics matters because scarcity cannot be escaped by good intentions. Someone must decide whether an organ goes to the sickest person, the person likely to gain the most years, the child, the person who has waited longest, the closest biological fit or the person close enough for the organ to arrive safely. Real systems mix these aims. Changing a weight in an allocation model can move advantage between groups without anyone naming a winner or loser in public.

And the future matters because transplantation is becoming less like hurried transport and more like active preservation. Machines can circulate warm or cold oxygenated fluid through some organs, allowing teams to assess function and sometimes reduce injury before implantation. Gene-edited pig kidneys have entered registered early human trials. These are important developments. They are not evidence that shortage, rejection or ethical conflict are about to disappear.

A transplant shows modern medicine at full scale: molecular, surgical, logistical, legal and moral, all at once. Learn how the chain works and hospitals stop looking like collections of departments. They become systems for coordinating risks that no single expert can hold alone.

The Core Ideas

A Donated Part Has a Clock

A removed kidney can look remarkably solid. It has weight, shape and enough structural strength to be held, turned and stitched. That appearance invites the wrong comparison. It is not a manufactured component waiting on a bench. It is a community of living cells whose normal conditions have been interrupted.

Inside a body, blood continually delivers oxygen and fuel, removes carbon dioxide and waste, carries hormones and keeps temperature and chemistry within narrow ranges. Clamp an organ's vessels and that service stops. Cells spend their remaining energy. Pumps in their membranes begin to fail. Sodium and water move where they should not. Acidity rises. Calcium enters compartments that normally exclude it. The fine lining of blood vessels becomes injured, and immune signals begin to gather before the recipient's immune system has even met the graft.

Cooling is the great delaying move. Lower temperature slows chemical reactions and reduces the rate at which cells consume energy. Preservation solutions also control swelling, acidity and ionic balance. Yet cold does not pause biology. It exchanges rapid warm injury for slower cold injury, and different tissues tolerate the exchange differently. A kidney can often survive a journey that a heart would not. A cornea has no blood vessels in its clear central tissue and can be banked under conditions unlike those required by a liver. Blood-forming stem cells may be collected, processed and sometimes frozen because individual cells can survive a route that a whole vascularised organ cannot. Tissue banks exploit other differences. Bone and tendons can be processed in ways that reduce living cells while preserving useful structure. Skin may provide temporary biological cover. A heart valve may be transplanted for its architecture more than for a full population of active donor cells. The word viable therefore means different things across the field.

Then comes a second injury. Restoring blood sounds wholly beneficial, but

reperfusion abruptly supplies oxygen to stressed cells and activates inflammatory and clotting pathways. Damaged mitochondria, reactive oxygen species, complement and white cells can turn rescue into further harm. Surgeons may see a transplanted kidney pinken and begin making urine, but visible recovery does not prove that every microscopic vessel has recovered. A graft can work immediately, work late, work poorly or never establish useful function.

This explains why time is counted so carefully. Warm ischaemia, cold ischaemia, storage, transport and implantation are related clocks rather than one universal deadline. A duration acceptable for one donor, organ and recipient may be wrong for another. Exact thresholds change with technique and programme, so the useful principle is more durable: preservation buys a declining probability, not a guaranteed reservation.

It also explains why machine perfusion matters. Instead of leaving an organ static in a cold container, a machine can circulate oxygenated fluid through its vessels at cold, cool or near-body temperature. The aim may be to reduce preservation injury, test function, deliver treatment or allow more time. A machine does not return an organ to innocence. It gives clinicians more information and more control over a living process that has already begun to change.

The first fact of transplantation is therefore physical rather than surgical. A graft becomes movable only by leaving the person and conditions that maintained its useful state. For a heart, usefulness depends on protecting living tissue until circulation returns. For a tendon, preserving architecture may matter more than preserving every donor cell. For blood-forming stem cells, the crucial property is the capacity to survive processing and engraft. Each starts a different clock. Everything that follows tries to keep the right property intact long enough to matter.

The Immune System Reads Ownership

The immune system was not designed to respect gifts. Its working question is whether a cell, pattern or signal belongs, threatens, or appears in the wrong place. A transplanted organ arrives carrying millions of cells whose surface markers were made from another genome. To the recipient, generosity and foreignness can occupy the same tissue.

Blood group is the first familiar layer. A and B antigens are not confined to red cells; they are also expressed on the lining of blood vessels in many organs. A recipient may already carry antibodies against a donor's incompatible blood-group antigen. When those antibodies bind inside a newly perfused graft, complement and clotting can damage vessels at speed. This is why ABO compatibility matters, why some incompatible living-donor transplants require specialised preparation, and why blood-group rules differ by organ and programme rather than reducing to one school chart.

Human leucocyte antigens, or HLA, form another layer. They are molecules used to present fragments of proteins to T cells. They vary greatly across people, which helps populations recognise a wide range of infections. The same diversity makes another person's tissue conspicuous. Recipient T cells may recognise donor HLA directly on cells carried in the graft, or recognise pieces of donor molecules after recipient cells process them. B cells can produce antibodies directed against donor HLA. The response is not one switch called rejection. It is a set of cellular and antibody pathways acting over different timescales. Damage adds another layer. Cells stressed by retrieval and reperfusion release signals that activate innate immunity, the faster arm of defence that does not depend on a precise HLA match. A well-matched organ can therefore arrive inflamed, and a poorly matched one can sometimes settle with effective treatment. Compatibility and organ condition interact rather than lining up as two independent scores.

Previous exposure changes the starting position. Pregnancy can expose a person to fetal HLA inherited from the other parent. Transfusions and earlier transplants can do the same. Some candidates become sensitised,

meaning they carry antibodies against a wide range of potential donors. Their apparent place on a waiting list can therefore be misleading: an offered organ may repeatedly be biologically unusable. Allocation systems may give extra priority to highly sensitised patients because ordinary waiting time alone would leave them stranded.

Matching reduces risk; it does not create identity. The closest HLA match may be important for some organs and cell transplants, while urgency, size, blood group and other factors can dominate elsewhere. Modern immunosuppression also permits many imperfect matches. The famous kidney transplant between identical twins in 1954 worked because the brothers were genetically near-identical, allowing surgeons to demonstrate that the operation could sustain life without having solved immune difference. The next problem was to make unrelated people tolerable to each other.

A crossmatch is one practical answer. Recipient serum is tested against donor cells or donor antigens to look for antibodies capable of reacting. A positive result may warn of immediate danger. Better antibody assays have made risk more visible, though visibility creates harder decisions: an antibody can be detected without dictating one certain outcome, and a negative test cannot promise permanent peace.

The deepest ambition is tolerance, a state in which the graft is accepted with little or no continuing general immunosuppression. It can occur in unusual circumstances and is an active research goal. Routine transplantation still depends on control rather than erasure. The immune system continues reading ownership. Medicine changes the consequences of the reading.

Success Is a Managed Compromise

The simplest account says that anti-rejection drugs prevent rejection. The better account begins with a dosing problem that has no clean answer. The recipient needs enough immune restraint to protect the graft, while retaining enough defence to control infection, abnormal cells and the ordinary damage of daily life. The safe middle moves with time, organ, age, other illness, previous exposure and the drugs themselves.

Treatment often starts intensely. Induction therapy around the operation can suppress or deplete parts of the immune response while the graft is most inflamed and foreign antigens are abundant. Maintenance treatment then uses combinations of drugs that interfere with T-cell activation, proliferation or other immune pathways. Using several mechanisms can reduce reliance on one toxic dose. It also creates interactions, monitoring demands and several routes to harm.

Rejection is classified partly by mechanism and timing. Hyperacute rejection, now uncommon where testing is reliable, can follow pre-existing antibodies and damage vessels soon after blood flow begins. Acute cellular or antibody-mediated rejection may arise later and can sometimes be reversed if detected and treated. Chronic graft injury is less tidy. Immune damage, drug toxicity, recurrent disease, infection, high blood pressure, metabolic stress, ageing and the condition of the donated organ can converge. A graft may lose function gradually without one dramatic episode explaining the decline.

The medicines carry their own price. Suppressing immune surveillance increases susceptibility to infections and some cancers. Calcineurin inhibitors, central to many regimens, can injure kidneys and contribute to high blood pressure, diabetes and neurological effects. Steroids affect bone, muscle, mood, glucose and appearance. Other agents suppress marrow or upset the gut. The balance is not the same for a young kidney recipient, an older liver recipient or a child after heart transplantation. It changes again when infection appears, pregnancy is considered or the graft begins to fail. Drug concentrations vary with absorption, genes, food, liver and kidney

function, and interactions with antibiotics or other medicines. Monitoring a blood level is therefore a way of estimating exposure, not proof that the immune system is perfectly controlled.

This is why transplant follow-up is permanent. Blood tests measure organ function and drug concentrations. Biopsies may distinguish immune injury from other causes. Viral loads, cancer screening, vaccination, cardiovascular risk and bone health enter the same long record. Adherence matters because some drugs have narrow therapeutic ranges and missed doses can expose the graft to immune attack. Yet describing non-adherence as careless can conceal cost, side effects, depression, unstable housing, confusing regimens or the wish to stop feeling like a patient.

