OR-07 The district infirmary: ten beds, a sterile room, a lab bench and a midwife

HEALING after the FALL, research library, OR-07

Researched 10 October 2026 by Claude Opus agent for THRIVING after the FALL, Book Four. Library document, unverified.

How to read this document

The book places one infirmary, with ten beds, a sterile room, a lab bench and a midwife, above about ten villages and 3,000 people. This report treats it as an institution. It asks what a place this size can and cannot do, who staffs it, how far patients travel, what it costs in labour, water and fuel, which cases it must refuse, and what killed such places in the past.

It builds on neighbouring reports rather than repeating them: FO-11 (kits, staffing ratios, triage), WO-12 (sterilisation), WO-10 (anaesthesia), WO-08, MA-03 and CH-11 (outcomes of non-physician operators), NU-01 and NU-03 (nursing), OR-01 (the village worker), OR-06 (the shelf) and OR-08 (the district mutual). OR-04, written at the same time, holds the lab bench and its tests, so this report says nothing on how tests are done.

Figures carry their source. My own arithmetic for 3,000 people, and claims I could not confirm, carry [VERIFY]. Village rules the owner must decide carry [OWNER].

1. Findings by section

1.1 What 3,000 people generate in a year

Every plan for the infirmary starts from how many people will need it. None of the studies below measured a population of 3,000 without a hospital above it. They give rates, and I scale them.

Births. FO-11 uses the humanitarian planning figure of a crude birth rate of 4%, which gives about 120 births a year for 3,000 people (THRIVING library, FO-11). A settled post-Fall population might sit between 3% and 4%, so 90 to 120 births [VERIFY].

Caesareans. Three different floors are in use, and they differ fourfold. - The UN process indicators set caesareans at 5% to 15% of all births as the acceptable range (MEASURE Evaluation n.d.). At 120 births that is 6 to 18 a year. - Ronsmans and colleagues questioned the 5% minimum. They argued that need is harder to define than it looks and that there was little practical experience with the indicators (Ronsmans 2002, abstract only). - The unmet obstetric need approach counts only absolute maternal indications, where the mother will very probably die without an operation. These run at about 1% to 2% of births. In Tanga, Tanzania, interventions for such indications were 1% of births and the caesarean rate was 1.4% (BMC Pregnancy and Childbirth 2007, search summary). - Across countries, maternal and neonatal mortality fell as caesarean rates rose up to about 19% (Molina 2015, search summary). That design is ecological and says little about a district without blood or anaesthesia. - Nordberg estimated a minimum

need of 225 caesareans per 100,000 people a year in rural eastern Africa, against an observed 25 (Nordberg 1984, abstract only).

For 3,000 people these give 1 to 2 caesareans a year for absolute indications, about 7 by Nordberg's estimate, and 6 at the UN floor [VERIFY, my arithmetic]. FO-11 plans for "about 6 a year" from the 5% figure (THRIVING library, FO-11). I agree with the number but not the reasoning: 5% is a process target set for whole countries with referral, not a measured need. The honest planning range is one caesarean every two to twelve months.

All major operations. Nordberg found 25 hernia repairs per 100,000 against an estimated need of 175, and 4 operations for strangulated hernia against a need of 30 (Nordberg 1984, abstract only). A separate study in Meru, Kenya, put the basic need at about 1,000 major operations per 100,000 a year [VERIFY, secondary]. The Lancet Commission on Global Surgery set a target of 5,000 operations per 100,000 a year by 2030 (Meara 2015, secondary summaries). For 3,000 people these give about 30 major operations a year by Nordberg's basic need and 150 by the Commission's target. Hernias contribute 5 repairs and about 1 strangulation a year [VERIFY, my arithmetic]. Thirty operations a year is fewer than one a week.

Admissions. The best population-based figures come from the Kilifi surveillance area in coastal Kenya. - Adults living within 5 km of the hospital were admitted at 1,446 (women) and 991 (men) per 100,000 person-years. Across the whole area the rates were 785 and 668. Admissions fell 20% (women) and 11% (men) with every 5 km of distance. In-hospital mortality was 10.3%. The study covered 790,635 person-years from 2007 to 2012 (Etyang 2014). - Children under five were admitted at 64 per 1,000 child-years, with 7,200 admissions from 2004 to 2006. Admissions fell about 21% for each hour of walking. Median travel was 237 minutes on foot and 61 minutes by vehicle (Moïsi 2011, search summary).

For 3,000 people with about 1,650 adults and 450 children under five, these rates give about 12 to 24 adult admissions and about 30 child admissions a year, before births [VERIFY, my arithmetic and age structure]. Kilifi is malarious, with vaccines and a functioning hospital. A post-Fall district without vaccines would see more measles, pertussis and neonatal tetanus, so double the figure for planning: 100 to 150 non-obstetric admissions a year. Add births if women come in to deliver.

What that means for ten beds. At an average stay of five days, 150 admissions use 750 bed-days, about two beds on an average night. If 120 births come in for two days each, that adds 240 bed-days, about 0.7 of a bed [VERIFY, my arithmetic]. On an ordinary night, seven or eight of the ten beds stand empty. Ten beds for 3,000 people is 3.3 per 1,000. - That is above the Chinese commune standard of 1 bed per 1,000 (Feng 2017). - It is above the England and Wales census count of hospital patients in 1901, 120 per 100,000, or 1.2 per 1,000, workhouses excluded (Census of England and Wales 1901, search summary). - It is about 30 times Jamkhed's 50 beds for over 500,000 people (Center for High Impact Philanthropy 2012).

The beds are surge capacity for epidemics, a mass casualty or a bad winter, and a waiting room for women near term from far villages. The book should not imagine ten full beds as the normal state. The daily work is the outpatient door, the labour room and the occasional operation.

1.2 Where ten beds sit in the guidance

The two main frameworks never imagined a surgical unit for 3,000 people.

