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ORIGINAL ARTICLE

Cross-Sectional Survey of Haemophilia Treatment Centres (HTCs) in India: Towards a Context-Sensitive Stratification Model

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Received: 24 November 2024 | **Revised:** 22 June 2025 | **Accepted:** 3 July 2025

Funding: The authors received no specific funding for this work.

Keywords: haemophilia | healthcare disparities | India | stratification | treatment centres | universal standards

ABSTRACT

Introduction: Haemophilia treatment centres (HTCs) coordinate multidisciplinary care, yet the European HTC standards on which global accreditation systems really do not reflect the wide resource gradient found in India.

Aim: To assess HTC capacities across India and explore a tiered stratification model suited to diverse settings.

Methods: A nationwide, self-administered survey (February 2021–April 2022) was e-mailed to all 291 HTCs registered with the Indian Association of Haemophilia and Allied Disorders. It captured infrastructure, laboratory capability and clinical services. Descriptive statistics and Spearman correlation were applied.

Results: Ninety centres (30%) responded from 24 states/UTs. Only 34% fulfilled European HTC (EHTC) criteria and 11% met comprehensive-care (EHCCC) criteria; 55% were unclassified despite providing haemophilia care. Laboratory-to-clinical functionality showed a moderate correlation ($r = 0.61$, $p < 0.001$). Twenty-seven percent of centres operated without an onsite coagulation laboratory, whereas 40% lacked full-time nurses and 60% lacked multidisciplinary teams. Factor VIII/IX supplies were uninterrupted at 31% of sites; 38% offered prophylaxis to at least one patient.

Conclusion: Rigid European categories mask the stepwise growth of Indian HTCs. A four-tier model—anchored in predefined criteria for clinical and laboratory services could guide incremental upgrading while preserving patient safety.

1 | Introduction

Haemophilia, though rare, imposes lifelong morbidity and cost. The World Federation of Haemophilia (WFH) estimates only 18% of the ≈140,000 Indians with haemophilia are formally registered which accounts for 6% of the identified cases worldwide [1]. Current Indian practice depends heavily on a scattered network of government, private and not-for-profit HTCs with heterogeneous

- Haemophilia is a rare bleeding disorder that requires specialised treatment provided by Haemophilia Treatment Centers (HTCs). However, the current European classification standards for HTCs often do not reflect the diverse needs and capabilities of centres in countries like India, where healthcare resources vary widely.
- This study surveyed 90 HTCs in India to evaluate their clinical and laboratory services and propose a universal classification system. The results showed that only 34% of Indian HTCs met basic European standards, and over half lacked access to comprehensive laboratory facilities. Despite these challenges, many centres provided critical care for haemophilia patients using available resources.
- The study suggests a more inclusive model that categorises HTCs based on their unique capacities. This approach aims to improve haemophilia care by recognising and addressing the disparities in resources and infrastructure across different regions. By adopting this framework, HTCs worldwide can work towards tailored improvements in care quality, benefiting patients everywhere.

resources. International accreditation frameworks, derived mainly from European and North-American experience, require full on-site laboratory diagnostics, inhibitor management and comprehensive clinical teams [2–6]. Many Indian centres cannot yet meet these benchmarks because of funding, geographic and workforce constraints. Treating every facility that fails these benchmarks as 'sub-standard' may be counter-productive: it discourages incremental investments and obscures the achievements of centres that have already expanded access to factor replacement therapy [2–6].

The World Federation of Haemophilia (WFH) defines HTCs as centres that offer comprehensive care, including 24-h haematological services and various support services [4]. Haemophilia comprehensive care centres (HCCCs) are expected to offer even more extensive care, including specialised services such as inhibitor management and home therapy. These standards are largely based on European models, such as the European Haemophilia Treatment Centres (EHTCs) and European Haemophilia Comprehensive Care Centres (EHCCCs) [5, 6]. However, these standards may not fully reflect the conditions in low- and middle-income regions, including government-funded centres in India, where funding and workforce models differ markedly from European contexts [7].

A survey on adherence to this classification conducted in 21 centres across 14 European countries revealed that 36% of patients received treatment outside of centres that met the definitions of EHTCs or EHCCCs [8]. Indian Association of Haemophilia and Allied Disorders (IAHAD) serves as the analogous governing body in India [9].