Success also needs several denominators. Patient survival asks whether the person is alive. Graft survival asks whether the transplanted part still functions, sometimes counting death with a working graft as failure and sometimes separating it. Function, freedom from dialysis, hospital admissions, side effects, fertility, work and quality of life answer different questions. A transplant can extend life while imposing a heavy treatment burden. A patient can survive after a graft fails. An organ can function when the recipient dies from another cause.

The language of cure therefore misleads. A transplant may replace a lethal or disabling condition with a longer life under active management. That is a remarkable exchange. It remains an exchange.

Donation Must Be Legitimate Before It Is Useful

A graft can be biologically suitable and still be unavailable because it was not obtained legitimately. Donation begins with a question that matching and preservation cannot answer: may cells, tissue or an organ be taken from this person, under these circumstances, for another person's benefit?

A deceased donor is not created by a transplant team deciding that another patient needs organs. Donation becomes possible only after a separate clinical process has concluded that treatment can no longer save or benefit the patient, and after death has been diagnosed and confirmed under the

rules applying in that country and setting. Keeping those decisions separate is central to legitimacy.

There are two broad deceased-donation routes. In donation after death confirmed using neurological criteria, a patient with devastating brain injury remains mechanically ventilated while doctors apply a formal standard. The current UK Code treats death as one state, defined by permanent loss of the capacity for consciousness together with permanent loss of the capacity to breathe. Its clinical wording is *diagnosis and confirmation of death using neurological criteria*. Circulation and some bodily functions can continue temporarily under ventilation after death has been confirmed, which is why a family's visual experience can conflict with the diagnosis. Terminology, tests and law differ elsewhere.

In controlled donation after circulatory death, treatment is withdrawn because it is no longer beneficial, circulation stops, death is confirmed after the required observation and safeguards, and retrieval may then begin. The intervals and procedures are defined by law, professional guidance and local protocols. The family must be able to trust that withdrawal would have occurred even if donation were impossible. Some programmes also practise uncontrolled donation after unsuccessful resuscitation, with a different sequence and safeguards. Donation does not cause the decision; it changes what may follow it.

Consent is equally setting-specific. Some countries require explicit registration. Some presume or deem consent for eligible adults unless they opt out. Some use authorisation by next of kin. The legal label does not describe the whole practice. In the United Kingdom, specialist nurses check recorded wishes and involve the family. Donation may fail when relatives do not know what the person wanted, when circumstances make support impossible or when clinical criteria are not met. Opt-out legislation can change the starting presumption, but it cannot supply intensive-care capacity, trained staff, timely referral or confidence in the service. Organ donation is possible after only a small fraction of deaths because circulation, timing, location, infection, cancer and organ condition matter. Tissue

donation can remain possible in wider circumstances and on a different timetable. Register totals therefore describe expressed wishes, not a reserve of organs waiting to be collected.

The family conversation occurs under severe strain. A relative may look warm, have a pulse and be supported by machines while being told that death has been confirmed. Another family may be asked about donation soon after agreeing that life-sustaining treatment should stop. The clinical distinction can be exact while the emotional transition remains difficult. Treating hesitation as ignorance is a poor way to protect trust.

Living donation changes the moral structure. A blood-forming stem-cell donor may undergo injections and a collection procedure. A kidney donor loses a whole organ. A liver donor undergoes a major resection. These risks are not interchangeable, and the donor usually begins healthy and receives no clinical benefit from the donated material. Teams therefore assess anatomy, general health, psychological readiness, coercion, financial pressure and whether the risk is acceptably low. Independent scrutiny matters because affection can produce both generosity and pressure. A person may freely want to accept a risk that clinicians still judge excessive.

All donation rests on a social licence. People must believe that death is confirmed honestly, consent is respected, bodies are treated with dignity, allocation is fair and no hidden market decides whose need counts. This trust is not sentimental decoration around the science. It is part of the supply chain.

Scarcity Turns Medicine Into Allocation

An organ offer is not a prize awarded to the person who has waited most patiently. Nor is there one universal waiting list. Different organs fail in different ways, can travel for different lengths of time and require different anatomical and immunological fits. Allocation systems are therefore organ-specific attempts to turn several competing values into repeatable decisions.

Urgency is one value. A patient with rapidly failing liver function may have

days, while a person with kidney failure can sometimes remain alive on dialysis for years, although dialysis carries serious burdens and risks. Expected benefit is another. An organ that could function for many years may produce more benefit in a recipient likely to survive long enough to use it. Compatibility matters because an offer that triggers immediate immune destruction helps nobody. Size matters for hearts, lungs, livers and children. Geography matters because travel consumes preservation time. Waiting time matters because without it some people would be passed over indefinitely.

No formula can maximise all of these at once. Giving absolute priority to the sickest can direct organs towards people least likely to survive the operation. Maximising predicted life-years can disadvantage older people, disabled people or those whose medical records reflect unequal access to earlier care. Prioritising perfect compatibility can lengthen waits for groups whose HLA types are less common in the donor pool. Giving local candidates first access can preserve organs efficiently while producing regional inequality.

The algorithms also inherit the world that feeds them. Referral for transplantation depends on diagnosis, clinician judgement, centre capacity and whether a patient can complete assessment. Listing may require evidence that surgery and long-term treatment are likely to be tolerated. Social support, travel, language, housing and ability to attend appointments can affect this judgement, even where ability to pay does not formally decide access. A technically neutral criterion can therefore reproduce unequal conditions outside the transplant centre. Biology and population history enter too. HLA types vary in frequency, so candidates whose tissue types are less common among registered donors may wait longer for a compatible offer. Broad ethnic labels do not define an individual's match, but unequal donor representation can still affect access. Fairness may require changing recruitment, sharing and priority rather than pretending the pool is socially neutral.

Highly sensitised kidney candidates show why correction is sometimes built

into allocation. A patient with antibodies against many donor HLA types may receive frequent offers that fail crossmatching. Extra priority and broader sharing can compensate for that biological disadvantage. Paediatric priority can recognise that childhood growth, development and lifetime treatment burdens differ from adult cases. These are not departures from fairness. They are rival accounts of what fairness requires.

Allocation also decides which risks are acceptable. An older organ, an organ from a donor with certain infections, or one that has suffered more warm ischaemia may carry a higher chance of poor function. The relevant comparison is often not between that organ and an ideal one. It is between accepting now and remaining exposed to illness or death while waiting. Consent to such an offer should therefore concern the real alternatives, not a fantasy stockroom containing a perfect replacement.

Scarcity also creates pressure for markets. Payment for an organ is different from reimbursing a donor's lost earnings, travel or care. The first makes access to a body part depend on purchasing power and can transfer medical risk towards people whose poverty weakens their freedom to refuse. Organ trafficking may involve invalid consent, financial gain, coercion, deceptive recruitment or the movement of organs obtained through abuse. Its scale is difficult to measure because the activity is hidden and definitions vary. The governing principle is clearer than any estimate: increasing supply by making vulnerable people the inventory is not an allocation solution. Ethical systems need lawful donation, transparent costs, traceability and long-term donor care.

Public systems publish policies, audit outcomes and revise models because these choices need reasons. Yet mathematical precision can disguise judgement. A score may be calculated to two decimal places while resting on a disputed choice about urgency, benefit or equity. Allocation is medicine under scarcity, and scarcity makes ethics operational.

A Transplant Is a System, Not an Operation

The surgeon's work is indispensable and visually dominant. It is also one segment in a chain that can fail long before an incision or years after the wound closes.

For the recipient, the chain begins with recognition that organ failure has reached a point where transplantation might offer more benefit than alternatives. Assessment then asks whether the patient can survive the operation, whether infection or cancer would make immunosuppression dangerous, whether blood vessels and anatomy permit implantation, and whether long-term treatment is feasible. A committee may decline, defer or list. Being listed means eligible for consideration, not promised an organ.

For a deceased donor, another chain runs in parallel. Hospital staff must recognise potential donation, refer at the right time, stabilise circulation and oxygenation, confirm death using the applicable criteria, identify consent, support relatives, test blood and tissues, characterise organ function and disclose risks. Retrieval teams travel to the donor rather than moving the donor to one national workshop. Several organs may be recovered for several recipients at several centres. One donor can therefore create a scheduling problem across a country. Identity and traceability must survive every handover. Blood samples, labels, vessels, transport boxes and electronic records have to refer to the same donor, organ and intended recipient. A clerical error can defeat excellent medicine with no biological warning.

At the hub, data become offers. Blood group, size, HLA, antibodies, urgency, location and allocation policy narrow the candidates. A transplant centre reviews the organ and donor information, contacts the intended recipient, checks current health and decides whether to accept. The answer may change when inspection, biopsy or perfusion reveals damage. Refusal is not necessarily waste, and acceptance is not proof of safety. Both are decisions under incomplete information.

Transport joins the theatres. Labels, packaging, temperature, identity and

timing must remain correct while roads, weather and aircraft behave normally or fail to. The recipient operation may begin before the organ arrives so diseased tissue can be removed and vessels prepared, but timing that too aggressively creates a different danger. In kidney transplantation the native kidneys are often left in place; a donated kidney is commonly positioned lower in the abdomen and connected to nearby vessels and bladder. Other organs demand different reconstruction. General operative craft belongs to surgery. Transplant surgery adds the problem of integrating tissue that is injured, foreign and scarce.

