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Rising Infertility in Developing Countries: Cameroon as a case study of infectious, health-system, environmental, and socioeconomic drivers

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Abstract

Infertility is emerging as a significant but under-recognized public health challenge in many developing countries, with profound demographic, psychosocial, and economic consequences. Cameroon provides a compelling case study for examining the multifactorial drivers of rising infertility across sub-Saharan Africa. This paper synthesizes epidemiological evidence to analyze infectious, health-system, environmental, and socioeconomic determinants shaping infertility patterns. Persistent reproductive tract infections including untreated sexually transmitted infections, post-abortal sepsis, and puerperal infections remain leading contributors to tubal factor infertility. Weak health-system capacity, limited access to skilled obstetric and gynecological care, inadequate laboratory diagnostics, and fragmented referral pathways exacerbate delayed diagnosis and treatment. Environmental exposures, including pesticide use, heavy metals, and endocrine-disrupting chemicals associated with rapid urbanization and informal industrial activity, further compound reproductive risks for both men and women. Socioeconomic pressures poverty, gender inequities, stigma, and limited insurance coverage for fertility services intensify barriers to timely intervention and amplify psychosocial distress. The Cameroon case illustrates how infectious burden interacts with structural and environmental vulnerabilities, producing a cumulative risk framework rather than isolated causes. Addressing infertility in similar contexts requires integrated strategies encompassing infection prevention, strengthened reproductive health systems, environmental regulation, male reproductive health inclusion, and financial protection mechanisms. Recognizing infertility as a cross-sectoral development issue is essential for advancing reproductive justice and sustainable population health outcomes in resource-constrained settings.

Keywords: Infertility; Cameroon; Reproductive tract infections; Health-system capacity; Environmental exposure; Socioeconomic determinants

1. Introduction

1.1. Global burden and LMIC relevance (WHO framing; why underprioritized)

Infertility, commonly defined as failure to achieve a clinical pregnancy after 12 months of regular unprotected intercourse, is recognized by the World Health Organization (WHO) as a disease of the reproductive system with important wellbeing and rights implications.[1] WHO estimates indicate that about 17.5% of adults roughly one in six experience infertility during their lifetime, showing that the condition is widespread across regions and income groups.[1] Despite this, infertility is often underprioritized in low- and middle-income countries (LMICs), where policy attention has historically emphasized reducing maternal mortality, preventing HIV/STIs, and addressing high fertility. Underinvestment persists even though infertility can drive severe psychosocial harm (stigma, anxiety, relationship disruption), catastrophic household spending, and gender inequities in blame and care-seeking.[1,2] In LMIC settings,

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the preventable fraction is frequently larger because infections and unsafe maternity or post-abortion care can cause lasting tubal and uterine damage, while timely diagnostics and treatment remain limited.[2]

1.2. Cameroon case rationale (demographic transition, urbanization, environmental context, stigma)

Cameroon illustrates how persistent infection-related infertility risks can intersect with demographic transition, urbanization, and widening social gradients in access to care. Facility-based evidence from urban centers has reported infertility prevalence among couples seeking services near one in five, with secondary infertility often predominating consistent with accumulated reproductive tract pathology after prior pregnancies or exposures.[2] Demographic sources suggest gradual shifts in fertility timing within sub-populations: while early childbearing remains common nationally, urban and more educated women show increasing postponement of first birth, likely linked to longer schooling and changing employment trajectories.[3,4] This matters because delayed attempts to conceive can increase age-related subfertility and miscarriage risk, and can coincide with longer cumulative exposure to modifiable risks (STIs, smoking, metabolic disease) for both partners.[8] Cameroon also spans diverse environmental contexts: agricultural zones with pesticide use; urban and peri-urban areas with traffic pollution and informal industrial emissions; and workplaces where heat and chemical exposures may affect semen quality and ovulatory function.[6] Finally, infertility is strongly shaped by sociocultural norms. Stigma and gendered blame can delay presentation to biomedical care, promote unregulated therapies, and reduce male participation in evaluation, amplifying the duration and cost of infertility.[2]