DCP3. The Disease Control Priorities project defines a first-level hospital as 50 to 200 beds serving 50,000 to 200,000 people. It lists 44 essential procedures, 28 of which belong at the first level, 23 of them emergencies (Mock 2015). The book's infirmary is between 1/20 and 1/60 of that size in beds and between 1/17 and 1/67 in population [VERIFY, my arithmetic]. DCP3 assigns the infirmary's likely work to two platforms: - **The primary health centre:** normal delivery, abscess drainage, suturing lacerations, splinting non-displaced fractures and dental extraction. - **The first-level hospital:** caesarean, assisted delivery, ectopic pregnancy, hysterectomy for rupture or haemorrhage, perforation

repair, appendicectomy, bowel obstruction, hernia including incarcerated hernia, chest drain, trauma laparotomy, open-fracture debridement, traction, fasciotomy, amputation, skin graft and burr hole (Mock 2015).

WHO's levels of care. The WHO guide to infrastructure and supplies divides surgical care into three levels (WHO 2005). - **Level 1, the small hospital or health centre.** It is meant to give emergency measures for 90% to 95% of trauma and obstetric cases, excluding caesarean section. It refers obstructed labour and bowel obstruction. Its procedures are normal delivery, uterine evacuation, circumcision, hydrocele, suturing, pressure control of bleeding, debridement, temporary reduction and stabilisation of fractures and possibly a chest drain. Its staff are paramedical workers without formal anaesthesia training and a nurse-midwife. Its drugs include ketamine, lidocaine, diazepam, adrenaline and atropine. Its equipment includes adult and child resuscitators, a foot sucker and an oxygen concentrator. - **Level 2, the district hospital of 100 to 300 beds.** It adds caesarean section, laparotomy (usually not for bowel obstruction), amputation, hernia repair, tubal ligation, plaster of Paris, cataract and removal of airway foreign bodies. It needs one or two trained anaesthetists, district medical officers, senior clinical officers, nurses and midwives. Thiopental, suxamethonium, a full anaesthesia system, a pulse oximeter and a laryngoscope appear here. - **Level 3** adds bowel surgery, child and newborn surgery, chest surgery and fistula repair.

By WHO's scheme, the book's infirmary is a Level 1 unit asked to do Level 2 work. Caesarean section, which the brief puts at the centre, is excluded from Level 1 by name. That exclusion assumes an ambulance and a district hospital within reach. After the Fall the choice is not between Level 1 and Level 2 care. It is between a caesarean in the infirmary and a dead mother and child. That is the strongest reason to train an operator, and it is also why the operator must be trained to a standard the guidance sets for hospitals ten to thirty times larger.

1.3 Small hospitals in the record

English cottage hospitals. Small hospitals run by general practitioners are the closest historical match to the book's infirmary. - Albert Napper converted a cottage at Cranleigh, Surrey, in 1859. St Thomas' was about 45 km away and the Guildford workhouse infirmary about 12 km (Wikipedia, Cottage hospital). - There were earlier attempts. Southam had 4 beds in 1818. Wellow, Nottinghamshire, opened with 6 beds and one nurse in 1842, and one surgeon served it for 25 years (Wikipedia, Cottage hospital, citing Emrys-Roberts 1991). - About 294 were founded between 1855 and 1898 (Wikipedia, Cottage hospital, citing Abel-Smith 1960). The Community Hospitals Association counts about 240 within thirty years (Community Hospitals Association n.d.). - Horace Swete, a village surgeon at Wrington, published plans for hospitals of 6 and 12 beds in 1870 (Swete 1870, catalogue record only). I could not read the text. - Throughput was modest. Harlington, Harmondsworth and Cranford Cottage Hospital treated 46 patients in 1912 to 1913, 24, 18 and 2 from its three parishes and 2 passing accident cases (Wikipedia, Cottage hospital).

At five days a stay, Harlington's 46 patients would fill about 0.6 of a bed on an average night [VERIFY, my arithmetic, stay length unknown]. This is the same picture as section 1.1. The cottage hospital was mostly empty, and its value lay in the few cases it could not send away.

Nearly 20% of the hospitals nationalised in 1948 were cottage hospitals. From the 1960s policy favoured large district general hospitals, and many closed or became community hospitals, a model developed in Oxfordshire in the 1970s (Community Hospitals Association n.d.). They were not closed because they killed people. They were closed because a larger hospital, reachable by ambulance, could do more. Without the ambulance and the larger hospital, that reason disappears.

Lambaréné. Albert Schweitzer began in 1913 in a converted fowl-house, given by the Paris Missionary Society. In the first nine months he and his wife saw about 2,000 patients, 30 to 40 a day. His wife gave the anaesthetics. His interpreter and assistant, Joseph, was paid 70 francs a month (Schweitzer 1922). On 15 August 1913 he operated on a strangulated hernia. He wrote that the aseptic precautions were far from perfect but the patient recovered (Schweitzer 1922).

The hospital's later history is the institutional lesson (Wagner 2015). - Schweitzer was interned in 1917 and the first hospital fell into ruin. - He rebuilt it in 1924. Dysentery outbreaks about 1925 showed it had no room to isolate infectious patients, and a third site was completed in 1927. - Patients came with one or two relatives who cooked and washed in the compound. People and animals shared the ground. Some buildings had no electricity or running water. - Visitors called the regime autocratic and paternalistic. - After Schweitzer's death in 1965, falling donations and ageing buildings brought a crisis. A foundation took over in 1974, a modern hospital opened in 1981, staff struck in 2011, and the first African director took office in 2012. - In 2013 it had about 270 staff, 6,246 inpatients and 22,300 outpatients (Wagner 2015).

Lambaréné shows three things. One founder can build a hospital with very little. The family can carry the hotel work of a ward. And a hospital built around one person enters crisis when that person and that person's donors go.

Mission hospitals in Africa. The brief's picture of one doctor and fifty beds is common in memoirs. I found no audited series from a single-doctor mission hospital that reports outcomes against a defined population. The Tanzanian study of 14 district hospitals found that mission and government hospitals differed significantly in obstetric surgical quality, though not in which grade of operator did better (McCord 2009, abstract only). Mission audits are written by survivors of the system, about hospitals that kept going. Hospitals that closed rarely published.