After reperfusion, responsibility spreads again. Intensive-care staff manage circulation, ventilation and bleeding. Laboratories measure drug levels, antibodies and infection. Pathologists read biopsies. Pharmacists detect interactions. Coordinators organise appointments and communication. Primary care, dentists, dermatologists, cancer services, obstetric teams and emergency departments may all need to understand the immunosuppressed state. The graft's future depends on whether the system remains joined after discharge.

Tissues and cells reveal the model's range. A cornea can restore optical clarity without the vascular connections of a kidney and often requires less systemic immune suppression. In an allogeneic blood-forming stem-cell transplant, cells enter through a vein and rebuild marrow rather than being stitched into place. The immune direction can even reverse: donor white cells may attack the recipient in graft-versus-host disease, while the same donor response can attack residual leukaemia. The transplant is biologically powerful precisely because it moves a living system, not inert material.

The Donor Pool Can Widen, Never Become Free

The 1954 kidney transplant with durable function crossed the immune barrier by using an identical twin. Modern transplantation expanded by refusing to wait for such exceptional circumstances. Each expansion has altered one constraint while exposing another.

Living kidney donation uses renal reserve: one healthy kidney can usually

sustain the donor's ordinary filtration needs, but the donor permanently loses reserve. Partial liver donation uses the liver's capacity to regenerate mass in donor and recipient. These routes can schedule operations, shorten waiting and provide organs that have spent little time without blood. They also place a healthy person under anaesthesia and leave them with less tissue than before. Good outcomes do not erase that asymmetry. The ethical standard must remain stricter for the person who does not need the operation.

Paired exchange addresses incompatibility. If donor A cannot safely give to recipient A, and donor B cannot give to recipient B, the system may find a crosswise match. Larger pools permit chains involving several pairs and sometimes an altruistic donor. The innovation is organisational as much as surgical: a computer search, common testing standards, trust between centres and coordinated theatres turn several failed pairs into a sequence of transplants. Exchanges may use simultaneous operations where a broken promise could collapse the arrangement, while non-simultaneous chains depend on carefully governed commitments. The spare capacity is created by coordination, not by finding extra kidneys.

Deceased donation has widened too. Donation after circulatory death now supplies a large share of UK deceased donors. Split-liver techniques can allow one liver to serve two recipients in selected circumstances. Programmes consider older donors and organs with conditions once treated as automatic exclusions. The label sometimes used is expanded-criteria donation, but the important move is comparative. The organ is assessed against the recipient's risk of waiting, not against a youthful ideal donor who may never appear.

Normothermic regional perfusion can restore warm oxygenated circulation to abdominal organs after death has been confirmed following circulatory arrest. In the current UK protocol, clamps and an open aortic vent isolate the abdominal circuit, with immediate stop-and-check steps if heart contractions return. The design aims to prevent blood reaching the brain. Ex situ machine perfusion circulates fluid through an organ outside the body. These

methods may improve preservation, permit functional assessment and increase use. They also require equipment, staff, protocols and ethical clarity. A reading from a machine is evidence under defined conditions, not a certificate of future performance.

Xenotransplantation pushes the boundary farther. Pigs are anatomically suitable for several organs, can be bred under controlled conditions and can be gene edited to remove or alter some molecules that provoke human immune and clotting responses. Gene-edited pig kidneys have moved from decedent studies and individual experimental procedures into registered early human trials. That is a change in research status, not proof of routine efficacy or durability. Rejection, coagulation, infection, animal welfare, scalable production, lifelong surveillance and the possibility of pathogens crossing species remain material questions.

Engineered tissues and regenerative medicine may eventually replace some donated structures, but whole organs contain branching vessels, specialised cells, nerves, ducts and mechanical architecture arranged at several scales. Growing a cluster of cells is not the same task as producing a transplantable liver.

The causal loop closes here. Once a graft is separated from the body and environment that sustained it, an organ-specific, tissue-specific or cell-specific clock begins. Every method that buys time or crosses greater biological distance can make more transplants possible. It also creates new injury, new uncertainty and new claims on shared resources. The donor pool can grow. It cannot become costless.

How It Actually Works

Before the body became movable

Replacing damaged tissue is an old ambition, but for most of history the body set a hard boundary. Skin could be shifted from one place to another on the same person because it carried the same biological identity. Teeth and pieces of tissue were sometimes transferred between people, usually with poor evidence and worse infection control. The deeper problem was hidden. Surgeons lacked anaesthesia, antisepsis, vascular suturing, blood-group knowledge and any account of immune rejection. Even if a part could be attached, there was no reason for it to remain alive.

Skin grafting exposed the first useful distinction. An autograft, moved within one body, could take because blood vessels grew into tissue that the immune system recognised as its own. An allograft from another person might appear to heal and then fail. The same hands and technique could produce opposite outcomes. Something inside the recipient was keeping a record of ownership.

At the start of the twentieth century, vascular surgery supplied another missing piece. Alexis Carrel developed methods for joining blood vessels with fine sutures and performed organ-transplant experiments in animals. The work showed that vessels could be reconnected without immediate leakage or clotting ending every attempt. It did not solve rejection. An organ could now be plumbed into another body and still be destroyed for reasons the plumbing could not explain.

Blood transfusion had already taught medicine that one person's material could be harmless to one recipient and dangerous to another. Karl Landsteiner's ABO work made catastrophic incompatibility intelligible and helped turn transfusion into a controlled practice. Organs added a harder problem. Their vascular lining expresses blood-group antigens, but their cells also display HLA and many other differences. A safe transfusion rule was therefore a foundation, not a transplant matching system.

The cornea provided a partial exception. In 1905, Eduard Zirm transplanted corneal tissue from a deceased donor into a labourer whose eyes had been damaged by lime. One graft remained clear and restored useful sight. The cornea's relative lack of blood vessels and its local immune environment reduce some of the barriers faced by a kidney or heart. Its success was not a preview of easy organ replacement. It was evidence that different tissues occupy different immunological worlds.

Rejection acquires a mechanism

War forced the skin question into clinics. During the Second World War, Peter Medawar studied grafts used on badly burned patients. Skin taken from another person could provide temporary cover, but repeated grafts from the same donor were rejected more quickly. That acceleration mattered. Mechanical failure or poor nutrition should not remember a previous donor. An adaptive immune response could.

Medawar and other immunologists turned rejection from a mysterious property of flesh into a biological process. In experiments with Rupert Billingham and Leslie Brent, exposure to foreign cells early in life could produce acquired tolerance in mice. The work helped establish that the immune system learns distinctions and that those distinctions can, under special conditions, be altered. Medawar shared the 1960 Nobel Prize with Frank Macfarlane Burnet for discoveries concerning acquired immunological tolerance.

The practical problem remained severe. A surgeon could reconnect a kidney. The recipient's immune system could then destroy it. Irradiation and early drugs suppressed immune cells but also damaged marrow and defence against infection. The field needed enough control to protect the graft without making ordinary microbes lethal.

The twin experiment

On 23 December 1954, at the Peter Bent Brigham Hospital in Boston, a team led by Joseph Murray transplanted a kidney from Ronald Herrick to his identical twin, Richard. The operation used lessons from earlier kidney surgery and dialysis, but its decisive condition was genetic. As identical twins, they were genetically near-identical across the tissue markers that drive ordinary allograft rejection.

The transplant worked. Richard left dialysis and lived for years with the donated kidney. The case demonstrated that a human kidney could be removed from a healthy donor, implanted into another person and sustain long-term life, while the donor lived with one remaining kidney. Set beside failed allografts and the developing immunology, it strengthened the case that biological difference, rather than transplantation itself, drove rejection.

It also proved less than its reputation suggests. Most patients do not have an identical twin. The team had bypassed the defining problem rather than solved it. The operation opened a door through which almost nobody could yet walk.

The physical arrangement was less like removing one kidney-shaped socket and filling it. A donated kidney could be placed in the lower abdomen, connected to the iliac blood vessels and joined to the bladder, while the recipient's own kidneys often remained where they were unless they caused a separate problem. This route reduced surgical disruption and made the graft easier to examine or biopsy. It is a useful correction to the spare-part picture: successful replacement often means adding and rerouting rather than restoring the original layout.

Dialysis changed the moral pressure around kidney transplantation. It could keep some people alive while they waited, supplied a comparison against which transplant outcomes could be judged and allowed teams to prepare rather than operate only at the edge of death. It also made scarcity visible. Machines, staff and places were limited, and the decisions about who received dialysis anticipated later arguments over organs.

Chemical permission

The 1950s and 1960s were a harsh period of experimentation. Whole-body irradiation could reduce rejection but exposed patients to infection and marrow failure. Drugs developed in cancer and immune research were tried because they restrained rapidly dividing lymphocytes. Azathioprine, often combined with corticosteroids, made unrelated kidney transplantation more feasible. Episodes of rejection could sometimes be treated by increasing steroids rather than accepting immediate loss.

This was a change in the field's logic. The aim was no longer to find a recipient naturally identical to the donor. It was to create a temporary and incomplete biological permission. The price appeared quickly. Patients survived rejection and then died from infection. Drugs injured organs they were meant to protect. Teams learned by adjusting combinations, measuring function and studying failures that could not ethically be reproduced as controlled experiments.

Tissue typing improved at the same time. HLA science and crossmatching allowed clinicians to identify some dangerous donor-recipient combinations before surgery. Organ sharing widened the search beyond one hospital. A kidney from a deceased donor could be offered to a compatible recipient elsewhere, provided information and transport moved fast enough. Transplantation began to resemble a network rather than a heroic local experiment.