Just as health systems follow a hierarchical structure, from primary to quaternary care, and neonatal intensive care units (NICU) services offer a clear analogy for this effective tiered approach. In NICU systems, a Level I nursery offers basic stabilisation and promptly transfers complex cases to progressively higher tiers, while Levels III–IV provide advanced ventilation, surgery and extracorporeal support for the sickest newborns. Similarly, our HTC Levels I–IV move step-wise from essential acute-bleed management (Level I) to comprehensive surgery, immune-tolerance induction and molecular diagnostics (Level IV), with explicit referral pathways so that patients seamlessly 'step up' to centres equipped for higher-complexity haemophilia care [10–12] (Figure 1). Previous studies have examined the optimal configuration for HTC stratification, with recommendations varying between two and four tiers depending on factors such as geographical location and resource availability. In some cases, such as Thailand, as many as six levels are considered [13]. A 2017 pilot survey of 52 Indian HTCs (85% response across 17 states) found that functional laboratories existed at 53% of centres; only four met EHTC and two met EHCCC standards. All centres managed acute bleeds, but just half treated chronic arthropathy (Level III) and 16% performed surgery (Level II). Only one-third of laboratories met quality-control requirements and conducted factor assays [14].

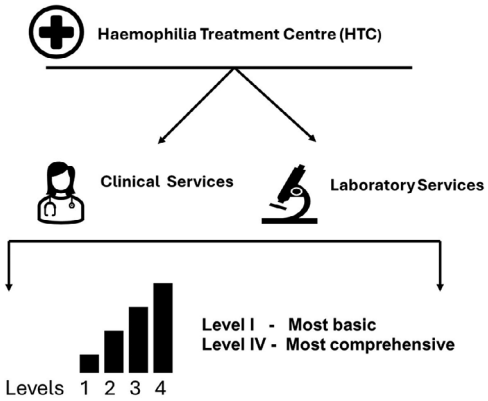

FIGURE 1 | Haemophilia Treatment Centre stratification.

We surveyed all recognised 291 Indian HTCs [9] by IAHAD to quantify service gaps and to test the feasibility of a staged, context-sensitive stratification that would acknowledge progress while setting clear targets for scale-up.

2 | Materials and Methods

2.1 | Design and Setting

A cross-sectional, questionnaire-based survey was conducted from 1 February 2021 to 30 April 2022. All 291 facilities listed by IAHAD as administering factor concentrates were invited by email and telephone reminders.

2.2 | Questionnaire

Nine domains captured centre ownership, patient volume, clinical services, staffing, space allocation, factor availability, prophylaxis practice, surgical capability and laboratory tests. Face validity was confirmed by five domain experts; the electronic

TABLE 1 | The levels of clinical services in Haemophilia Treatment Centres (HTC).

Levels of facility	Functionality	Facility requirement
Level I	Ability to manage acute bleeds. Maintain an in-house database and make efforts to work towards sending data to the National Haemophilia Registry	A doctor trained in basic haemophilia care. Availability and expertise to use factor concentrates (CFC) Dedicated/part time nurse who can administer CFC.
Level II	In addition to Level I, Ability to support patients with chronic synovitis/arthropathy.	Level I + Physiotherapist with or without facility for radioisotope synovectomy.
Level III	In addition to Level II, Ability to perform surgery for PWH, 24-hour clinical facility, and facility to initiate continuous or intermittent prophylaxis. Ability to use bypassing agents. Submit data to the National Haemophilia Registry.	Level II + Haematologist/MD Physician or Paediatrician who is trained in haemophilia surgical care. Back-up surgical team, 24-hour emergency services. Ability to manage other rare bleeding disorders; dedicated nurse coordinator; PMR doctor, occupational therapist; social worker; dentist; psychiatrist (multidisciplinary care). Provides advisory services, including genetic counselling, to patients and healthcare professionals.
Level IV	Ability to conduct immune tolerance induction treatment (ITI). Work in close association with National Haemophilia registry.	Level III + Physician/Haematologist trained in ITI.

TABLE 2 | The levels of diagnostic/laboratory services in the Haemophilia Treatment Centers (HTC).