The Chinese commune hospital. Rural China built a three-tier system: the village health station with its barefoot doctor, the commune hospital, and the county hospital (Feng 2017). - Commune hospitals had 8 to 15 staff and 1 bed per 1,000 people. - Rural beds rose from 0.1 to 0.8 per 1,000 during the commune period. - Staff in township and county hospitals rose from 1.1 to 1.5 per 1,000. - In 1973 the state pledged to pay 35% of commune hospital costs, excluding drugs. - By 1976, 90% of brigades had a cooperative medical scheme, and commune hospitals managed its funds. - A country study gives township health centres 10 to 30 beds for 10,000 to 30,000 people, with assistant doctors as the most qualified staff (Library of Congress n.d., secondary).

The collapse is documented. After the household responsibility system replaced collective farming, the cooperative scheme collapsed, village practitioners became private, and township and county hospitals became autonomous and fee-charging (Feng 2017). Coverage fell from 80% to 90% in 1979 to 40% to 45% by 1984 (search summaries, secondary) [VERIFY].

The Frontier Nursing Service. Mary Breckinridge founded the Frontier Nursing Service in 1925 in the mountains of eastern Kentucky. Nurse-midwives worked from outposts, each serving about 250 families within a five-mile ride, and visited on horseback. From 1925 to 1954 the service recorded maternal mortality of 9.1 per 10,000 births, against 34 per 10,000 for the United States. Over 10,000 births had been attended by 1958. A graduate school of midwifery opened in 1939 (Frontier Nursing University n.d., secondary). A hospital at Hyden stood above the outposts. I did not find its bed count.

The service is the best match for the book's district. Its outcomes came from trained midwives spread out to the villages, with a small hospital as backup, not from the hospital itself. It also chose its own population and reported its own figures, so the comparison with national rates is not a controlled one [VERIFY].

Jamkhed. The Aroles began the Comprehensive Rural Health Project in 1970 in a leased cowshed. By 2011 its hospital had 50 beds for a rural population of over 500,000, with about 20,000 outpatients a year. Villages averaged 1,500 people, and about 80% of health problems were handled at village level by trained village health workers. The whole project, hospital included, cost about $550,000 a year in 2011 (Center for High Impact Philanthropy 2012). OR-01 covers Jamkhed's village workers (THRIVING library, OR-01). For this report, Jamkhed's lesson is the ratio: one small hospital for a population over a hundred times the book's district, made possible because the villages did most of the work.

1.4 The ICRC field hospital

The ICRC's manual *Hospitals for War-Wounded* is the most complete written plan for a surgical hospital built from nothing (Hayward-Karlsson 1998). It was written from Lopiding at Lokichokio in Kenya, which the ICRC opened in June 1987 for the Sudanese war-wounded and handed to the Kenyan Ministry of Health on 30 June 2006. Its peak capacity is given variously as 500, 560 and 700 beds. It reportedly performed over 60,000 operations in 19 years, over 4,000 a year at its peak, and about 95% of patients arrived by air (Sudan Tribune 2006, search summary) [VERIFY]. Its work fell away after the January 2005 peace.

The manual's standards, scaled to ten beds, are blunt. - **Staff.** Count 1.7 medical and non-medical staff per bed, not counting thirteen key posts from director and surgeon to teaching nurse and water engineer, so 85 for 50 beds. Every essential department must run 24 hours a day, 7 days a week. The manual holds that untrained people can be trained for every role. Do not recruit qualified staff from health services that are working, and do not recruit everyone from one ethnic or family group. - **Water.** At least 100 litres per patient per day for drinking, washing and cooking. Independent ICRC hospitals averaged 300 litres. Hospitals in rich countries use about 1,000. - **Power.** A 50-bed hospital needs 100 kVA for essential services. - **Laboratory.** Its main jobs are haemoglobin and safe blood, then malaria smears and stool parasitology. It must run day and night for grouping and cross-matching. OR-04 covers how. - **Blood.** Use unpaid donors. Store at 4 to 6°C and discard after 21 days. War-wounded hospitals used on average 45 units per 100 admissions, 60 when evacuation took under six hours and over 100 for mine injuries. The manual prints, in capitals, the rule never to give untested blood. - **X-ray** is not indispensable. - **Kitchen and laundry.** Two or three meals a day, with food for relatives too. Hot and cold water for laundry, and theatre linen soaked in disinfectant. - **Safe surgery** means a place where laparotomy can be done under general anaesthesia with intubation and with 24-hour nursing after the operation.

At 1.7 per bed, ten beds need 17 staff before any key post [VERIFY, my arithmetic]. That figure assumes full beds and war wounds. Section 1.7 builds a leaner roster for a mostly empty civilian infirmary. The ICRC's figures still show what a full surge costs.

FO-11 holds the ICRC's triage categories and post-operative mortality of 2.2% to 6.1% (THRIVING library, FO-11). Its warning carries over to the infirmary: the first failure to expect is spending labour on patients who will die whatever is done.

1.5 The non-physician surgeon

The infirmary will almost certainly not have a surgeon. The record of operators trained for three years after school is the most important evidence in this report. WO-08 and MA-03 already give the main series, and CH-11 gives the hernia trial. I add the Malawi and Tanzanian studies and the limits of all of them.

What the series show.

Study	Setting	Operators	Main finding
Vaz 1999 (THRIVING library, WO-08)	Mozambique, 10,258 operations	14 técnicos de cirurgia	Post-operative mortality 0.4% (emergency), 0.1% (elective)
Pereira 1996 (THRIVING library, MA-03)	Mozambique, 2,071 caesareans	Técnicos against doctors	Only superficial wound separation differed
Fenton 2003	Malawi, 8,070 caesareans	Clinical officers did 65%	Maternal death 1.3% at district hospitals, 0.6% central

Study	Setting	Operators	Main finding
Chilopora 2007	Malawi, 38 district hospitals, 2,131 operations	Clinical officers did 88%	Maternal death 1.2% against 0.4%, not significant
McCord 2009	Tanzania, 14 district hospitals, 1,072 operations	Assistant medical officers	No significant difference from doctors
Gessessew 2011	Tigray	Non-physicians did 63.3%	No significant difference in maternal or fetal deaths
Wilson 2011 (THRIVING library, MA-03)	Meta-analysis, 16,018 women	Clinical officers against doctors	Maternal death OR 1.46 (0.78 to 2.75), more wound problems
Ashley 2021 (THRIVING library, CH-11)	Sierra Leone RCT, 230 men	Associate clinicians, mesh hernia	Recurrence 0.9% against 6.9% at one year
Bolkan 2017 (THRIVING library, WO-08)	Sierra Leone	Trainee and qualified officers	Caesarean mortality 0.7% and 0.4%

MA-03 reports Pereira's series as 958 caesareans by técnicos, and WO-08 gives 978. One of them is a transcription slip. I could not read the original to settle it [VERIFY].