Blood-forming stem-cell transplantation followed a related but distinct route. High-dose treatment could destroy diseased or defective marrow, after which donor cells could repopulate blood formation. E. Donnall Thomas and others developed the method through repeated failures, better HLA matching, infection control and supportive care. Here the graft was a mobile population of cells. Its immune cells could attack the host, producing graft-versus-host disease, yet that same response could help eliminate remaining leukaemia. Foreignness was both treatment and danger.

The procedure also rearranged the meaning of transplant day. Before donor

cells arrive, conditioning chemotherapy or radiation may suppress marrow, disease and recipient immunity. The cells themselves are infused through a vein, often without an operation resembling solid-organ surgery. The dangerous interval follows as blood counts fall, infection risk rises and the graft attempts to engraft. Months or years later, the new blood and immune system may be largely donor-derived. The moved part has no stable organ shape, yet it can replace one of the body's deepest biological systems.

Liver, heart and the boundary of death

The kidney is paired, anatomically forgiving and supported by dialysis. The liver and heart offered less margin. A recipient could not wait through prolonged failure while a team learned slowly, and the operations demanded control of major vessels, bleeding and immediate organ function.

In 1963, Thomas Starzl's programme began human liver transplantation. Its early recipients died. Bleeding, clotting, preservation, infection and rejection combined faster than one technical correction could separate them. In 1967, the programme achieved sustained survival in several liver recipients. The achievement came from a system of changes: operative technique, anaesthesia, intensive care, donor management, immunosuppression and a willingness to revise a programme whose first results looked like defeat.

Heart transplantation carried an additional problem. A usable heart often came from a person whose circulation was being maintained by ventilation after catastrophic brain injury. The public and the law had to understand how death could be diagnosed when the chest still moved and the skin remained warm.

Teams including Norman Shumway's group at Stanford had spent years developing the operation in animals and studying rejection. On 3 December 1967 in Cape Town, Christiaan Barnard transplanted the heart of Denise Darvall into Louis Washkansky. The heart worked. Washkansky died eighteen days later from pneumonia while heavily immunosuppressed. Both facts belong in the same sentence of history. Surgery had crossed the technical barrier and exposed the biological bargain.

Heart transplants spread quickly, then contracted as poor survival and public unease caught up with the initial excitement. Professional standards for confirming death using neurological criteria developed during the same period. They were not invented solely to obtain organs: intensive care had created patients whose circulation could be supported after permanent loss of the capacities required by the governing definition of death.

Transplantation made the consequences of that definition unusually visible.

The ethical rule often called the dead-donor rule states that vital organs should be removed only from patients already dead and that retrieval must not cause death. Disputes continue over its philosophical basis and application, especially as circulation can be restored to selected organs after death is confirmed. Clinical programmes cannot resolve those disputes by speed or good outcomes. They need standards that keep death determination, family communication, retrieval methods and public explanation aligned. A technically successful programme that appears to blur the boundary can damage donation far beyond one case.

From experiment to service

Ciclosporin changed the balance around the end of the 1970s and start of the 1980s. Its more selective effect on T-cell activation allowed stronger protection against rejection than many earlier regimens with a different pattern of toxicity. Kidney, liver, heart and later lung transplantation became more reproducible. Tacrolimus and newer combinations refined control, though none removed infection, cancer, kidney injury or chronic graft loss.

Ciclosporin's success also created a durable irony. A drug that protected kidneys could itself damage them. Clinicians had to measure concentrations, combine agents and lower doses as early inflammation settled. The better the drugs became, the more the task shifted from administering a powerful medicine to maintaining a changing exposure. Pharmacology turned rejection from an immediate verdict into a long negotiation, then made monitoring part of the treatment rather than proof that treatment had ended.

The field professionalised around the drugs. Registries compared centres and eras. Allocation organisations separated organ offering from the discretion of one surgeon. Specialist nurses supported donor families. Histocompatibility laboratories ran at all hours. Retrieval standards, packaging, traceability and adverse-event reporting became as important as the stitch. A transplant programme became accountable for who was assessed, who was listed, which organs were accepted, and what happened years later.

National sharing altered professional authority. An organ no longer belonged, even informally, to the hospital that identified the donor. Data entered an allocation process, offers moved through ranked candidates and centres had to record acceptance or refusal. This widened access and made patterns auditable, but it also produced a new form of discretion. A surgeon or multidisciplinary team still had to decide whether the organ described on a screen was suitable for the particular patient waiting at home. Policy could rank the offer; it could not perform the final judgement.

Living donation expanded from identical twins to relatives, partners, friends and anonymous donors. Better imaging and minimally invasive kidney removal reduced, without erasing, donor burden. Paired exchange turned incompatible relationships into compatible networks. Partial-liver donation demonstrated regeneration while introducing a larger donor operation and a small but serious risk of death or lasting harm.

Tissue transplantation grew on another scale. Corneas, heart valves, skin, bone and tendons could be recovered, processed and banked under distinct rules. Some restored sight or movement; some repaired defects; some carried lower rejection pressure because they contained fewer living immune targets or lacked a direct blood supply. They still required consent, screening, traceability and control of contamination. The word transplant covered a family of transfers, not one operation enlarged or reduced.

The current chain

For the intended recipient, the chain often begins with a call rather than a scheduled admission. The person may travel to hospital while another team is still retrieving or examining the organ. Blood is taken, infection and current health are checked, and the risks of that donor are discussed. Surgery may be cancelled because the organ is damaged, another candidate has greater priority, transport fails or the recipient is temporarily unsafe to operate on. That cancelled night can be a sign that the safeguards worked, although it feels nothing like success to the person sent home.

By the year ending 31 March 2026, the United Kingdom recorded 1,428 deceased organ donors and 1,017 living donors. Those donations led to 4,666 organ transplants. Donation after circulatory death supplied more deceased donors than donation following death confirmed using neurological criteria. The figures show how thoroughly practices once described as marginal have entered the main service.

The same report recorded 8,296 active waiting-list patients at year end, with thousands more temporarily suspended. It also estimated that about 64,800 people in the UK were living with a functioning transplant, while warning that counts across organ groups can include people more than once. A current service must therefore manage two populations at the same time: people waiting for a scarce graft and people whose earlier transplant needs lifelong support.

That support includes the possibility that success will reverse. A kidney graft can fail gradually and return its recipient to dialysis. A heart, liver or lung recipient may need assessment for another transplant while carrying the effects of the first operation and years of immune suppression. Re-listing creates a difficult comparison between prior benefit, current urgency, new antibodies and the claims of candidates who have never received an organ. Some patients are too unwell for another procedure. Others live with reduced graft function that is still better than the available alternative. The service therefore has no clean moment when one case ends. Failure, rescue, retransplantation and palliative care all sit on the same continuum.

Machine perfusion is altering the middle of the chain. UK programmes now use or evaluate cold and normothermic systems for kidneys, livers, lungs and other organs, along with normothermic regional perfusion after circulatory death. An organ can be supplied with oxygen, nutrients and sometimes blood at controlled pressure. Teams can observe flow, chemistry or function instead of judging only from donor history and appearance. The promise is better selection and less avoidable injury. The danger is treating new measurements as more certain than their validation permits.

Perfusion also changes time without making time irrelevant. A liver producing bile or clearing lactate on a warm circuit supplies evidence that static storage cannot. A kidney showing flow and resistance may look more or less promising. Lungs can be ventilated and assessed outside the body. Yet the measurements are organ-specific, device-specific and linked to protocols still being tested. Teams need to know whether a threshold predicts recipient benefit, not merely whether the machine can produce a reassuring number. Better observation is valuable because uncertainty remains.

Registered early human trials of gene-edited pig kidneys now exist. This is a more formal stage than a decedent study or individual experimental procedure and a much earlier stage than routine care. The transplant must survive human antibodies, complement, clotting, cellular immunity and chronic biology. Regulators must also consider infections that could affect contacts or the wider public. A recipient may therefore accept lifelong monitoring partly for a risk that belongs to other people.

The field began by moving tissue faster than it died and suppressing a response it barely understood. It now tries to assess, condition and sometimes repair tissue before implantation, while writing scarcity and risk into national systems. The operation became safer by becoming less solitary.

How we know

Transplant evidence is unusually rich and unusually selective. National registries record donors, offers, waiting lists, procedures and outcomes, but definitions differ by country, organ and era. Patient survival, graft survival, death-censored graft survival and function are not interchangeable. Centre results also reflect whom centres accept and which organs they use.

Historical accounts draw on operative records, case series, laboratory work, memoirs and later interviews. Pioneer memoirs preserve technical detail while defending programmes, priorities and decisions. Early failures were not always reported as completely as successes, and famous firsts can hide the teams, donors and recipients that made them possible.

Current UK figures use NHS Blood and Transplant's completed *Activity Report 2025/2026*, covering 1 April 2025 to 31 March 2026 with data reported by 18 May 2026. Annual transplant totals are flows; waiting-list figures are point-in-time stocks. Xenotransplantation status was rechecked on 3 September 2026 against regulators and trial registries. Registration establishes that formal testing exists, not that efficacy, durability or ordinary availability has been shown. Exact clinical decisions remain organ-specific, centre-specific and personal.