1.3. Conceptual model + aims/objectives (infectious ↔ system ↔ environment ↔ socioeconomic pathways)

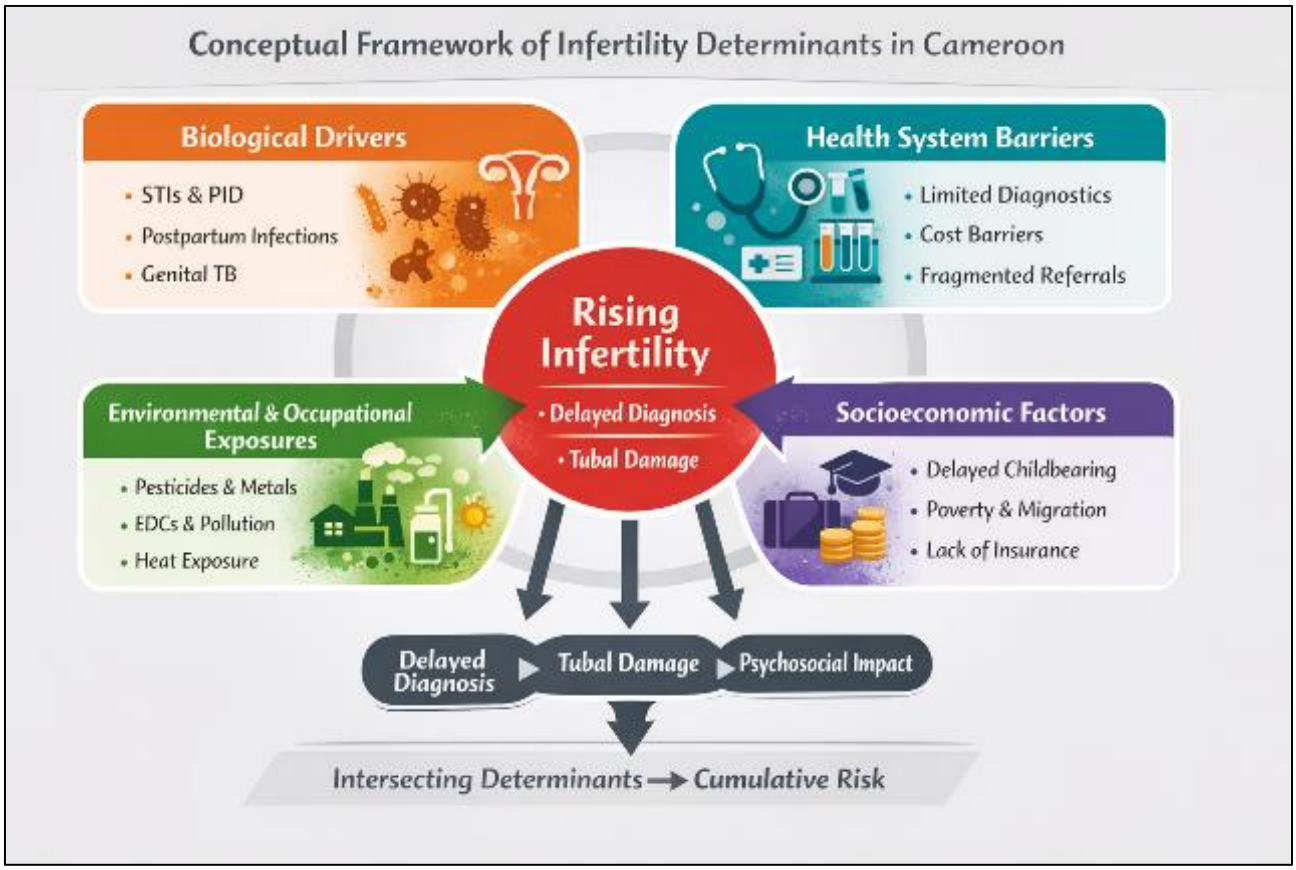

Figure 1 Conceptual framework of infertility determinants in Cameroon

This manuscript uses an integrated determinants framework in which infertility reflects cumulative biological risks shaped by structural conditions. Infectious drivers (untreated STIs, postpartum infection) can progress to pelvic inflammatory disease, tubal scarring, chronic endometritis, and adhesions mechanisms central to secondary infertility in many African cohorts.[2,5] Health-system constraints (limited diagnostics, fragmented referrals, high out-of-pocket costs, and weak male-factor services) magnify these risks by delaying effective treatment and narrowing options when couples finally seek care.[2] Environmental and occupational exposures (pesticides, heavy metals, endocrine-disrupting chemicals, heat stress) may impair gamete quality through endocrine disruption and oxidative stress.[6] Socioeconomic

change, including delayed childbearing linked to education and career building, interacts with age-related declines in fecundability and cumulative male-factor risk, producing a mixed infertility profile in urban populations.[7,8] The objectives are to: (i) synthesize recent evidence on infertility prevalence and patterns in Cameroon; (ii) map key determinants across infectious, environmental, socioeconomic, and health-system domains; and (iii) propose a tiered, feasible policy response emphasizing prevention, standardized diagnostics, equitable referral, and appropriately regulated fertility services.[1,2,7]

1.4. Paper roadmap (what each section delivers)

Section 2 describes the narrative scoping approach. Section 3 summarizes Cameroon's epidemiologic profile, including secondary and male-factor patterns. Section 4 analyzes determinants across infections, maternity-related morbidity, health-system gaps, environmental exposures, and delayed childbearing. Section 5 translates findings into a tiered strategy (prevention and early detection first, then referral strengthening, financing reforms, and regulated fertility services). Later sections outline implementation priorities and research gaps, including surveillance needs, exposure assessment, and pragmatic evaluations of standardized infertility packages that can be scaled through district health systems and monitored with equity indicators across regions and vulnerable groups nationally.[1,2,7]

2. Methods

2.1. Design choice (narrative scoping synthesis + policy analysis)

This study adopts a narrative scoping synthesis combined with structured policy analysis to examine infertility determinants in Cameroon. A scoping approach was selected because infertility evidence in LMICs is heterogeneous and dispersed across clinical cohorts, demographic surveys, environmental health studies, and policy documents rather than uniform national surveillance systems [6]. In sub-Saharan Africa (SSA), infertility drivers often overlap across infectious, environmental, and structural domains, requiring integrative analytical methods rather than single-outcome meta-analytic pooling [7]. Variations in infertility definitions, diagnostic criteria, and sampling strategies across studies further limited the feasibility of quantitative synthesis [8]. The policy analysis component aligns with global reproductive health frameworks that call for integrating infertility into universal health coverage and national reproductive health agendas [9].

2.2. Search strategy (2020–2025; databases; keywords)

A structured literature search was conducted for publications between January 2020 and February 2026. Databases searched included PubMed/MEDLINE, PubMed Central, Google Scholar, African Journals Online (AJOL), and selected institutional repositories. Search terms combined controlled vocabulary and free-text keywords such as: "infertility," "Cameroon," "sub-Saharan Africa," "secondary infertility," "male infertility," "Chlamydia trachomatis," "pelvic inflammatory disease," "postpartum infection," "endocrine disrupting chemicals," "delayed childbearing," and "assisted reproductive technology." Priority was given to peer-reviewed empirical studies conducted in Cameroon [10]. Where Cameroon-specific data were limited, high-quality SSA evidence was included to contextualize regional epidemiologic patterns and sociocultural dynamics [11]. Policy documents and demographic reports were also reviewed to capture trends in fertility timing, health-system indicators, and population transitions relevant to infertility risk [12].