The Malawi caesarean audit in detail. Fenton and colleagues followed 8,070 caesareans prospectively, 5,236 in 23 district hospitals and 2,834 in two central hospitals (Fenton 2003). - 94% were emergencies, 63% for obstructed labour. - 85 mothers died (1.05%): 1.3% at district hospitals and 0.6% at central hospitals. Fifteen died on the table. - Perinatal mortality was 11.2% overall and 13.6% at district hospitals. - Haemorrhage at operation featured in 53% of maternal deaths, and a deficit of two or more units of blood in 53%. - Clinical or paramedical officers did 65% of operations and interns 22%. - All 45 anaesthetists were paramedics, and untrained staff gave 703 anaesthetics (9%). - 4,934 operations were under general anaesthesia and 3,136 under spinal.

The mothers in this series died mostly of bleeding without blood, not of a bad incision. That points the infirmary's planning at the blood panel (section 1.8) as much as at the operator.

Chilopora's comparison. In 38 district hospitals over three months of 2005, clinical officers did 1,875 of 2,131 major obstetric operations. Maternal deaths were 22 (1.2%) for clinical officers against 1 (0.4%) for medical officers, p = 0.292. Early neonatal deaths were 2.2% against 1.6%, and wound infection 7.3% against 5.5%. Clinical officers train for three years plus a one-year internship. Senior clinical officers teach the juniors because there is usually no doctor. The assessors were not blinded and referral hospitals were excluded (Chilopora 2007).

Retention and cost. In Mozambique 88% of técnicos were still in district posts after seven years, against almost none of the doctors (THRIVING library, WO-08). Over 30 years a major obstetric operation cost $38.9 by a técnico against $144.1 by a specialist, and $60.3 even if técnicos' pay were doubled (Kruk 2007, abstract only). Non-physician clinicians practised in 25 of 47 sub-Saharan countries and equalled or outnumbered doctors in nine. They usually trained for three or four years after secondary school, many came from rural areas and returned there, and some were trained for caesarean section, eye surgery or anaesthesia (Mullan and Frehywot 2007, abstract only). In Zambia, 86.4% of 21,245 operations were judged not complex and teachable to non-surgeons, and the authors advised teaching local and regional anaesthesia (Watters and Bayley 1987, abstract only).

The limits of this evidence. - **Supervision bias.** Most of the good series come from programmes run by surgeons

and obstetricians who trained, supervised and audited the operators. The Swedish-Mozambican group behind Vaz, Pereira, Kruk, McCord and Chilopora is one research network. DCP3 says mid-level operators are safe "provided that they are properly trained and supervised" (Mock 2015). After the Fall the supervisor is gone. - **Referral bias.** Every series had a referral hospital above it. Hard cases went up and are missing from the district figures. Chilopora excluded referral hospitals outright. - **Volume.** These operators did many operations a year. The book's infirmary may see 30 major operations a year and 1 to 7 caesareans. CH-08 found that non-physician cataract surgeons managed a median of only 76 operations a year, and 10% left within three years (THRIVING library, CH-08). An operator who does four caesareans a year will lose the skill. - **First generations.** A first generation of surgeons trained without supervision may see mortality near 11% (THRIVING library, WO-08). I take this as the warning figure for the book's first trainee.

What modern science infers. Given three years of training, supervised practice and a steady caseload, an operator without a medical degree does common emergency operations about as safely as a junior doctor. The confidence interval leaves room for a modest excess of deaths, and wound problems are more frequent. None of the conditions is guaranteed after the Fall. The book's operator needs a caseload larger than one district provides, which means sharing operators with neighbouring districts or training on animals and cadavers [OWNER].

1.6 Water, fuel, power and space

Water. Two authorities disagree by a factor of two or more. - WHO's environmental health standards for health care set minimums of 5 litres per outpatient consultation, 40 to 60 litres per inpatient per day, 100 litres per operation or delivery, 60 litres per cholera patient per day, 100 litres for respiratory isolation and 300 to 400 litres for viral haemorrhagic fever. Water should contain no faecal coliforms per 100 ml, turbidity under 5 NTU and free chlorine of 0.5 to 0.7 mg/l (Adams 2008, secondary). - The ICRC sets at least 100 litres per patient per day, and its own hospitals averaged 300 (Hayward-Karlsson 1998).

For the infirmary on an ordinary day, with two to three inpatients, a birth every three days, an operation a fortnight and 10 to 30 outpatients, WHO's figures give about 250 to 400 litres a day. With ten full beds and the ICRC's minimum, the need is about 1,000 litres a day [VERIFY, my arithmetic]. Carried in 20-litre containers, 1,000 litres is 50 trips a day. That rules out any site without a well, spring or gravity pipe within the compound.

Rain can supply part of it. A year at 300 litres a day is about 110 m^3, which needs about 170 m^2 of roof at 800 mm of rain and 80% capture, and the full 1,000 litres a day needs about 570 m^2 [VERIFY, my arithmetic]. Storage for three days of full use is 3 m^3 [OWNER].