What People Get Wrong

"A transplant is a cure"

The word replacement suggests completion. A failed organ is removed or bypassed, a working one takes over, and the disease is finished. The model is persuasive because function can improve quickly. A kidney recipient may stop dialysis. A liver recipient can regain chemistry that no machine could replace. A corneal graft can return a clear image.

The graft creates a new medical state. Immune suppression, infection risk, drug toxicity, cancer surveillance, recurrent disease and chronic graft injury continue. Some recipients need biopsies, repeated procedures or another

transplant. Others live for decades with excellent function. Those outcomes are compatible because cure is the wrong category. Transplantation exchanges one set of risks for another and can make the exchange overwhelmingly worthwhile. The disease that damaged the original organ may also recur in the graft, while unrelated illness can become more important as recipients live longer. Long survival expands the work rather than closing the case.

The correction matters for consent and public language. A patient should not be judged ungrateful for struggling after a successful operation, and a functioning graft should not make side effects disappear from outcome reports. Survival, function, independence, treatment burden and quality of life need separate attention.

"A close match means the body will accept it"

Matching is often described as though clinicians search for the biological equivalent of the recipient and then remove rejection from the problem. Identical twins made the first durable kidney success famous, and the language of matches encourages the idea that modern programmes repeat that solution at scale.

Most solid-organ transplants cross many genetic differences. Blood-group rules, HLA, donor-specific antibodies, organ type and crossmatching help estimate or avoid parts of the risk. They do not make donor cells become self. Immunosuppression remains necessary for most recipients, and rejection can occur despite a favourable match. The reverse is also true: an imperfect match can work for years because modern treatment controls responses that matching alone cannot prevent. Matching priorities differ between kidneys, livers, hearts and blood-forming cells, so a number presented as decisive in one service may be secondary in another.

Stem-cell transplantation complicates the slogan further. A close HLA match can reduce graft-versus-host disease, but donor immune cells remain capable of attacking the recipient. Matching is risk reduction within a larger system, not a promise of acceptance.

"The operation is the hard part"

Surgery supplies the image everyone remembers: clamps released, colour returning, a new heart beating. It deserves the attention. Yet many transplant failures occur because another link breaks. A potential donor is not referred. Consent is unknown. An organ is damaged before retrieval. A test reveals antibodies. Transport runs late. Infection appears under immune suppression. A drug is missed or interacts with another prescription. Chronic injury accumulates without spectacle.

The operation became repeatable because the surrounding system matured. Intensive care keeps donors stable. Laboratories type tissues and detect antibodies. Allocation organisations find recipients. Couriers protect time and identity. Pharmacists manage narrow drug ranges. Registries reveal patterns no single surgeon could see. Follow-up teams maintain the compromise for years.

This correction changes what improvement looks like. A better suture may matter less than earlier referral, a faster laboratory, clearer family communication, reliable transport or a safer medicine regimen. Transplantation advanced when heroic surgery became institutional routine. That routine includes correct labels, current contact details, refrigerated transport, weekend laboratories and a pharmacist who notices an interacting antibiotic before the next dose.

Organ non-use shows why the surrounding judgement matters. An offer may pass through several centres because the donor history, injury or transport time creates unacceptable risk for their intended recipients. One refusal can be prudent; a repeated pattern can reveal avoidable caution, poor information or uneven expertise. Counting discarded organs without examining the decisions can punish safety. Ignoring the pattern can protect waste. The improvement problem is therefore diagnostic, not rhetorical.

"Only brain-dead people can donate organs"

The belief comes from the history of heart transplantation and from intensive-care images of ventilated donors. Donation after death confirmed using neurological criteria remains important because circulation can be maintained temporarily until retrieval, limiting warm injury.

It is not the only route. In controlled donation after circulatory death, treatment that no longer benefits the patient is withdrawn, circulation stops, death is confirmed under the applicable standard and retrieval then begins. Some programmes also use uncontrolled donation after unsuccessful resuscitation. In the United Kingdom, the circulatory route now accounts for more deceased donors than the neurological-criteria route. Kidneys, livers, lungs and other organs may be donated depending on the circumstances and programme.

The distinction matters because each route has different timing, preservation and communication challenges. It also prevents one country's terminology from being treated as universal biology. Death determination is governed by professional standards and law, while organ viability depends on what happens before and after circulation stops. Tissues may also be donated after deaths that would not permit solid-organ recovery, making the public category of deceased donor wider than one intensive-care pathway.

"Doctors stop treatment to obtain organs"

This fear persists because donation often becomes possible near the moment treatment ends. The same hospital contains a dying patient and people hoping for organs. Without clear separation, a conflict of interest seems built into the scene.

The governing principle is that decisions about futile or non-beneficial treatment and the diagnosis of death are made independently of the needs of transplant recipients. Donation is considered only within that framework. Specialist donation teams may support the process, but they do not create the underlying decision that recovery is impossible. Families are involved, recorded wishes are checked, and legal safeguards apply.

No system deserves trust merely because it states these rules. Practice must make the separation visible, audit it and communicate it under pressure. A family's uncertainty may reflect the difficulty of the situation rather than hostility to donation. Recorded consent helps because relatives do not have to reconstruct a decision from silence. It does not turn a bereaved family into a procedural obstacle that can be ignored. The correction matters because dismissing the fear can damage the trust on which deceased donation depends.

"The waiting list is first come, first served"

A line feels fair because everyone can see the rule. Organ allocation cannot use one line without producing avoidable deaths and unusable matches. A liver candidate in immediate danger, a kidney candidate with rare compatibility, a child needing a size-appropriate organ and a distant recipient separated by preservation time present different claims.

Real policies combine factors such as urgency, compatibility, expected benefit, waiting time, age rules, size and geography. The weights differ by organ and country and are revised as outcomes and values change. Some systems give added priority to highly sensitised patients because repeated incompatible offers would otherwise make their waiting time almost meaningless. Candidates can also be temporarily suspended when infection, surgery or changing health makes transplantation unsafe, so headline list totals contain different clinical states.

This does not make allocation objective in the sense of value-free. It makes values explicit enough to operate and review. A score can conceal judgement behind arithmetic, so the right question is not whether an algorithm is used. It is which disadvantages it recognises, which outcomes it rewards and who loses when the weights change.

"Pig organs are about to end the shortage"

The claim sounds plausible because several barriers have moved at once. Gene editing can alter pig molecules that provoke human antibodies and clotting. Better immune suppression and pathogen-controlled breeding reduce other risks. Pig kidneys have been studied in deceased human models and individual living recipients, and registered early trials now exist.

That is evidence of entry into clinical research, not evidence of a solved supply problem. A registry entry establishes the existence of a study; it does not establish benefit. Durability remains uncertain. Rejection pathways can emerge after initial function. Coagulation, growth, anatomy and drug burden require study. Known and unknown infections raise a public-health issue beyond the recipient, which is why long follow-up and limits on contact or tissue donation may form part of research protocols. Animal welfare and the acceptability of breeding pigs as organ sources remain ethical questions rather than technical debris.

The correction protects progress from hype. Xenotransplantation may become important even if it first helps selected patients under demanding surveillance. Promising work becomes easier to judge when it is not required to end scarcity on a headline timetable. Even a dependable pig organ would need manufacturing standards, specialised teams, fair eligibility rules and public funding. Biological abundance would not remove institutional scarcity.

Use It

Follow the chain, not the photograph

A transplant photograph usually shows one moment: an organ in a bowl, a retrieval team, a recipient leaving hospital. The useful unit of analysis is the entire chain. Ask how a potential donor was recognised, how consent was established, how tissue was assessed, how an offer was allocated, how time was controlled, how the recipient was prepared and how the graft will be maintained.

This lens travels beyond medicine. Systems fail at handovers because each specialist can perform well while the whole sequence performs badly. A laboratory result that arrives after an organ has been accepted is not a good result delivered late; it is a failed part of allocation. A perfect operation followed by fragmented medicine review is not a complete success. Measure the joins.

Separate the outcome being claimed

When someone says transplantation has a high success rate, ask what survived, for how long, in which patients and under which definition. Patient survival, graft survival, organ function, freedom from dialysis, rejection-free survival and quality of life are different outcomes. A centre can improve graft survival by accepting lower-risk recipients or refusing difficult organs. A new preservation method can increase organ use while changing the risk profile of the organs transplanted.

The same discipline applies to most health claims. A surrogate marker is not a lived outcome. An average does not describe the distribution. A five-year estimate from one era may not answer a newly diagnosed patient's question. Precision begins by naming the denominator.

Then ask who entered the denominator. A survival curve for transplanted patients excludes people never referred, declined at assessment, removed from the list or dying before an offer. It can answer how selected recipients fared without answering how a whole population with organ failure fared. The missing group may be the policy problem.

Ask where the risk moved

Innovation often reduces one danger by transferring it. Living donation can shorten a recipient's wait by placing operative risk on a healthy donor. Stronger immunosuppression can reduce early rejection while increasing infection or drug toxicity. Using an older organ can reduce waiting-list exposure while raising the chance of shorter graft life. Machine perfusion can improve assessment while consuming equipment, staff and money that might have been used elsewhere.

Risk transfer is not proof that an intervention is wrong. It is a demand for complete accounting. Identify every affected person: donor, recipient, family, other candidates, staff and the public. Xenotransplant infection surveillance makes this especially plain because a research participant may carry obligations intended partly to protect people who receive no organ.