2.3. Eligibility, screening, and data charting

Eligible sources included: (1) observational clinical or population-based studies reporting infertility prevalence or associated factors; (2) laboratory or epidemiologic studies assessing infectious, environmental, or male-factor determinants; (3) systematic reviews relevant to SSA infertility; and (4) national or international policy documents addressing reproductive health systems. Editorials without empirical grounding and single case reports were excluded unless they contributed conceptual or ethical framing. Data extraction captured study design, setting, infertility definition, sample size, exposures examined (e.g., STIs, postpartum infection, environmental toxicants, age-related factors), and reported reproductive outcomes. Policy documents were charted for strategic priorities, financing mechanisms, and governance implications relevant to Cameroon's health system [13].

2.4. Evidence handling and triangulation

Given limited population-representative infertility surveillance in Cameroon, facility-based prevalence estimates were interpreted cautiously. Such studies may overestimate burden because they include couples actively seeking care and may represent more severe or prolonged infertility cases [10]. To reduce bias, findings were triangulated across multiple regional studies and compared with broader SSA evidence to identify consistent mechanistic pathways [11]. Differences in infertility definitions (≥12 months vs ≥6 months) and diagnostic variability were explicitly acknowledged

[8]. Environmental exposure findings were interpreted through mechanistic plausibility from reproductive toxicology literature [14].

2.5. Ethics and reporting stance

This manuscript synthesizes publicly available data and policy documents and does not involve human subjects; therefore, institutional ethical approval was not required. Potential publication bias toward tertiary urban facilities and underrepresentation of male-factor data are acknowledged. Interpretations remain cautious and policy-oriented within existing evidence constraints [9].

3. Results I: Epidemiology and patterns in Cameroon

3.1. Definitions and typology (primary/secondary; female/male/unexplained; ≥12 months/≥6 months ≥35 yrs)

Infertility is conventionally defined as failure to achieve a clinical pregnancy after 12 months of regular unprotected intercourse; however, earlier evaluation (≥6 months) is recommended when the female partner is 35 years or older due to accelerated age-related decline in fecundability [13]. Clinically, infertility is categorized as primary (no prior pregnancy) or secondary (inability to conceive after at least one previous pregnancy). In sub-Saharan African settings, secondary infertility often predominates, reflecting cumulative reproductive tract damage [14]. Etiologically, infertility may be attributed to female factors (e.g., tubal disease, ovulatory dysfunction), male factors (e.g., oligozoospermia, azoospermia), combined factors, or remain unexplained after standard evaluation. In Cameroon, diagnostic variability complicates precise etiologic distribution estimates [15].

3.2. Prevalence evidence (facility/regional findings; interpretation limits)

Population-representative infertility estimates for Cameroon remain limited, but facility-based studies consistently report substantial burden. A multi-hospital study in Douala documented infertility prevalence among couples seeking care approaching 19–20%, with secondary infertility representing a significant proportion [16]. Regional findings from the South West and other urbanized zones similarly indicate high clinic-based infertility caseloads, reinforcing the perception that infertility constitutes a major reproductive health concern in tertiary facilities [17].

However, interpretation requires caution. Facility-derived prevalence reflects care-seeking populations rather than general community prevalence, potentially inflating estimates due to referral bias and self-selection of more persistent or severe cases [16]. Moreover, definitions vary across studies, with some using ≥12 months of infertility and others including ≥6 months for older women, limiting direct comparability [13]. The absence of consistent male-factor testing in certain settings further complicates accurate etiologic classification [18].

Despite these methodological constraints, triangulation across studies suggests infertility is both clinically significant and socially visible in Cameroon's urban centers. Secondary infertility and infection-related signatures recur across cohorts, while urban populations increasingly present with age-related or mixed etiologies [14,19]. These converging signals justify policy attention even in the absence of nationally representative surveillance.

3.3. Secondary infertility and infection-linked signatures (tubal factor; chronic pelvic pathology)

Secondary infertility appears particularly prominent in Cameroonian clinical cohorts and mirrors broader SSA trends [14]. Mechanistically, untreated sexually transmitted infections especially *Chlamydia trachomatis* can ascend to cause pelvic inflammatory disease (PID), resulting in tubal scarring, hydrosalpinx, and impaired gamete transport [15]. Postpartum infections, septic abortion, and inadequately treated reproductive tract infections may further contribute to chronic endometritis, intrauterine adhesions, and pelvic adhesions [16].

In many infertility clinics, hysterosalpingography findings frequently demonstrate tubal obstruction or distortion, reinforcing infection-linked pathways [17]. The predominance of tubal-factor infertility in secondary cases supports a cumulative damage model, where earlier reproductive or infectious events manifest years later as infertility. These patterns underscore the importance of STI prevention, partner treatment, and infection control during maternity care as central infertility prevention strategies [15,19].

3.4. Male-factor infertility (underdiagnosis; lab constraints; sociocultural barriers)

Male-factor infertility remains underrecognized in Cameroon, partly due to sociocultural norms that equate fertility with masculinity and may discourage early semen testing [18]. Where laboratory capacity exists, semen analysis often

reveals abnormalities in concentration, motility, or morphology consistent with oligozoospermia or asthenozoospermia [20]. However, inconsistent laboratory standards, equipment limitations, and variable adherence to updated WHO semen criteria complicate comparability across facilities [18].