Levels of facility	Functionality	Facility requirement
Level I	PT, APTT, TT, mixing studies/correction studies, daily use of quality controls (pooled normal plasma (PNP) or commercial plasma)[a]	Manual/semi-automated/automated instruments. Trained manpower
Level II	Factor VIII and IX assay, time dependent Inhibitor screen[b,c]	Level I + Trained manpower to perform these tests
Level III	Inhibitor titre/Bethesda assay. Other rare factor assays. vWF assays (quantitative and functional), Platelet function tests[d]	Level II + Platelet aggregometer.
Level IV	Facility for mutation studies and ability to perform antenatal testing through CVS (Chorionic villous sampling)	Level III + Molecular lab

[a]Should be able to perform in case of emergency whenever required.

[b]All routine assays should be performed at least once every 2 weeks.

[c]The inhibitor screen is an APTT-based test that evaluates the effect of mixing test plasma with control plasma after incubation for 1–2 h. A positive inhibitor screen indicates the presence of an inhibitor and necessitates an inhibitor assay (Bethesda or Nijmegen modifications).

[d]*TAT: within 3 h.*

form was pilot-tested for usability. This study is being reported based on the CHERRIES (Checklist for Reporting Results of Internet E-Surveys) statement guidelines [15]. The usability and technical functionality of the electronic questionnaire was field tested by a core group before sending them out. The contact mode for the participants was telephone calls and emails to ensure receipt of the questionnaire. Survey forms were emailed individually as attachments or by Google forms and responses were captured automatically. This was a voluntary survey where the objectives of the study were described, the duration of 30 min was mentioned, no incentives were offered, and an informed consent was taken from each participant prior to the beginning of the survey. Responses from physicians who did not give consent or those who did not work in an HTC in India were excluded.

2.3 | Definitions

An HTC was defined as a facility offering access to clotting factor concentrates (CFC) through means such as HFI through the world federation of haemophilia (WFH) humanitarian aid program [16], central government procurement, or state supply via National Health Missions [17], and equipped to administer the factor, with at least one part-time doctor and a nurse trained in factor infusion, regardless of patient volume. HTC levels were pre-specified (Tables 1 and 2). Level I required a doctor + nurse trained in factor infusion with 24-h access to concentrates; Level IV added immune-tolerance induction and molecular diagnostics. European EHTC/EHCCC criteria served as an external reference. Centres without on-site labs but meeting clinical criteria were still classified.

TABLE 3 | Profile of HTCs ($n = 90$).

Variable	*n*	%
Which sector does your HTC belong to, private or government		
Government sector	52	57.78
Private sector	38	42.22
Which category best represents the level of care offered at your facility?		
Primary care	22	24.44
Secondary care	27	30.0
Tertiary care	41	45.56
Profile of patients coming to your hospital		
Haemophilia patients only (Standalone Centre: exclusively for haemophilia patients)	8	8.89
Multispecialty	82	91.11
How would you describe the space allocated for day-care services for haemophilia treatment at your centre?		
No exclusive or shared day care facility	15	16.67
Shared space for Haemophilia treatment	39	43.33
We have dedicated space (day care centre) exclusively for PwH (Patients with Haemophilia)	36	40.0
How do you best describe your centre in patient care of PwH		
Shared space for inpatient care	20	22.22
We do not have in-patient care facility	9	10.0
We have standalone in-patient care facility only for PwH	11	12.22
We Share the in-patient care with Internal medicine	6	6.67
We Share the in-patient care with Paediatric medicine	9	10.0
We share the inpatient facility with other haematology patients	16	17.78
We Share with both in Internal medicine and Paediatrics	19	21.11

2.4 | Analysis

Data were entered in Excel and analysed in SPSS v21 ((IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp). Continuous variables are median (range); categorical variables as number (%). Correlation between laboratory and clinical level used Spearman's ρ.

3 | Results

3.1 | Response and Geography

Ninety HTCs (30%) responded, representing 78% of Indian states/UTs. Fifty-eight percent were government-funded and 91% were multi-specialty hospitals.

3.2 | Patient Load

Median case-load was 126 (1–2972) PwH; less than 10 patients were only in six centres and 55% of centres had >250 patients registered with them (Table 3).

3.3 | Infrastructure

Dedicated day-care units existed in 40% of sites; 43% administered infusions in shared spaces. Standalone haemophilia wards were rare (12%).