Read an allocation rule as a moral document

An allocation score can look like neutral calculation. Translate it back into sentences. How much priority goes to immediate danger? How much to predicted years of benefit? Does waiting time compensate for earlier disadvantage? How are children treated? What happens to people with uncommon blood groups or antibodies against many donors? How much weight does distance receive because the organ cannot travel safely forever?

Every answer favours some claims over others. The value of an algorithm is that it can make decisions consistent, fast and auditable. Its danger is that judgement disappears into coefficients. Public fairness requires both the rule and a plain account of what the rule is trying to protect.

Then compare the stated aim with the pattern produced. Do some groups wait longer after clinical need is considered? Does a transport rule protect viability while disadvantaging remote regions? Do prediction models inherit poorer historical outcomes from patients who previously received worse care? A fair intention cannot validate an opaque effect. The useful response is repeated audit, public explanation and revision, not the claim that mathematics has removed judgement.

Distinguish consent law from donation capacity

Changing from opt-in to opt-out consent can alter the legal starting point. It does not manufacture suitable donors. Most deaths do not occur under circumstances that permit organ donation. Potential donors can be lost through late referral, physiological instability, limited intensive-care capacity, incomplete conversations, unknown wishes or family opposition. Organs may be offered and then declined because risk or damage is too great.

So evaluate donation policy across the full conversion path: eligible deaths, referrals, approaches, consent or authorisation, retrieval, organs recovered, organs transplanted and recipient outcomes. A larger register is useful but not equivalent to more transplants. Public campaigns that imply otherwise may create disappointment and blame families for failures produced elsewhere in the system.

Do not turn people into supply

The phrase donor-pool expansion sounds like finding stock in a forgotten warehouse. In practice it means accepting organs, donors or procedures that earlier systems judged too risky, too complex or too uncertain. Donation after circulatory death, older donors, infection-positive donors under selected treatment, split organs, paired exchange and machine perfusion can all increase use. Each requires new consent language, evidence, expertise and follow-up.

The disciplined question is not whether the organ is ideal. It is whether using it produces a better expected path than waiting, for this recipient, under transparent conditions. The answer can be yes without pretending the added risk is zero. A system improves when it becomes better at making bounded comparisons, not when it relabels uncertainty as opportunity.

The same danger appears in transplant language that favours gifts, miracles and second chances. These words can express real gratitude. They can also flatten the donor into a source and the recipient into a moral debtor. Deceased donors had lives and families before they had organs. Living donors remain patients after the operation. Recipients do not owe a particular emotion, public story or perfect use of the graft.

This lens matters whenever help creates a relationship without direct contact. Gratitude can coexist with grief, ambivalence and fear. Respect is better protected by consent, privacy, donor care and honest outcome reporting than by requiring everyone to inhabit an uplifting narrative.

Correspondence between donor families and recipients is often mediated and anonymous, with rules intended to protect both sides. Some people

seek contact; others do not. Neither choice determines the moral value of the donation. A gift can be honoured without converting grief or survival into a public relationship.

The limits

This book cannot tell any individual whether to donate, accept an organ, join a waiting list or choose a transplant centre. Those decisions depend on organ, disease, age, anatomy, antibodies, alternatives, local policy and personal values. Average outcomes cannot substitute for a clinical team that knows the case.

The evidence has structural limits too. Randomised trials answer some drug and preservation questions, but many allocation and donor decisions cannot be randomised ethically or practically. Registry comparisons are powerful and vulnerable to selection. Centres that accept harder cases can look worse. Definitions change. Early transplant history reports successes more readily than unrecorded failures, while memoirs place pioneers at the centre of work done by teams.

There is also no single global system. Consent, death determination, organ payment, allocation and access differ across countries. A principle defensible in a publicly funded national service may operate differently where insurance, geography or private payment shapes care. The UK examples in this book are examples, not templates for every jurisdiction.

And transplantation cannot solve the conditions that create organ failure. Prevention, blood-pressure control, vaccination, safer work, clean air, infection treatment, maternal care and equitable access to ordinary medicine may avert more suffering than additional transplant capacity. The dramatic rescue should not obscure the quieter system that could reduce the need for rescue.

The one thing to keep

Keep the chain.

A transplant is often described as one person's death giving another person

life. That sentence catches the emotional truth and misses the working truth. Between the two people lies a chain of diagnosis, consent, preservation, matching, allocation, transport, surgery, immune control and long follow-up. Every link protects something different: life, autonomy, tissue, fairness, identity, safety or trust.

The chain explains both the achievement and the limit. Medicine can make a heart beat in another chest, a kidney filter another person's blood, a cornea transmit light and donor marrow build a new immune system. It cannot make the transfer biologically free, ethically private or permanently finished. Foreign tissue remains alive because many people keep managing the consequences of its movement.

Once you see that, the phrase moving parts between people changes. The parts are living. The people include donors, recipients, families and everyone waiting. The movement is a public institution disguised as an operation.

Terms

Transplantation

Moving cells, tissue or an organ to restore function. Material may come from the same person, another human or another species, creating different immune and ethical problems.

Graft

The transplanted material: an organ, skin, cornea, bone, tendon or blood-forming cells. A graft may supply living cells, preserved structure or both. Graft survival and patient survival are related but separate outcomes.

Autograft

Tissue moved from one site to another in the same person, such as skin used to cover a burn. Because donor and recipient are identical, immune rejection is not the main barrier.

Allograft

A graft transferred between genetically different members of the same species. Most donated human organs are allografts, so compatibility testing and immune control are central. The term says nothing by itself about organ quality or degree of match.

Isograft

A graft between genetically identical individuals, usually identical twins. The 1954 Herrick kidney transplant used this rare situation to bypass most rejection before effective immunosuppression existed.

Xenograft

Cells, tissue or an organ moved between species. Gene-edited pig organs are experimental xenografts. Their challenges include rejection, clotting, anatomy, infection, animal welfare and long-term surveillance.

Solid-organ transplant

Transfer of a vascularised organ such as a kidney, liver, heart, lung, pancreas or intestine. Blood vessels must be connected and useful circulation established before preservation injury becomes irreversible.

Tissue transplant

Transfer of cornea, skin, bone, tendon or heart valves. Storage, processing, blood supply and immune behaviour differ, so organ rules cannot be copied across tissues.

Haematopoietic stem-cell transplant

Transfer of blood-forming stem cells from the patient or a donor after conditioning treatment. The cells rebuild marrow and immunity rather than replacing one shaped organ.

Donor

The person, living or deceased, from whom graft material is obtained. Donor welfare, consent, infection and cancer screening, anatomy and organ function all affect whether donation can proceed.

Recipient

The person who receives the graft. Eligibility depends on likely benefit, operative risk, alternatives, ability to sustain treatment and organ-specific factors, not need alone.

Donation after death confirmed using neurological criteria

Organ donation after a person's death has been diagnosed and confirmed using neurological criteria while mechanical ventilation maintains circulation temporarily. Death confirmation is separate from organ retrieval. Tests, terminology and legal frameworks vary between jurisdictions.

Donation after circulatory death

Donation after circulation has stopped, death has been confirmed under the applicable safeguards and retrieval begins. Controlled programmes follow an independent decision to withdraw non-beneficial treatment; uncontrolled programmes may follow failed resuscitation. Warm ischaemia and rapid coordination are important features of both routes.

Living donor

A healthy person who gives a kidney, part of a liver, tissue or cells. Assessment protects voluntary consent and limits risk to someone receiving no medical benefit.

Consent or authorisation

Lawful permission for donation. Systems may use recorded or deemed consent, family authorisation or combinations. Every model still requires communication and clinical suitability.

Waiting list

The set of patients accepted for possible transplantation. Being listed does not promise an organ, and temporary suspension can occur when illness or other conditions make immediate transplantation unsafe.

Allocation

The process deciding which candidate receives an offered organ, using organ-specific factors such as urgency, compatibility, benefit, waiting time, size and transport. Allocation converts public values into operational priorities and therefore requires audit as well as calculation.

ABO compatibility

Compatibility based on A, B and O blood-group antigens and antibodies. These antigens also occur on vascular linings, so an incompatible organ can trigger rapid antibody-mediated injury.

Human leucocyte antigen

A highly variable family of molecules, shortened to HLA, that present protein fragments to T cells. Differences between donor and recipient help make an allograft immunologically visible.

Sensitisation

Development of antibodies against HLA through pregnancy, transfusion or previous transplantation. Highly sensitised candidates may be incompatible with many donors and need broader sharing or added priority. Sensitisation can make calendar waiting time a poor measure of access.

Donor-specific antibody

An antibody in the recipient directed against an antigen carried by the donor. It may exist before transplantation or develop later and can contribute to antibody-mediated rejection.

Crossmatch

A test of whether recipient serum reacts against donor cells or antigens. A positive result can reveal dangerous pre-existing antibodies, though testing estimates risk rather than guaranteeing an outcome.

Ischaemia

Insufficient blood flow and oxygen. Once an organ is removed or circulation stops, ischaemic injury begins. Temperature, duration, donor condition and organ type influence how much damage follows.

Cold ischaemic time

The period during which an organ remains cooled without normal blood flow before implantation and reperfusion. Shorter is generally preferable, but acceptable durations are organ-specific rather than universal.