Underdiagnosis may also stem from delayed male presentation and limited integration of male reproductive health into primary care services. This imbalance can result in prolonged female-focused investigations before male assessment is conducted. Expanding standardized semen analysis at district level could significantly shorten time-to-diagnosis and reduce unnecessary invasive procedures [20].

3.5. Emerging urban pattern: delayed childbearing and age-related subfertility

Although Cameroon maintains relatively early median age at first birth nationally, urban and more educated populations show gradual postponement of childbearing [19]. Delayed attempts to conceive into the early thirties and beyond increase exposure to age-related declines in ovarian reserve and oocyte quality [13]. Male age-related declines in semen quality and cumulative exposure to occupational or lifestyle risks may compound this effect [20].

Urban clinics increasingly report mixed etiologic profiles combining prior infection-related damage with age-related subfertility, suggesting an epidemiologic transition in infertility patterns among higher socioeconomic strata [19].

Table 1 Cameroon Infertility Profile Prevalence Ranges, Dominant Types, and Evidence Strength

Dimension	Evidence Range/Pattern	Dominant Type	Strength of Evidence
Facility-based prevalence	~19–24% among couples seeking care [16,17]	Secondary infertility common	Moderate (facility-based)
Primary vs secondary	Secondary frequently predominates [14]	Tubal-factor signatures	Moderate
Female-factor patterns	Tubal obstruction, PID history [15,17]	Infection-linked	Moderate
Male-factor contribution	Semen abnormalities documented [18,20]	Underdiagnosed	Limited–Moderate
Urban trends	Increasing delayed childbearing [19]	Mixed/age-related subfertility	Emerging

4. RESULTS II: determinants of rising infertility in Cameroon

4.1. Infectious drivers (STIs/PID; partner reinfection; genital TB; mechanisms; evidence)

Infectious conditions remain among the most consequential and preventable drivers of infertility in Cameroon and comparable sub-Saharan African settings. Sexually transmitted infections (STIs), particularly *Chlamydia trachomatis* and *Neisseria gonorrhoeae*, are strongly associated with pelvic inflammatory disease (PID), a syndrome characterized by ascending infection of the upper genital tract [18]. PID can result in tubal epithelial damage, fibrosis, hydrosalpinx formation, and impaired ciliary transport, thereby reducing the probability of successful fertilization and embryo transport [19]. Even subclinical or asymptomatic infections may trigger inflammatory cascades leading to scarring and adhesions, underscoring the importance of laboratory-based detection rather than sole reliance on syndromic management [20].

In Cameroon, evidence from facility-based cohorts consistently identifies prior STI history and positive serology for *Chlamydia trachomatis* as significant correlates of secondary infertility [19]. Reinfection due to untreated sexual partners further compounds this risk. Limited partner notification systems and sociocultural reluctance to disclose STI diagnoses can perpetuate cycles of reinfection, increasing cumulative tubal damage over time [18]. Where reinfection occurs repeatedly, chronic salpingitis and pelvic adhesions may develop, rendering conservative antibiotic therapy insufficient to restore fertility [19].

Genital tuberculosis (TB), although less frequently diagnosed, represents an additional infectious contributor in high TB-burden regions. Female genital TB may lead to endometrial destruction, intrauterine adhesions, and tubal occlusion, often presenting silently until infertility evaluation is undertaken [21]. Because genital TB is frequently underdiagnosed

due to nonspecific symptoms and limited access to endometrial biopsy or advanced imaging, its contribution to infertility may be underestimated in Cameroon [21].

Mechanistically, infection-driven infertility is mediated through inflammatory cytokine release, oxidative stress, disruption of mucosal immunity, and fibrotic remodeling of reproductive tissues [20]. These processes may persist long after acute infection has resolved. Importantly, infectious drivers disproportionately affect young women early in reproductive life, meaning that infertility manifestations may emerge years after the initial insult [19].

The cumulative evidence suggests that infectious infertility in Cameroon is not solely a matter of individual risk behavior but reflects structural gaps in STI screening, partner treatment, and accessible diagnostic services [18]. Strengthening routine screening, particularly for asymptomatic infections, and integrating male participation into STI programs represent critical preventive strategies [20]. Given the documented burden of infection-linked secondary infertility, infectious drivers remain central to understanding rising infertility patterns nationally [19].

4.2. Maternal morbidity pathways (postpartum infection, post-abortal sepsis, unsafe procedures, adhesions)

Maternal morbidity pathways intersect closely with infectious determinants and contribute substantially to secondary infertility in Cameroon. Postpartum infections, including endometritis and salpingitis following delivery, may result from inadequate infection prevention and control (IPC), prolonged labor without timely intervention, or limited access to skilled birth attendance [18]. Inflammatory damage during the puerperal period can impair endometrial receptivity and tubal patency, increasing long-term infertility risk [19].

Post-abortal sepsis and complications arising from unsafe or poorly managed uterine evacuation procedures represent another pathway. In settings where access to comprehensive post-abortion care is inconsistent, uterine instrumentation under suboptimal conditions may result in intrauterine adhesions (Asherman syndrome), cervical stenosis, or chronic pelvic infection [20]. Adhesions can distort the uterine cavity, interfere with implantation, and increase miscarriage risk even if conception occurs [21].

Evidence from Cameroonian infertility clinics frequently documents histories of complicated deliveries, retained products of conception, or septic abortion among women presenting with secondary infertility [19]. While precise national incidence data are limited, the recurrence of these clinical narratives supports maternal morbidity as a significant etiologic contributor [18]. Importantly, these pathways highlight that infertility prevention is closely linked to maternal health system strengthening. Investments in clean delivery practices, antibiotic stewardship, timely management of postpartum infections, and safe miscarriage care are therefore dual-benefit interventions reducing both maternal morbidity and long-term infertility burden [20].