Fuel. I found no measured figure for firewood per hospital bed. The estimate below is mine and is labelled as such [VERIFY]. - **Cooking.** Rural Ghanaian households burned 1.6 to 2.8 kg of firewood per person per day (UEW repository n.d., search summary). Patients, relatives and staff on duty might be about 12 people on an ordinary day, so roughly 15 to 25 kg. - **Hot water.** Heating one litre from cold to boiling takes about 0.36 MJ. An open fire delivers perhaps 10% to 15% of the wood's energy to the pot, and dry wood holds about 15 MJ per kg, so each litre boiled costs about 0.15 to 0.25 kg of wood. If 100 litres a day are heated for laundry, delivery and theatre, that is 15 to 25 kg. - **Sterilising.** WO-12 estimates that a 39-litre pressure cooker needs at least 1,500 W and about 90 minutes for a full run (THRIVING library, WO-12). That is about 8 MJ, or 3 to 5 kg of wood on a fire.

The total is of the order of 35 to 60 kg of wood a day, or 13 to 22 tonnes a year [VERIFY]. That is a woodlot of several hectares or a steady flow of loads from the villages. An improved stove would roughly halve it [VERIFY]. Fuel is a standing tax that cottage-hospital histories ignore, because coal arrived by rail.

Power. The ICRC's 100 kVA for 50 beds is out of reach. WHO lists an oxygen concentrator at Level 1, which needs steady electricity. Otherwise the essential load is light at night. A foot sucker, a pressure cooker on wood and a ketamine anaesthetic need no electricity.

Space. NU-03 gives 3.5 m^2 per person as a shelter standard and about 4 m^2 per bedridden cholera patient (THRIVING library, NU-03). For an infirmary I suggest a minimum plan rather than a standard (see Protocols). The essentials are separation. The labour room, the operating room, the general ward and the isolation room are four separate spaces. Lambaréné's dysentery of about 1925 showed the cost of having no isolation room (Wagner 2015).

1.7 Staff, hours and what paying them means

The arithmetic of one post. A post covered 24 hours a day, 7 days a week, is 168 hours a week. At 40 hours a person that is 4.2 full-time staff. Relief factors for leave and sickness in European rostering raise it to between 4.5 and 5.5 (soon.works n.d.). The infirmary needs at least one person awake on the ward and one midwife reachable at all times. Those two lines alone need 8 to 11 people at modern working hours, or 4 to 6 if each person works far longer hours and sleeps on site [VERIFY, my arithmetic].

What others staffed. These are the reference points. - **ICRC:** 1.7 staff per bed (Hayward-Karlsson 1998). - **Chinese commune hospital:** 8 to 15 staff (Feng 2017). Township and county staff ran at 1.1 to 1.5 per 1,000, which would give 3 to 5 for 3,000 people. - **UNHCR:** a clinical officer per 10,000 people, a laboratory technician per 15,000, and four nurses per inpatient ward (THRIVING library, FO-11). For 3,000 people that is 0.3 of a clinical officer. - **Wellow, 1842:** one surgeon and one nurse for six beds (Wikipedia, Cottage hospital).

A roster for the book. For a mostly empty civilian infirmary I propose a core of eleven to thirteen people, of whom four or five are trained [VERIFY, my proposal]. - **One clinician-operator.** Trained for three years in the técnico or clinical officer pattern. Does the operations and the hard medical cases. - **One second clinician.** Gives the anaesthetic, assists, and runs the outpatient door. Trained at least to WO-10's ketamine standard. Is the clinician-operator's successor in training. - **Two midwives.** One on call at all times. Train village birth attendants (MA-03, MA-02). - **Four to five ward keepers.** Nurse aides who keep one person awake on the ward at night. Can be trained in months, as the ICRC holds. - **One steriliser and bench keeper.** Keeps the steriliser (WO-12) and the lab bench (OR-04) and the dispensary shelf (OR-06). - **Two to three for water, fuel, laundry and cooking.** Often shared with relatives.

That is about 4 people per 1,000, roughly three times the Chinese township ratio [VERIFY]. At 2,000 hours each, 12 people work 24,000 hours a year. Spread over about 1,200 working adults in 3,000 people, that is 20 hours a year from each adult, or half a working week, before anyone pays for drugs, fuel or food [VERIFY, my arithmetic]. Relatives who stay with a patient, as at Lambaréné and in most African hospitals, absorb much of the cooking and washing. The ICRC plans to feed them (Hayward-Karlsson 1998).

Paying them. OR-08 proposes a district mutual with a premium per member, salaried staff and an elected board, and leaves the endowment of the infirmary to GOVERNING (THRIVING library, OR-08). The record gives three warnings. - The Chinese commune hospital lived on a collective that paid its staff and on a state that paid 35% of its costs. When the collective went, the system broke (Feng 2017). - Lambaréné lived on donations raised by one famous man and fell into crisis when he died (Wagner 2015). - Cottage hospitals lived on subscriptions, donations and small weekly fees from patients (Wikipedia, Cottage hospital).

The infirmary's staff cannot farm full time. Whatever pays them must be a standing levy on the district, in food, fuel or labour, not a fee charged at the door of a woman in obstructed labour [OWNER].

Training above the village worker. OR-01 covers the village worker, trained in months. The infirmary needs three grades above that. - **The clinician-operator:** three years plus a year of internship, the pattern behind every good non-physician series (Chilopora 2007, Mullan and Frehywot 2007). - **The midwife:** the Frontier Nursing Service ran a graduate school from 1939 (Frontier Nursing University n.d.). I did not find its course length. - **The ward keeper:** months.

For the first generation after the Fall, no teacher may hold a degree. The ICRC's teaching nurse post and Chilopora's

observation that senior clinical officers taught the juniors suggest the model: each trained person trains the next, and no one practises alone [OWNER].

1.8 Blood

Fenton's audit is clear: half the mothers who died at caesarean had a blood deficit of two or more units (Fenton 2003). The infirmary that operates without blood will lose mothers it could have saved. Nearly a third of maternal deaths from haemorrhage are attributed to lack of blood in a recent review (Battlefield to Blood Bank 2025, secondary). MA-02 notes that tools short of transfusion only buy time (THRIVING library, MA-02). FO-09 sends fresh whole blood to WO-13, but WO-13 covers bites and envenomation, so no library report yet holds transfusion. I disagree with that cross-reference and treat the donor panel here.