Reperfusion injury

Damage that occurs when circulation and oxygen return to previously ischaemic tissue. Inflammation, oxidative stress, complement, clotting and vessel injury can make restoration of flow a second biological shock.

Rejection

Immune injury directed against a graft. It may involve T cells, antibodies or both and can appear rapidly, acutely or as part of long-term decline.

Immunosuppression

Treatment that restrains immune responses so an allograft can survive. It lowers rejection risk while increasing vulnerability to infection, cancer, metabolic effects and drug-specific organ toxicity.

Induction and maintenance therapy

Induction gives strong immune control around transplantation. Maintenance continues afterwards. The balance changes as rejection risk, infection, toxicity and graft condition change.

Graft-versus-host disease

A complication of allogeneic stem-cell transplantation in which donor immune cells attack recipient tissues. The direction is the reverse of ordinary solid-organ rejection: the graft reads the host as foreign.

Machine perfusion

Circulation of controlled fluid through an organ outside the body, at cold or warmer temperatures. It can support preservation, assessment and treatment, and different devices measure different signals. It cannot certify future graft performance.

Go Deeper

Joshua D. Mezrich, *When Death Becomes Life: Notes from a Transplant Surgeon* (Harper, 2019)

Begin here for the working service. Mezrich moves between donor hospitals, retrieval journeys, operating rooms, recipient care and the history that made those routines possible. His strength is the chain: uncertainty follows the organ from the first telephone call through inspection, transport and implantation. The cases are vivid and the clinical perspective is candid about fear, error and attachment. It remains one surgeon's American account, so allocation rules and institutional practice should not be treated as universal. Read it for what transplantation feels like when decisions have to be made before all the evidence arrives. Pay attention to the rejected offers and cancelled operations, because they reveal the service as clearly as the successful cases.

David Hamilton, A History of Organ Transplantation: Ancient Legends to Modern Practice (University of Pittsburgh Press, 2012)

Use Hamilton for the full history. He connects grafting, vascular surgery, immunology, tissue typing, drugs, intensive care and public institutions without turning progress into a parade of firsts. The book is long and more technical than the present one, but it shows why no single breakthrough created transplantation. Its global range also corrects a story centred entirely on a few American and European surgeons. Read selectively at first: cornea and skin, experimental kidney work, immunological rejection, the early clinical programmes and the emergence of death criteria. Its footnotes are useful routes into original case reports, but the scale rewards a chapter-by-chapter approach rather than one uninterrupted march.

Thomas E. Starzl, The Puzzle People: Memoirs of a Transplant Surgeon (University of Pittsburgh Press, 2003)

Read Starzl as primary testimony from inside the dangerous early decades. He records liver-transplant failures, drug experiments, institutional conflict, patient relationships and the pressure to continue when results were poor. The prose is unusually direct for a surgical memoir. It is also a participant's account shaped by priority disputes and his own programme's choices. Pair its technical immediacy with Hamilton's wider history. The value lies in seeing how uncertain practice looked before later success made the route appear inevitable. Read the failures as data rather than prelude: they show how bleeding, infection, rejection and institutional confidence were separated only gradually.

Margaret Lock, *Twice Dead: Organ Transplants and the Reinvention of Death* (University of California Press, 2002)

Read Lock when the phrase brain death starts to sound like a purely technical definition. Her anthropology compares North American and Japanese debates, showing how law, clinical authority, bodies, families and cultural expectations shape acceptance of neurological death and organ retrieval. The comparison is historically situated and neither country should stand for an entire culture. Its lasting contribution is to show that a precise clinical standard can carry different public meanings. This is the strongest corrective to treating trust as a communications problem added after the science. Read it beside current professional codes, because the anthropology explains meaning while the codes define present clinical practice.

Notes and Sources

Scope and terminology

This book uses *transplantation* for the therapeutic transfer of human cells, tissues or organs, while keeping blood transfusion and reproductive tissue outside its scope. The broad framing follows the World Health Organization's Guiding Principles and NHS Blood and Transplant's division of organ, tissue and stem-cell services. Solid organs, banked tissues and haematopoietic stem cells do not share one storage method, immune profile or clinical pathway. They are grouped here because each requires living or biologically useful material to cross from a donor source into a recipient under systems of consent, screening, traceability and follow-up.

The phrase *moving parts* is therefore deliberately tested rather than accepted. Some grafts are vascularised organs containing living cells. Some tissues are used mainly for preserved structure. Blood-forming stem cells have no fixed organ shape and can rebuild marrow and immunity after infusion. Faecal microbiota transplantation, blood products, gametes,

embryos and reproductive tissue raise related questions but belong to other clinical and regulatory fields and are excluded.

Current United Kingdom activity

The figures in *Why You Should Care* and *The current chain* come from NHS Blood and Transplant's *Activity Report 2025/2026*, covering 1 April 2025 to 31 March 2026. The data were reported to NHSBT by 18 May 2026. The report recorded 1,428 deceased organ donors, including 636 in its donor-after-brain-death registry category and 792 donors after circulatory death; 1,017 living donors; and 4,666 organ transplants. At year end, 8,296 patients were active on a waiting list and 4,139 were temporarily suspended. NHSBT estimated that about 64,800 people in the UK were living with a functioning transplant, while warning that organ-group totals can count a person more than once after multi-organ transplantation.

These are service counts, not one interchangeable measure of need or outcome. The 4,666 transplants are an annual flow; 8,296 active and 4,139 suspended patients are point-in-time stocks on 31 March 2026. They should not be divided or treated as one stable population. During the financial year, 434 patients died while active on a list and 899 were removed, mostly because deteriorating health or ineligibility made transplantation impossible. A waiting-list snapshot also excludes people not referred, still under assessment, declined for listing or too unwell to remain active.

Living tissue, ischaemia and reperfusion

The cellular account of ischaemia and reperfusion follows standard transplant physiology: interruption of oxygen and substrate delivery depletes adenosine triphosphate, disrupts membrane pumps and ionic balance, increases acidosis and calcium loading, and injures mitochondria and vascular endothelium. Reperfusion can add oxidative, inflammatory, complement and coagulation injury. The exact importance of each pathway differs by organ, donor condition, temperature, duration and preservation method. The prose therefore explains a common mechanism without implying one universal safe time.

Static cold storage slows metabolism but does not stop injury. Normothermic and hypothermic machine-perfusion systems differ in temperature, perfusate, device, measurement and intended use. Nasralla and colleagues' 2018 randomised liver trial found lower measured graft injury and lower discard under normothermic preservation despite longer mean preservation, without proving superiority for every long-term outcome. Van Rijn and colleagues' 2021 trial tested hypothermic oxygenated perfusion in selected livers donated after circulatory death. NHSBT's ongoing PLUS trial evaluates whether access to normothermic liver perfusion increases functional organ use across the offering pathway. These sources support cautious claims about preservation, assessment and utilisation, not a general promise that a machine repairs any damaged organ.

Normothermic regional perfusion restores oxygenated circulation to selected abdominal organs after death has been confirmed following circulatory arrest. The current *UK National NRP Protocol*, version 1.14 dated 19 May 2025, uses clamping of the thoracic aorta and an open ascending-aortic vent to isolate and monitor the abdominal circuit. If heart contractions return after perfusion has begun, the protocol requires the pump to stop, further clamps to be applied and the aortic vent and flow to be checked before any continuation. These measures are designed to prevent cerebral perfusion. The text treats them as a specific UK protocol, not a universal method or a claim that ethical debate has ended.

Immune recognition, HLA and crossmatching

The account of allorecognition draws on current transplant-immunology reviews and the clinical testing material used by NHSBT. Donor HLA can be recognised directly by recipient T cells, while recipient antigen-presenting cells can process donor molecules and present their fragments. B cells and plasma cells can produce donor-specific antibodies. Tissue damage and innate immune activation interact with these adaptive responses. The manuscript avoids presenting rejection as one pathway or HLA matching as a complete measure of compatibility.

Pregnancy, transfusion and previous transplantation can sensitise a candidate to HLA. NHSBT's kidney-assessment guidance confirms that highly sensitised patients may wait longer and that the National Kidney Offering Scheme gives added priority to patients with high antibody levels. A crossmatch can reveal dangerous pre-existing antibody reactivity. Modern solid-phase assays can detect antibodies whose clinical significance still depends on strength, specificity, organ and context. A negative crossmatch lowers a defined risk; it cannot promise permanent acceptance.

The 1954 Herrick transplant was an isograft between identical twins and therefore bypassed most alloimmune difference. It did not solve the ordinary problem of an allograft between genetically different people. The wording follows the original 1956 JAMA report by Merrill, Murray, Harrison and Guild and later historical syntheses.

Rejection, immune suppression and outcome language

The distinctions among hyperacute, acute cellular, antibody-mediated and chronic graft injury are clinical organising categories, not perfectly separate diseases. Long-term graft loss can reflect alloimmunity, recurrent disease, infection, drug toxicity, cardiovascular and metabolic stress, donor quality and ageing. The book uses *chronic graft injury* rather than implying that every late decline is one process called chronic rejection.

Induction and maintenance regimens vary by organ and patient. Calcineurin inhibitors, antimetabolites, corticosteroids, mammalian target of rapamycin inhibitors, co-stimulation blockers and antibody therapies have different actions and adverse effects. Product labels and transplant guidance carry strong warnings about serious infection and malignancy under immune suppression. The manuscript names representative burdens without offering a regimen or dose and leaves detailed pharmacology to its neighbouring title.