4.3. Health-system constraints (diagnostic gaps, workforce, referral fragmentation, cost barriers, quality issues)

Health-system limitations significantly shape infertility trajectories in Cameroon. Diagnostic gaps are particularly pronounced at primary and district levels, where standardized infertility workups are inconsistently available [22]. Essential investigations such as semen analysis, ovulation assessment, hysterosalpingography, and endocrine testing may be absent, intermittently supplied, or unaffordable. As a result, couples often experience prolonged delays before receiving definitive etiologic classification [23].

Workforce shortages compound these constraints. Specialized gynecologists, urologists, and reproductive endocrinologists are concentrated in urban tertiary centers, limiting rural access. Task-sharing approaches remain underdeveloped in infertility care compared with other reproductive health services [22]. In addition, fragmented referral pathways may require patients to navigate multiple facilities independently, increasing financial and logistical burdens.

Cost barriers are substantial. Most infertility investigations and treatments in Cameroon are financed out-of-pocket, exposing households to catastrophic expenditure [24]. The absence of insurance coverage or public subsidies for fertility diagnostics discourages early presentation and may drive reliance on informal or unregulated providers. Quality assurance challenges including variability in laboratory standards for semen analysis and inconsistent adherence to evidence-based protocols further complicate outcomes [23].

These system-level constraints not only delay diagnosis but may also exacerbate underlying pathology. For example, untreated ovulatory dysfunction or recurrent infections may progress during prolonged diagnostic intervals. From a

policy perspective, strengthening district-level diagnostic capacity and establishing structured referral networks could reduce time-to-treatment and improve equity in access [22].

4.4. Environmental & occupational exposures (pesticides, metals, EDCs, air pollution; heat exposure; mechanisms)

Environmental and occupational exposures are increasingly recognized as contributors to infertility through endocrine disruption, oxidative stress, and direct gonadotoxic effects. In agricultural regions of Cameroon, pesticide exposure is common among farming households, potentially affecting both male and female reproductive function [24]. Certain organophosphates and carbamates have been associated with altered spermatogenesis and hormonal dysregulation in epidemiologic studies conducted in comparable SSA contexts [23].

Urban and peri-urban settings present distinct risks. Air pollution, heavy metals from informal industrial activities, and exposure to endocrine-disrupting chemicals (EDCs) such as phthalates and bisphenols may impair ovarian reserve and reduce semen quality [20]. EDCs can interfere with estrogen and androgen signaling pathways, disrupt folliculogenesis, and increase oxidative damage to gametes [24]. Heat exposure particularly among workers in high-temperature environments has been linked to reduced sperm concentration and motility due to testicular thermoregulation disruption [23].

Although Cameroon-specific biomonitoring data remain limited, mechanistic evidence supports biological plausibility for these exposures contributing to subfertility [20]. Importantly, environmental risks often intersect with socioeconomic vulnerability, as lower-income populations may face higher exposure levels and reduced access to protective equipment or regulatory enforcement. Incorporating reproductive health endpoints into environmental surveillance and occupational safety programs could help mitigate emerging infertility risks in rapidly urbanizing and industrializing regions [24].

4.5. Socioeconomic drivers (poverty, education/career timing, migration, insurance gaps, catastrophic OOP spending)

Socioeconomic conditions significantly influence both infertility risk and access to care in Cameroon. Poverty constrains timely healthcare utilization, increases vulnerability to untreated infections, and limits the ability to afford diagnostic evaluation once infertility is suspected [22]. Because most infertility services are financed out-of-pocket, even preliminary investigations such as hormonal assays or imaging can impose substantial financial strain on households [24]. In the absence of insurance coverage for fertility services, couples may delay evaluation for years, increasing cumulative biological risk and psychological distress [25].

Educational attainment and career advancement introduce more complex pathways. Urban and highly educated women are increasingly delaying childbearing to pursue higher education and employment opportunities, reflecting broader demographic transition trends in SSA [26]. While socially and economically beneficial, delayed attempts at conception may coincide with age-related declines in ovarian reserve and increased miscarriage risk [27]. Male partners may similarly delay family formation due to employment instability or labor migration, prolonging exposure to occupational hazards and lifestyle risk factors that affect semen quality [23].

Migration both internal rural-to-urban and international can further disrupt reproductive timing and access to consistent care. Mobile populations may experience fragmented health records, inconsistent STI follow-up, and irregular preventive services [22]. Collectively, these socioeconomic forces illustrate that infertility is not solely a biomedical phenomenon but is deeply embedded within economic structures, gendered labor patterns, and financial protection gaps [24,26].

4.6. Sociocultural norms and stigma (gendered blame, IPV risk, pluralistic care-seeking, delayed presentation)

Sociocultural norms shape the lived experience of infertility in Cameroon and influence patterns of care-seeking. In many communities, childbearing is closely linked to social identity, marital stability, and economic security. Women are often disproportionately blamed for infertility, even when male-factor causes are present [28]. This gendered attribution may discourage male participation in diagnostic evaluation and reinforce delayed or incomplete couple-based assessment [23].

Stigma surrounding infertility can contribute to secrecy, social isolation, and, in some cases, intimate partner violence (IPV) or marital dissolution [28]. Psychological distress may be compounded by community narratives framing infertility as spiritual punishment or moral failure, driving individuals toward unregulated traditional or informal remedies before seeking biomedical care [26]. Such pluralistic care-seeking pathways can delay accurate diagnosis and increase cumulative reproductive damage.