The walking blood bank. Without a refrigerated bank, blood comes from donors called in when needed and drawn as fresh whole blood. - A Kenyan protocol, LIFE-Blood, sets out a community walking blood bank in Turkana for haemorrhagic shock where banked blood is not available. In a pilot at Lodwar the bank had stockouts on 40 of 126 days (32%) (LIFE-Blood 2025, protocol read via search summary). - India banned unbanked directed transfusion over the risk of HIV (search summary, secondary) [VERIFY]. - The ICRC rule is never to give untested blood and to test for group, cross-match, hepatitis B and C, syphilis, HIV and malaria (Hayward-Karlsson 1998). OR-04 covers which of these tests the bench can do after the Fall.

For the infirmary. About ten caesareans, laparotomies and bad haemorrhages a year might need blood [VERIFY]. A panel of 30 to 50 adults, grouped and screened in advance, spread across the ten villages and willing to be called at night, would cover this [VERIFY, my proposal]. Each donor gives at most every 12 to 16 weeks [VERIFY, from European practice]. The panel list lives at the infirmary and with the village worker. Whether to transfuse blood that could not be screened for HIV or hepatitis, to a woman who will otherwise die within the hour, is a decision the owner must make in advance [OWNER].

1.9 The infirmary as a source of infection

Hospitals concentrate the sick, and they have often killed by doing so. - Nightingale's figures, via NU-01 and NU-03, show 888,312 institutional deliveries with 34 maternal deaths per 1,000, against 5.1 per 1,000 for home births (THRIVING library, NU-03). - Renkioi's mortality was 3.8% against Scutari's 11.9% (THRIVING library, NU-03). - In developing countries, healthcare-associated infection affected 15.5 per 100 patients, against 7.1 in Europe and 4.5 in the United States (Allegranzi 2011, search summaries). - In Africa, prevalence ranged from 2.5 to 14.8 per 100 patients. On surgical wards it ranged from 5.7 to 45.8, and surgical site infection from 2.5 to 30.9 per 100 operated patients (Bagheri Nejad 2011, abstract). - WO-12 records hepatitis and HIV spread through reused syringes in Egypt, Elista and Roka (THRIVING library, WO-12).

For a ten-bed infirmary the risks are specific. - Mothers deliver near patients with fever. - Instruments are reused. - The water is not always clean. - Relatives sleep and cook on the ward. - In an epidemic, the infirmary may admit cholera, measles or dysentery next to a fresh caesarean wound.

NU-03 shows that for non-surgical acute illness, care at home was as safe as hospital care, with a risk ratio of death of 0.88 (THRIVING library, NU-03). The building does not carry the treatment for most medical illness. The rule that follows is that the infirmary admits only those who need what only the infirmary has, and sends the rest home with a village worker. This is natural triage applied to admission.

1.10 Catchment, transport and the referral that is gone

In Kilifi, adult admissions fell by 11% to 20% with every 5 km of distance, and child admissions by about 21% with every hour of walking. Distance also raised the chance of dying in hospital (Etyang 2014, Moïsi 2011). Ten villages

around one infirmary, at the density of a rural district, might lie 5 to 15 km away, two to four hours on foot [VERIFY, geography assumed]. Without a road and a cart, the sickest arrive late or not at all.

The Lancet Commission's target is that 80% of people reach a hospital able to do the three bellwether procedures, caesarean, laparotomy and open-fracture care, within two hours (Meara 2015, secondary). For the book that sets a design rule. Each village keeps a stretcher, a team of four bearers on a rota, and a cart or animal for the long villages, and the infirmary sends word back by runner [OWNER].

The referral that is gone. Every guideline, series and manual in this report assumes a higher hospital. WHO's Level 1 refers caesarean and bowel obstruction. Malawi's district hospitals sent hard cases to central hospitals. Lopiding flew patients in. After the Fall, the infirmary is the top of the system. The cases it would have referred will either be attempted there or die there. That is why the refusal list in the Protocols matters as much as the procedure list. Refusing, and keeping the patient comfortable, is a real decision with a real cost, and the owner must set it in advance.

1.11 What killed such institutions

The record names six killers, and none of them is lack of skill. 1. **Loss of the payer:** the Chinese collective (Feng 2017) and Schweitzer's donors (Wagner 2015). 2. **Centralisation:** cottage hospitals merged into district general hospitals (Community Hospitals Association n.d.). This killer does not operate after the Fall. 3. **Loss of the one trained person:** Lambaréné depended on one man. Mozambique kept its técnicos where it lost its doctors (THRIVING library, WO-08). MI-12 holds the lone healer's burnout (THRIVING library, MI-12). 4. **War and attrition:** recent work on Tigray describes health workers lost to war [VERIFY, title only seen]. 5. **Infection:** lying-in wards and Scutari (THRIVING library, NU-03). 6. **Fees at the door:** once Chinese hospitals had to earn their income, they became autonomous and fee-charging (Feng 2017).

2. Evidence grades

Claim	Grade	What the record shows	What modern science infers
Non-physician operators do caesareans about as safely as doctors	A to B	Meta-analysis OR 1.46 (0.78 to 2.75), several series (Wilson 2011 via MA-03, Chilopora 2007)	Safe if trained and supervised, with more wound problems
Associate clinicians repair hernias well	A	One RCT (Ashley 2021 via CH-11)	Mesh needed, which may not exist
Cheaper per operation, retained in rural posts	B	Kruk 2007, WO-08	Strong case for the book
Small GP-run hospitals serve rural areas	B to C	Cottage hospitals, commune hospitals	No outcome data found
Midwives spread to villages cut maternal deaths	B	Frontier Nursing Service	Uncontrolled comparison
A caesarean floor of 5% of births	D as need	UN process indicator, questioned (Ronsmans 2002)	Absolute need nearer 1% to 2%
Hospitals concentrate infection	B	Nightingale, Allegranzi 2011, Bagheri Nejad 2011	Water, isolation and hand hygiene cut it
Walking blood bank works	B to C	ICRC practice, LIFE-Blood pilot	Stockouts frequent, screening the weak point

Claim	Grade	What the record shows	What modern science infers
WHO water minimum 40 to 60 L per inpatient	D	Expert standard (Adams 2008)	ICRC sets 100 L, so plan for both
One founder can sustain a hospital	X as model	Lambaréné crisis after 1965	Build succession in

3. Means ledger

The rungs: **Hands** (knowledge alone). **Hearth** (fire, water, cloth, knife). **Garden and still** (plants, ethanol, soap, pressure cooker). **Village dispensary** (300 people, trained lay healer, salvaged stock). **District infirmary** (3,000 people, ten beds, sterile room, lab bench, midwife). **Hospital before the Fall**, as reference.