3.4 | Human Resources

Full-time haemophilia physicians were available at 74% and nurses at 38%. Only two in five centres offered a complete multidisciplinary team. (Figure 2)

3.5 | Laboratory Capability

Twenty-two centres (24%) lacked any on-site coagulation laboratory; 53% used fully automated coagulometers. Only 40% could perform factor assays and inhibitor screening; Bethesda quantification was available at 31% (Figure 3).

3.6 | Clinical Services

Minor surgery was feasible at 29% of centres, major surgery at 16%, and immune-tolerance induction at 17%. Bypassing agents (aPCC or rFVIIa) were stocked at 49%.

3.7 | Factor Supply and Prophylaxis

Continuous annual supply of factor VIII/IX was reported by 31% of centres; 38% had never offered prophylaxis. Government programmes were the dominant source of concentrates (36%),

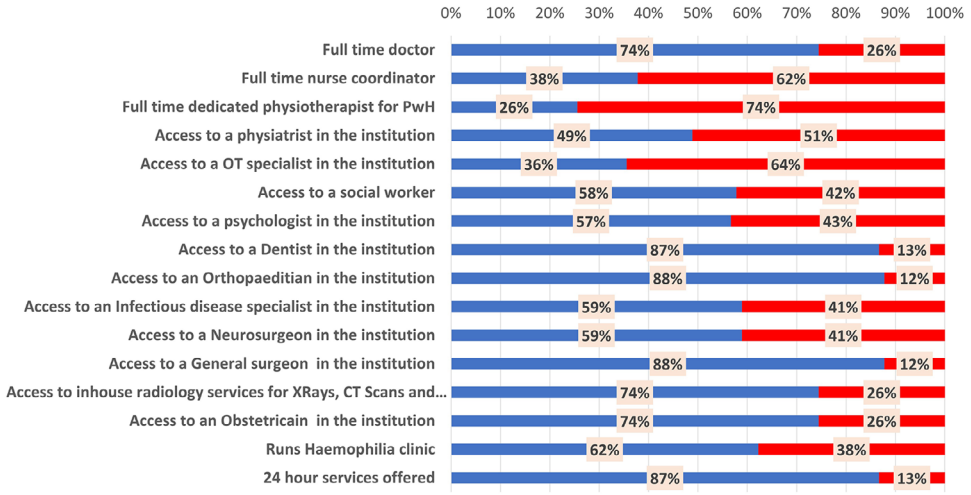

FIGURE 2 | Availability of clinical services.

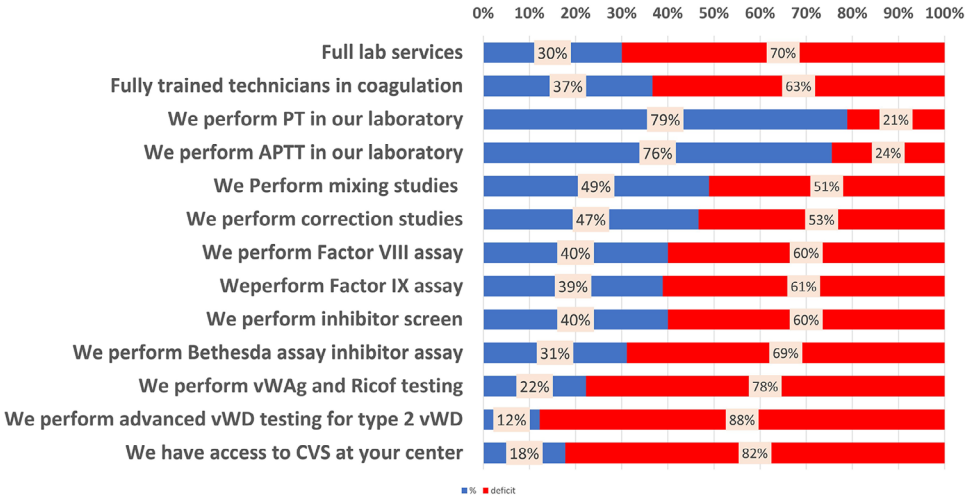

FIGURE 3 | Availability of laboratory services.

followed by mixed government + humanitarian supply (32%) (Table 4).