Reducing stigma through community engagement, confidential counseling services, and normalization of male evaluation is therefore essential. Integrating infertility education into broader reproductive health messaging can support earlier presentation and more equitable couple-centered management [27].

Table 2 Determinants → Mechanisms → Modifiable Program Levers (Cameroon-Specific)

Determinant	Biological/Structural Mechanism	Modifiable Program Levers
Poverty & catastrophic OOP spending [22,24]	Delayed care-seeking; incomplete diagnostic workup	Subsidized basic infertility package; insurance inclusion; diagnostic vouchers
Education/career-related delayed childbearing [26,27]	Age-related ovarian decline; cumulative male exposure risk	Fertility awareness counseling; early evaluation pathways ≥35 years
Migration & labor mobility [22]	Interrupted STI follow-up; fragmented records	Portable reproductive health records; integrated STI tracking
Gendered stigma & blame [28]	Delayed male testing; psychosocial stress	Couple-based counseling; male engagement campaigns
Pluralistic care-seeking [26]	Delayed biomedical diagnosis; prolonged infection	Community education; regulated referral networks
Occupational & socioeconomic exposure gradients [23,24]	Increased toxin and heat exposure	Workplace protections; occupational health integration

5. Policy and program response: A tiered national strategy

5.1. Prevention first (STI prevention/screening/partner treatment; safer maternity IPC; post-abortion care; NTD integration such as FGS where endemic)

A prevention-first strategy offers the highest return on investment for reducing infertility in Cameroon. Because infection-related tubal damage remains a dominant pathway, strengthening STI prevention and screening is foundational [26]. Routine screening for asymptomatic *Chlamydia trachomatis* and *Neisseria gonorrhoeae*, especially among sexually active young adults, should be integrated into primary care and antenatal services. Equally critical is systematic partner notification and treatment to prevent reinfection cycles that perpetuate pelvic inflammatory disease and long-term scarring [27].

Safer maternity care represents a second pillar. Improving infection prevention and control (IPC) during delivery, ensuring timely antibiotic treatment of postpartum infections, and expanding skilled birth attendance can reduce puerperal morbidity and subsequent infertility risk [28]. Comprehensive post-abortion care including safe uterine evacuation, prophylactic antibiotics where indicated, and follow-up prevents intrauterine adhesions and chronic pelvic inflammation [29].

Integration of neglected tropical disease (NTD) interventions is also relevant. In endemic regions, female genital schistosomiasis (FGS) may contribute to genital tract inflammation and subfertility; incorporating screening and praziquantel treatment within reproductive health services offers a cost-effective preventive measure [30]. Prevention initiatives should be embedded within broader sexual and reproductive health platforms to maximize reach and sustainability. By prioritizing infection control and maternal health quality, Cameroon can reduce preventable infertility before high-cost tertiary interventions become necessary [26,28].

5.2. Standardized couple-based diagnostic package at district level (minimum test set; task sharing; quality control)

Establishing a standardized basic infertility evaluation package at district hospitals is a pragmatic next step. The package should begin with couple-based triage: confirmation of infertility duration (≥12 months or ≥6 months if the female partner is ≥35 years), reproductive history, and identification of red flags requiring urgent referral [31]. Parallel first-line testing for both partners is essential. For men, at least one high-quality semen analysis performed according to standardized laboratory protocols should be routine [32]. For women, minimum evaluation includes menstrual history, pelvic ultrasound, ovulation assessment, and targeted endocrine testing when clinically indicated.

Where ovulation and semen parameters are acceptable, tubal and uterine assessment via hysterosalpingography (HSG) or alternative imaging should follow [31]. Task sharing can enable trained general practitioners or mid-level providers to conduct initial counseling and order standardized tests, reserving specialist referral for complex cases. Quality assurance mechanisms such as laboratory proficiency testing and adherence to clinical algorithms are crucial to prevent misclassification and unnecessary procedures [32].

Standardization reduces diagnostic delays, avoids duplication of tests across facilities, and promotes equitable access. It also creates structured data for monitoring and policy evaluation, linking clinical services with national reproductive health indicators [26].