Task	Hands	Hearth	Garden and still	Village dispensary	District infirmary	Hospital before the Fall
Obstructed labour	Recognise early, carry	Same	Same	Refer at once	Caesarean, symphys-iotomy only if trained	Caesarean, blood, ICU
Haemorrhage after birth	Rub uterus, bimanual compression	Same	Same	Misoprostol, refer	Manual removal, transfusion, laparotomy	Full
Strangulated hernia	Recognise, carry	Same	Same	Refer	Repair	Repair
Open fracture	Splint, cover	Boiled cloth	Sterile dressing	Clean, splint, refer	Debride, delay closure, traction	Fixation
Severe illness in a child	Danger signs	Fluids	Same	Antibiotics, refer	Admission, oxygen if any	Full
Epidemic	Isolate at home	Same	Same	Count and report	Isolation ward	Full
Blood	None	None	None	Group donors	Walking donor panel	Blood bank

What each rung changes. Hands and the village rung decide whether the patient arrives in time. The infirmary rung adds the operation, the anaesthetic and blood, which no lower rung can provide. The hospital rung adds intensive care, specialised surgery and banked blood, which the infirmary should not pretend to.

4. Harm test

Harm	Mechanism	Size in the record	Guard
Surgery by the untrained	First operations, no supervisor	First generation mortality near 11% (WO-08)	Three years' training, supervised count, audit

Harm	Mechanism	Size in the record	Guard
Anaesthesia by the untrained	Airway loss, ketamine overdose	9% of Malawi anaesthetics by untrained staff (Fenton 2003)	WO-10 doses, a second trained person
Cross-infection	Sick and wounded together	Up to 45.8 per 100 on African surgical wards (Bagheri Nejad 2011)	Isolation, water, the steriliser keeper
Untested blood	HIV, hepatitis, syphilis	Not quantified here	Pre-screened panel, owner's rule
Delay from distance	Late arrival	Admissions fall 11% to 21% per 5 km or hour	Bearers, waiting room
Single point of failure	One operator dies or leaves	Lambaréné, Tigray	Two trained clinicians always
Spending labour on the dying	Category IV patients	FO-11	Triage at the door

Ketamine. WO-10 holds the anaesthetic doses (THRIVING library, WO-10). For orientation only: about 2 mg/kg intravenously over at least a minute, or 6 to 10 mg/kg into a muscle, and no more than 1 mg/kg intravenously before the baby at caesarean. In Kenyan series of mid-level providers, brief desaturation occurred in about 3% and hallucination or agitation in up to 13%, with no deaths reported (THRIVING library, WO-10). Overdose signs are loss of the airway, slowed breathing and prolonged unconsciousness. The infirmary must not give ketamine without a second person able to hold an airway [OWNER].

5. Red flags

- **The infirmary admits patients who could be nursed at home.** Infection rises, and labour is wasted.
- **One clinician-operator and no successor in training.** The infirmary is one illness away from closing.
- **The infirmary operates without a donor panel.** Half the mothers who die at caesarean die for want of blood (Fenton 2003).
- **No count of operations and deaths.** Without numbers nobody knows whether the operator is safe.
- **Water is carried in by hand.** The infirmary will run short in a surge.
- **Fees at the door.** The poorest arrive later or not at all.
- **The operator does fewer than about ten major operations a year.** Skill decays [VERIFY threshold].
- **Isolation, labour and theatre share a room.**

6. The case against

Do not build the infirmary. The case against is strong.

Most of the gain lies elsewhere. Jamkhed handled about 80% of problems at village level and needed one 50-bed hospital for over 500,000 people (Center for High Impact Philanthropy 2012). The Frontier Nursing Service's results came from midwives in the villages. NU-03 shows that home care is as safe as the ward for acute medical illness. SY-03 argues that medicine's gains came in the same building as its harms (THRIVING library, SY-03). A district that spends half a working week per adult on an infirmary may get more by spending it on water, latrines, food and village midwives.

The infirmary concentrates infection. Nightingale's 34 against 5.1 deaths per 1,000 births is the oldest warning.

The operation is rare and the skill decays. One to seven caesareans a year will not keep anyone safe. A first generation of untrained surgeons kills.

The guidance does not support it. WHO places caesarean at a hospital ten to thirty times larger, and DCP3's first-level hospital serves 17 to 67 times as many people.

The romance. Lambaréné is the story everybody knows. Its own history shows an autocratic founder, a compound shared with animals and a crisis when he died.

The answer to the case against. Without the infirmary, a woman in obstructed labour, a man with a strangulated hernia and a child with an open fracture will die. These are few, but they are young, and the operation gives them decades of life. DCP3 costs emergency caesarean at $15 to $380 per DALY averted and hernia repair at $10 to $100, among the cheapest interventions in medicine (Mock 2015). The answer is to build a small infirmary that refuses most of the work offered to it and does a few things well.

7. 10-line summary

1. Three thousand people generate about 30 major operations, 1 to 7 caesareans, 100 to 150 non-obstetric admissions and 90 to 120 births a year [VERIFY].
2. Ten beds will stand mostly empty and are surge capacity.
3. WHO's guidance excludes caesarean from a unit this size, which assumes a referral hospital that no longer exists.
4. Non-physician operators trained three years do common emergency surgery about as safely as junior doctors, when supervised.
5. Malawi's district caesareans killed 1.3% of mothers, half of the dead short of blood.
6. Water needs 250 to 1,000 litres a day, so the infirmary must stand on its own water.
7. Fuel is about 13 to 22 tonnes of wood a year [VERIFY].
8. A core staff of 11 to 13 costs about half a working week per adult per year [VERIFY].
9. Small hospitals died of lost payers, lost founders and infection, not of lack of skill.
10. The infirmary must refuse more than it attempts.