Patient survival, graft survival, death-censored graft survival, organ function, rejection-free survival and quality of life use different denominators. The

manuscript deliberately avoids a single transplant success rate. Registry comparisons also reflect selection: centres that accept higher-risk recipients or organs may appear worse on unadjusted outcomes, while cautious centres may achieve strong short-term results by excluding difficult cases.

Donation, death and consent

The United Kingdom account follows the Academy of Medical Royal Colleges' *A Code of Practice for the Diagnosis and Confirmation of Death: 2025 Update* and NHSBT guidance. The Code treats death as a unitary state, defined as permanent loss of the capacity for consciousness combined with permanent loss of the capacity to breathe. The manuscript uses *death confirmed using neurological criteria* for the current clinical process. The NHSBT activity report retains *donor after brain death*, or DBD, as a registry category, while older terms, tests and legal formulations vary across jurisdictions.

The controlled donation-after-circulatory-death pathway emphasised in the UK account follows an independent decision that treatment no longer benefits the patient, withdrawal of treatment, cessation of circulation, confirmation of death under the applicable safeguards and only then organ retrieval. Uncontrolled donation after failed resuscitation exists in some programmes and follows different operational safeguards. Donation following death confirmed using neurological criteria can occur while ventilation temporarily maintains circulation. In every route, the treatment decision and death confirmation must remain separate from recipient need. The dead-donor rule and the ethics of regional perfusion remain subjects of philosophical and professional debate; the text states the working safeguards without pretending the debate has closed.

Consent law varies across the four UK nations and internationally. Deemed or presumed consent changes the legal starting position for eligible adults but does not make family involvement, clinical suitability or operational capacity disappear. NHSBT's completed 2025/2026 report recorded an overall consent or authorisation rate of 57 per cent, down from 59 per cent in the previous year, while family support approached 90 per cent when the

person had registered a decision to donate. These are observational service measures with several causes. The book uses them to distinguish a consent model from the whole donation pathway, not to attribute the change to legislation alone.

Living-donor assessment must protect voluntariness and donor welfare. NHSBT guidance describes medical, psychological and independent assessment, and the National Living Donor Kidney Sharing Scheme enables paired and pooled exchange. Reimbursement of reasonable costs is not the same as buying an organ. Risk estimates depend on donor characteristics, comparator population, procedure and follow-up period, so this general book does not supply a personal risk percentage.

Scarcity, allocation and unequal access

There is no single transplant list or universal formula. NHSBT uses separate offering schemes for kidneys, livers, hearts, lungs and other organs. Policies combine different weights for urgency, compatibility, size, waiting time, age, expected benefit, geography and preservation constraints. Highly sensitised kidney candidates provide a clear case in which simple calendar waiting would not measure access because many offers are biologically unusable.

The manuscript's equity discussion is an inference from how referral, assessment, listing and matching operate. Clinical criteria can interact with prior access to care, language, travel, housing, social support and centre capacity. HLA frequencies also differ across populations, while broad ethnic categories remain poor substitutes for an individual's tissue type. The claim is not that every disparity has one cause. It is that an allocation algorithm cannot correct inequity outside its input data unless the service measures and addresses the full pathway.

The commercialism and trafficking paragraph follows the WHO Guiding Principles, the 2018 Declaration of Istanbul and the Council of Europe Convention against Trafficking in Human Organs. These frameworks distinguish lawful reimbursement from payment for an organ and define several forms of trafficking, including removal without valid consent,

financial gain, coercion, deceptive recruitment and use of illicitly obtained organs. Estimates of prevalence are uncertain because hidden activity, inconsistent definitions and weak reporting prevent a reliable global count. No numerical estimate is retained in the body.

A transplant as a coordinated service

The account of referral, donor recognition, testing, allocation, retrieval, transport, implantation and long-term care is synthesised from NHSBT policies and patient pathways, the transplant histories by Hamilton and Starzl, and Mezrich's contemporary clinical account. The lower-abdominal placement of a kidney and the fact that native kidneys often remain in place are standard surgical descriptions. The book explains this anatomy because it corrects a literal swap model, not to teach operative technique.

Traceability and vigilance are ethical as well as logistical requirements. The WHO Guiding Principles call for quality systems, documentation of benefit and harm, lifetime traceability where appropriate and reporting of adverse events and reactions. A label, blood sample, electronic record and organ must continue to identify the same donor and recipient across institutions. The text uses this as a system example without implying that clerical failure is a common cause of graft loss.

Cornea, skin, bone, tendon and valve transplantation follow tissue-specific processing and banking rules. The 1905 corneal operation by Eduard Zirm is treated as the first successful human corneal allograft commonly recognised in modern histories. Its relative immune privilege and avascular central tissue help explain why corneal grafting did not make vascularised organ transplantation easy.

Blood-forming stem-cell transplantation

The stem-cell section follows the US National Cancer Institute and the NHS description of autologous and allogeneic transplantation, conditioning, engraftment, infection risk, graft-versus-host disease and graft-versus-tumour effects. Donor cells are infused through a vein and repopulate marrow; the treatment's danger often lies in conditioning and the period before blood counts recover rather than in an implant operation.

HLA matching is especially important in allogeneic transplantation, but a close match does not remove graft-versus-host disease. Donor immune cells can attack recipient tissues while also attacking residual malignant cells. This dual effect supports the book's wider argument that foreignness can be therapeutic and harmful at once. Disease-specific indications, conditioning regimens and cancer outcomes belong to oncology and specialist haematology rather than this title.

E. Donnall Thomas's programme is included as a major contributor to the development of marrow transplantation, not as a lone-inventor story. The history involved patients, donors, laboratory scientists, nurses, infection control, HLA work and several institutions, with failures preceding reproducible benefit.

Historical sequence and famous firsts

Alexis Carrel's vascular-anastomosis work showed that fine blood-vessel connections could sustain experimental organ circulation but did not solve immune rejection. Karl Landsteiner's ABO work made transfusion incompatibility intelligible and supplied one layer of later organ matching. Peter Medawar's wartime skin-graft observations and the 1953 experiments by Billingham, Brent and Medawar established acquired immune tolerance and the adaptive nature of rejection.

The kidney transplant performed on 23 December 1954 by the Boston team led on the recipient side by Joseph Murray transferred Ronald Herrick's kidney to his identical twin Richard. The original 1956 report established technical and physiological success without generalising beyond an isograft.

Later histories record that the graft supported Richard for years. That bounded outcome is enough to show what durable function meant.

Starzl and colleagues' 1963 paper reports the programme's first human liver cases and no durable survival. Their 1968 report documents the later clinical series after sustained survival emerged in 1967. The book therefore presents liver transplantation as programme-level accumulation rather than one successful first. Christiaan Barnard's team transplanted Denise Darvall's heart into Louis Washkansky on 3 December 1967. Washkansky died eighteen days later from pneumonia under heavy immune suppression. The operation and death are paired because separating them would overstate either technical failure or clinical success.

Professional criteria for confirming death using neurological criteria developed in response to intensive care's capacity to maintain circulation after catastrophic loss of brain function. Organ transplantation made the definition publicly consequential but was not its sole cause. Margaret Lock's comparative anthropology is used for the social meaning of death standards, while current UK practice is governed by current professional codes rather than a two-decade-old ethnography.

Ciclosporin's clinical adoption around the turn of the 1980s improved control of T-cell responses and helped make several organ programmes more reproducible. It also brought nephrotoxicity and other harms. Tacrolimus and later combinations changed the balance again. The history is presented as cumulative system change, not one drug ending rejection.

Machine perfusion and the current frontier

Current organ-perfusion claims are limited to what devices and trials establish. Perfusion can maintain oxygenated circulation, permit measurement and extend controlled preservation under defined protocols. A flow, resistance, lactate or bile measure is not automatically a validated prediction of recipient benefit. Evidence from one organ, device, temperature or donor group cannot be transferred to another without testing.

The book's xenotransplantation status was verified on 3 September 2026

through the US Food and Drug Administration and ClinicalTrials.gov. Two registered studies, NCT06878560 and NCT07224763, concern gene-edited pig kidneys in people with end-stage renal disease. Their registry records establish formal human testing, not reported efficacy or durability. The field has not established routine durability, scalable production, population safety or ordinary availability. FDA material supports continuing concern about recognised and unrecognised infectious agents, possible transmission to close contacts or the wider population, and long-term surveillance.

The frontier moves fast. Trial enrolment, recipient outcomes, regulatory requirements and programme status should be rechecked before publication. The manuscript avoids naming a single recipient whose outcome could date the book quickly and avoids assigning a lifespan to a pig graft before trials can support it.

Evidence limits

National registries provide large, useful observational records but cannot eliminate selection, changing practice or differences in definitions. Randomised trials are available for some medicines and preservation methods, while death determination, allocation weights and many donor choices cannot be randomised. Historical publications favour named firsts and successful programmes, and participant memoirs can defend priorities as well as preserve detail.

No composite patient or donor is presented as a reported case. The night-time call, cancelled operation and mediated correspondence in the body are general illustrations of documented service patterns rather than accounts of named individuals. Exact outcome probabilities and personal clinical recommendations are excluded because they depend on organ, disease, age, anatomy, antibodies, programme and current alternatives.

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