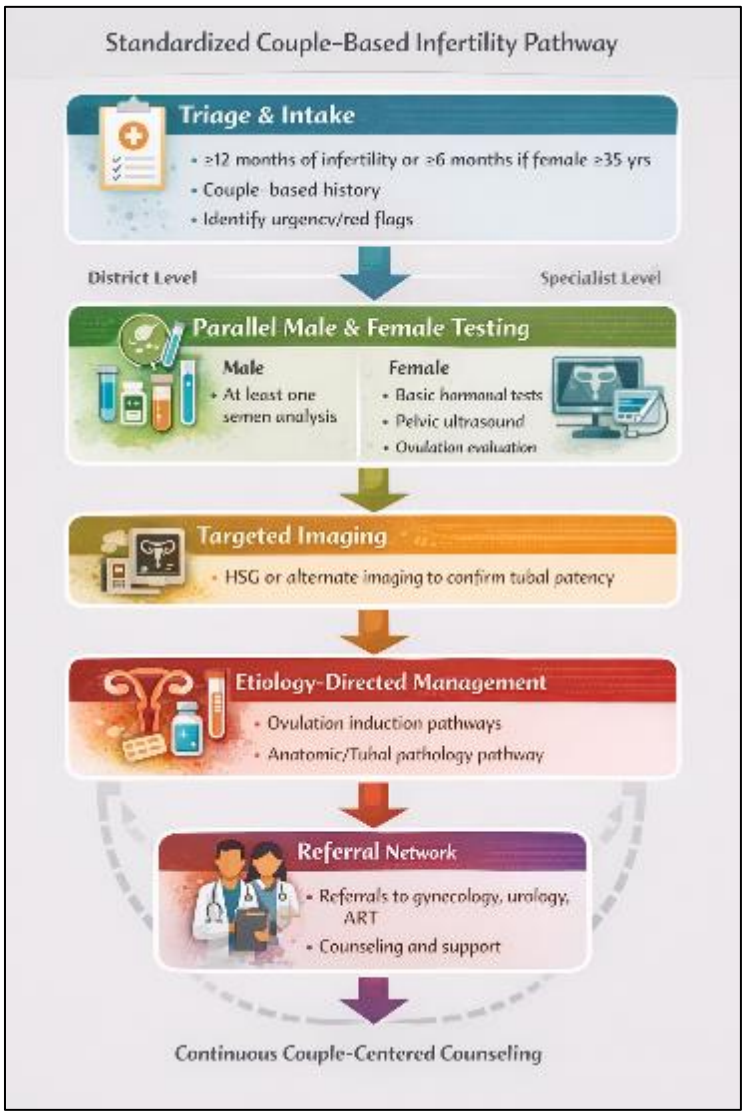

Figure 2 Standardized couple-based infertility pathway

5.3. Treatment + referral network (ovulation induction pathways; tubal disease referral; male urology links; counseling)

Following standardized diagnosis, treatment pathways must be clear and evidence-based. For women with confirmed anovulation, first-line ovulation induction using established protocols should be available at district level under appropriate supervision [31]. Where endocrine disorders such as thyroid dysfunction or hyperprolactinemia are identified, medical management can restore fertility without advanced intervention [32].

Cases suggestive of significant tubal disease such as bilateral obstruction or hydrosalpinx require timely referral to regional gynecologic centers for surgical evaluation or assisted reproductive technology (ART) consideration [27]. Clear referral criteria reduce prolonged empiric therapy and psychological distress. Parallel referral pathways to urology services are essential for men with azoospermia, severe oligozoospermia, or suspected varicocele [32].

Couple-centered counseling should accompany all treatment stages, emphasizing realistic success probabilities and time-sensitive decision-making, particularly for older patients [33]. A coordinated referral network linking primary, secondary, and tertiary care ensures continuity and minimizes attrition within the health system.

5.4. ART governance (regulation, accreditation, reporting, safety, ethics; avoiding exploitation)

Expansion of ART services in Cameroon must be carefully regulated to protect patients and maintain quality. National accreditation standards should define minimum laboratory requirements, embryology expertise, infection control measures, and transparent reporting of cycle numbers and outcomes [34]. Regulation prevents exploitative pricing, unproven adjunctive therapies, and unsafe embryo transfer practices that increase multiple gestation risk.

Ethical oversight should ensure informed consent, confidentiality, and nondiscrimination. Public reporting of pregnancy rates, complication rates, and multiple birth outcomes promotes accountability and trust [33]. Cross-border reproductive care, if utilized, should operate within regulated agreements to protect patient safety. By sequencing ART expansion after strengthening prevention and diagnostics, Cameroon can balance equity with fiscal sustainability [26,34].

5.5. Financing and UHC alignment

Infertility financing should align with universal health coverage (UHC) principles. The most cost-effective approach begins with subsidizing prevention and standardized diagnostic packages before extending coverage to high-cost ART [26]. Early STI detection, semen analysis, and ovulation assessment yield broader public health benefits and prevent downstream complications.

Public–private partnerships (PPPs) may support phased ART introduction while maintaining regulatory oversight [34]. Bundled diagnostic vouchers or insurance inclusion for first-line evaluation can reduce catastrophic out-of-pocket expenditure [24]. Cost-effectiveness analysis should be integrated into pilot programs to compare standardized infertility pathways against usual care, using metrics such as time-to-diagnosis and live birth per expenditure unit [31].

Sequenced financing ensures equitable access while safeguarding health system sustainability. National messaging should promote fertility awareness, normalize male evaluation, and counter misinformation without reinforcing stigma or blame [33].

6. Implementation roadmap and monitoring

6.1. Phased roadmap (0–18, 18–36, 36–60 months; roles: MoH, districts, labs, partners, regulators) (230 words)

A phased national roadmap allows Cameroon to sequence reforms realistically while building institutional capacity. Phase I (0–18 months) should focus on policy integration and standard setting. The Ministry of Health (MoH) would formally incorporate infertility into reproductive health strategies and develop national clinical guidelines aligned with universal health coverage principles [34]. District facilities would be trained on the standardized basic infertility package, including couple-based triage and early semen analysis. Laboratories would undergo quality assessment to ensure minimum technical capacity. Regulatory bodies would begin drafting accreditation standards for fertility services [35].

Phase II (18–36 months) should prioritize diagnostic expansion and referral network strengthening. Regional hubs would be equipped for hysterosalpingography, endocrine testing, and supervised ovulation induction. Structured referral algorithms linking district facilities to gynecology and urology specialists would be operationalized [36]. Partnerships with academic institutions and professional societies could support workforce training and laboratory

quality assurance. Concurrently, pilot financing mechanisms—such as subsidized diagnostic bundles—would be introduced to reduce catastrophic out-of-pocket spending [37].

Phase III (36–60 months) would focus on regulated ART service development and national registry implementation. Accredited centers would report standardized outcomes, ensuring transparency and safety [38]. Regulatory agencies would monitor pricing, ethical compliance, and data reporting. Throughout all phases, collaboration between MoH, district health offices, laboratory networks, civil society organizations, and development partners is essential for sustainability [34,36].