8. Open questions

- How many operations a year does an operator need to stay safe?
- What did a single-doctor mission hospital achieve, measured against a defined population?
- How many beds did the Frontier Nursing Service's Hyden hospital have, and what did it cost?
- What did Swete and Burdett record on the mortality of small against large hospitals?
- How much fuel did small rural hospitals burn?
- What is the safest anaesthetic when no trained anaesthetist exists (WO-10)?
- Can a walking blood bank be screened adequately after the Fall (OR-04)?

9. Sources to read in full

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At the bedside after the Fall

Household. Know the danger signs that need the infirmary: labour longer than a day, bleeding after birth that will not stop, a hard painful lump in the groin that will not go back, a broken bone through the skin, a child who cannot drink. Do not wait for morning. Carry the patient on a stretcher with four bearers. Send one relative to cook and wash.

Village of 300. The village worker keeps the bearer rota, the stretcher and the list of grouped donors. The worker sends women from far villages to wait near the infirmary in the last weeks of a pregnancy with known risk [OWNER]. The worker nurses at home every patient who does not need an operation, oxygen or isolation.

District of 3,000. The infirmary keeps two trained clinicians, two midwives, a ward keeper awake at night, a steriliser keeper, its own water, a donor panel and a register of operations and deaths. It admits those who need what only it has. It refuses what it cannot do safely. It meets monthly to review every death [OWNER, fixed day].

Protocols

Protocol 1. The minimum plan

- ☐ Water inside the compound: well, spring or gravity pipe. Storage 3 m^3, three days at full use [OWNER]. Chlorine residual 0.5 to 0.7 mg/l at the tap (Adams 2008).
- ☐ Four separate rooms: labour (2 beds), operating room, general ward (6 beds), isolation (2 beds) with its own latrine and its own bucket and basin.
- ☐ Floor space at least 4 m^2 per bed, beds at least 1 m apart [VERIFY, extrapolated from NU-03].
- ☐ A steriliser corner between theatre and labour room, run to WO-12: 121°C for 30 minutes wrapped, packs dated and used within 4 weeks (THRIVING library, WO-12).
- ☐ A lockable room for bench and shelf (OR-04, OR-06).
- ☐ Kitchen and laundry for relatives, downwind, with one hot-water copper.
- ☐ Latrines downhill and at least 30 m from the water source [VERIFY].
- ☐ Two lamps for night work in labour room and theatre.

Protocol 2. The roster

- ☐ Two clinicians. One operates, one gives the anaesthetic. Neither operates alone.
- ☐ Two midwives. One within ten minutes of the labour room at all times.
- ☐ Four to five ward keepers. One awake on the ward every night, shifts of no more than 12 hours.
- ☐ One steriliser and bench keeper.
- ☐ Two to three for water, fuel, laundry and kitchen, plus relatives.
- ☐ One clinician in training at all times [OWNER].

Protocol 3. Admission rule

Admit only if the patient needs at least one of: an operation, a delivery with a known risk, isolation, transfusion, injectable treatment that cannot be given at home, or observation every hour. Everyone else goes home with the village worker and a date to return. Review every inpatient each morning for discharge.

Protocol 4. What the infirmary may attempt

With a trained operator and a second trained person only: - [ ] Caesarean section for obstructed labour, haemorrhage before birth, or a dying mother. Decision to incision within one hour [VERIFY target]. - [ ] Manual removal of placenta, evacuation of the uterus. - [ ] Laparotomy for ectopic pregnancy, uterine rupture or bleeding after birth. - [ ]

Strangulated hernia repair. - [ ] Debridement of wounds and open fractures, closure delayed 4 to 5 days (THRIVING library, FO-11). - [ ] Amputation of an unsalvageable limb. - [ ] Chest drain, suprapubic catheter, abscess drainage.

Protocol 5. What the infirmary must refuse

- ☐ Bowel resection, unless the operator is trained for it [OWNER].
- ☐ Surgery on infants under one year beyond drainage.
- ☐ Chest surgery beyond a drain, fistula repair, cataract unless trained (CH-08).
- ☐ Elective operations the patient can live without.
- ☐ Intubation and muscle relaxants without a trained anaesthetist.
- ☐ Operations on the dying (FO-11). Keep them warm, free of pain and with family.

Protocol 6. The walking donor panel

- ☐ 30 to 50 adults across ten villages, grouped and screened in advance [VERIFY].
- ☐ Each donor at most every 12 to 16 weeks [VERIFY].
- ☐ Stored blood at 4 to 6°C, discarded after 21 days. At most 4 to 6 units for one patient (Hayward-Karlsson 1998).
- ☐ The owner's rule on unscreened blood written before it is needed [OWNER].

Protocol 7. Transport

- ☐ Each village keeps one stretcher and a rota of four bearers per night [OWNER].
- ☐ A runner goes ahead so the infirmary is ready on arrival.
- ☐ Women with known risk from villages more than two hours away wait at the infirmary from 37 weeks [OWNER].

Protocol 8. Audit and succession

- ☐ On a fixed day each month, count admissions, operations, births and deaths [OWNER].
- ☐ Review every death within 7 days: operator, anaesthetist, delay, blood, outcome.
- ☐ Report to the district board.
- ☐ The operator counts supervised operations. The owner sets the number before independent work [OWNER].

Numbers to carry

1. **About 30 major operations a year** for 3,000 people [VERIFY].
2. **1 to 7 caesareans a year** for 3,000 people [VERIFY].
3. **1.3% maternal mortality** at caesarean in Malawi district hospitals.
4. **Half the dead short of blood.**
5. **40 to 60 L per inpatient per day** (WHO), **100 L** (ICRC).
6. **1.7 staff per bed** (ICRC).
7. **4.2 full-time staff** for one post covered all week.
8. **3 years plus 1 of internship** for a clinician-operator.

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