6.2. Monitoring & evaluation (coverage indicators, time-to-workup, semen analysis uptake, STI partner treatment, postpartum infection sentinel rates, equity stratifiers) (190 words)

Monitoring and evaluation (M&E) should integrate infertility indicators into existing reproductive health reporting systems. Core coverage indicators include: proportion of infertility clients receiving complete basic workup within three months; proportion undergoing semen analysis at first-line evaluation; and proportion of suspected STI cases with documented partner treatment [35]. Sentinel maternity facilities should track postpartum infection rates as a proxy for secondary infertility prevention effectiveness [36].

Equity stratifiers—such as urban versus rural residence, income quintile, age group, and educational level—are essential to detect disparities in access and outcomes [37]. Time-to-diagnosis and referral completion rates should be measured to evaluate system efficiency. ART centers, where operational, must report cycle numbers, pregnancy rates, multiple gestation rates, and adverse events under regulatory oversight [38].

Continuous feedback loops between district facilities and national authorities will allow real-time adjustments. Integration with digital health records, where feasible, can strengthen longitudinal tracking and reduce data fragmentation [39].

- Box 1. Minimum National Infertility Dashboard Indicators
- % clients completing standardized workup ≤3 months
- % male partners receiving semen analysis
- % STI cases with documented partner treatment
- Postpartum infection rate (sentinel sites)
- Referral completion rate
- Catastrophic OOP expenditure proportion

6.3. Risk register (feasibility constraints: labs, supply chains, stigma, costs; mitigation actions)

Implementation risks include inadequate laboratory infrastructure, inconsistent reagent supply chains, workforce shortages, and persistent stigma discouraging male participation [35]. Financial constraints may limit early uptake of diagnostic subsidies [37]. Mitigation strategies include phased procurement planning, laboratory mentorship networks, pooled purchasing agreements, and targeted community engagement campaigns to normalize couple-based evaluation [36]. Regular supervisory audits and transparent reporting can reduce quality variability and reinforce accountability [38].

7. Research gaps, limitations and future directions

7.1. Surveillance priorities (population estimates; infertility module in surveys; routine facility reporting)

Cameroon lacks population-representative infertility prevalence data. Incorporating infertility modules into national demographic and health surveys would provide standardized estimates of primary and secondary infertility across regions [39]. Routine facility reporting systems should also include infertility indicators such as etiologic classification and male-factor prevalence to strengthen longitudinal surveillance. Establishing a national infertility registry, particularly if ART services expand, would further enhance transparency and evidence-based planning [38].

7.2. Priority study designs + partnerships (exposure biomonitoring, male-factor cohorts, pragmatic trials; implementation science)

Priority research should include prospective cohorts assessing the incidence of infertility following laboratory-confirmed STIs to quantify causal pathways [35]. Biomonitoring studies measuring pesticide metabolites, heavy metals, and endocrine-disrupting chemicals could clarify environmental contributions [40]. Dedicated male-factor cohorts are

essential to estimate semen parameter distributions and modifiable exposure risks within Cameroonian populations [32]. Pragmatic trials comparing standardized infertility packages with usual care would generate cost-effectiveness and time-to-pregnancy data relevant for UHC decisions [34]. Partnerships between universities, public health institutes, and international reproductive health networks can strengthen methodological rigor and laboratory capacity while fostering implementation science approaches tailored to district health systems [36].

7.3. Evidence limitations (facility bias, heterogeneity, exposure measurement gaps, male data scarcity; generalizability)

Current evidence is limited by reliance on facility-based cohorts, which may overrepresent severe infertility cases and urban populations [42]. Heterogeneity in infertility definitions and diagnostic protocols reduces comparability across studies [36]. Environmental exposure data are sparse, with limited biomarker-based measurement in Cameroonian contexts [40]. Male-factor infertility remains underreported due to sociocultural barriers and laboratory constraints [43]. These gaps restrict precise national burden estimation and generalizability. Nonetheless, convergence of infectious, socioeconomic, and system-level evidence supports the urgency of integrated policy reform and structured research investment [41,39].

8. Conclusion

8.1. Integrated synthesis (how infections + system gaps + environment + socioeconomic shifts jointly drive rising infertility)

Infertility in Cameroon reflects the convergence of biological vulnerability and structural constraint. Persistent infectious exposures particularly untreated sexually transmitted infections and postpartum complications continue to generate tubal damage and chronic pelvic pathology. These risks are amplified by health-system gaps, including delayed diagnosis, fragmented referral pathways, limited laboratory capacity, and high out-of-pocket costs that discourage early care-seeking. Simultaneously, environmental and occupational exposures associated with agricultural chemicals, informal industrial activity, and urban air pollution introduce endocrine and oxidative stress pathways that may impair gamete quality. Socioeconomic transitions further reshape infertility profiles: delayed childbearing linked to education and labor participation interacts with age-related declines in fecundability, while migration and economic instability disrupt continuity of care. Together, these overlapping determinants produce a cumulative risk model in which preventable and emerging factors reinforce one another across the life course.

8.2. Policy "bottom line" (prevention + standardized diagnostics + male engagement + financing + regulated ART)

The policy imperative is clear: prioritize prevention through strengthened STI control and safer maternity care; institutionalize a standardized couple-based diagnostic package at district level; normalize and scale male-factor evaluation; and align infertility services with universal health coverage financing. Expansion of assisted reproductive technologies must proceed within a regulated, transparent framework that protects patients and ensures quality. Sequencing investments from prevention to diagnostics to specialized treatment maximizes equity, sustainability, and public health return.

8.3. Call to action (rights-based framing; measurable next steps; regional relevance)

Infertility should be recognized as a reproductive justice issue. With measurable targets and phased implementation, Cameroon can model equitable infertility care for similar low- and middle-income settings.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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