3.8 | European Classification

Thirty-one centres (34%) met EHTC standards and 10 (11%) met EHCCC standards. The remaining 49 (55%) could not be classified despite providing services. Laboratory and clinical stratification levels showed moderate association ($\rho = 0.61$, $p < 0.001$) (Table 5 and Figure 4).

4 | Discussion

This nationwide mapping reveals marked heterogeneity in Indian HTC capability. The majority function below European thresholds, yet many still deliver critical acute bleed management and factor distribution. Lab facilities trail clinical services, underscoring the importance of inter-centre referral networks. The four-tier framework we used accommodates this gradient. Level I mirrors essential care designation: a doctors, nurses and factor access and a formal link to a higher-level laboratory. Progression to higher levels is incentivised by clearly defined staffing and testing requirements, analogous to neonatal and trauma service tiering [10, 18].

A Level 1 centre can progressively upgrade its capacity by establishing formal collaboration with a higher-tier centre through a hub-and-spoke model. In this structure, the Level 1 centre (spoke) maintains clear, defined lines of communication with a higher level hub, ensuring timely access to shared services such as coagulation diagnostics (e.g., FVIII, FIX assays, inhibitor testing), surgical expertise and multidisciplinary care. The hub provides not only referral pathways for complex cases but also advisory support and structured training to build local capacity over time. While spoke centres coordinate pre- and post-treatment care and monitoring. Through periodic surveys and audits, gaps can be identified and reported to health authorities, facilitating resource allocation, establishing formal hub-spoke linkages and defining measurable upgrade criteria for lower-tier centres to progress to higher levels of haemophilia care.

TABLE 4 | Factor supply and utilisation.

Variable	n	%
What best describes factor source at your centre		
No free factor sources at our centre and patients have to buy on their own	6	6.67
We get free factors from HFI only	22	24.44
We get free factors through the government supply (NHM, ESI, ECHS)	32	35.56
We buy factor using our Institutional Funds	1	1.11
We get factors from both HFI and Government	29	32.22
What best describes the availability of the factor VIII and IXa		
We have factor supply more than 75% of the year but not 100%	45	50
We have factors available throughout the year (100% of the time) from the source we procure from	28	31.11
We have supply 50%–75% of the time of the year	9	10
We only have factor supply <25% of the time of the year	4	4.44
We only have supply 25%–50% of the time of the year	4	4.44
Percentage of patients on prophylaxis at your centre		
<1%	21	23.33
>25%	6	6.67
0%	34	37.78
1%–5%	17	18.89
5%–25%	12	13.33
>25%	6	6.7
Bypassing agent utilisation		
We do not have any Bypassing agents	46	51.11
We get bypassing on demand on case-to-case basis	4	4.44
We have both aPCC and rFVIIa at our centre	28	31.11
We only have aPCC at our centre	4	4.44
We only have rFVIIa at our centre	8	8.89

TABLE 5 | Levels of laboratory and clinical functionality.

Level	Laboratory functionality (*n*)	Clinical functionality (*n*)
1	24	19
2	9	21
3	27	35
4	8	15
Total	68	90

Note: Correlation Spearman rho $r = 0.609$ (2 tailed $p = 0.000$).

Such a staircase avoids the binary' centre / non-centre' label and provides regulators with a planning tool. Comparison with the 2017 pilot survey suggests modest progress: the proportion of centres able to perform factor assays increased from 33% to 40%, and access to inhibitor screening rose from 33% to 40%. However, the proportion of centres meeting EHTC/EHCCC criteria remained low.

4.1 | Policy Relevance

Mapping level distribution pinpoints where incremental investments—that is, regional coagulation labs, nurse training or state factor tenders—will yield the greatest equity gains. The data will inform the policymakers in Ministry of Health and Family Welfare and the National Health Mission officials. The Donabedian model, a well-established framework for evaluating healthcare services through structure, processes and outcomes, complements this approach [19]. It emphasises achieving excellence at every level of healthcare delivery, regardless of the starting point, by linking clear quality improvement (QI) processes to key performance indicators (KPIs) specific to haemophilia care [20]. This model also aligns with a future certification and accreditation systems that can be designed for HTCs, enabling them to progressively undertake higher levels of care, including advanced therapies such as gene therapy [21–23].

4.2 | Limitations

Include self-reporting and a 30% response rate; however, respondent centres span all regions and care for an estimated two-thirds of registered PwH, supporting external validity.

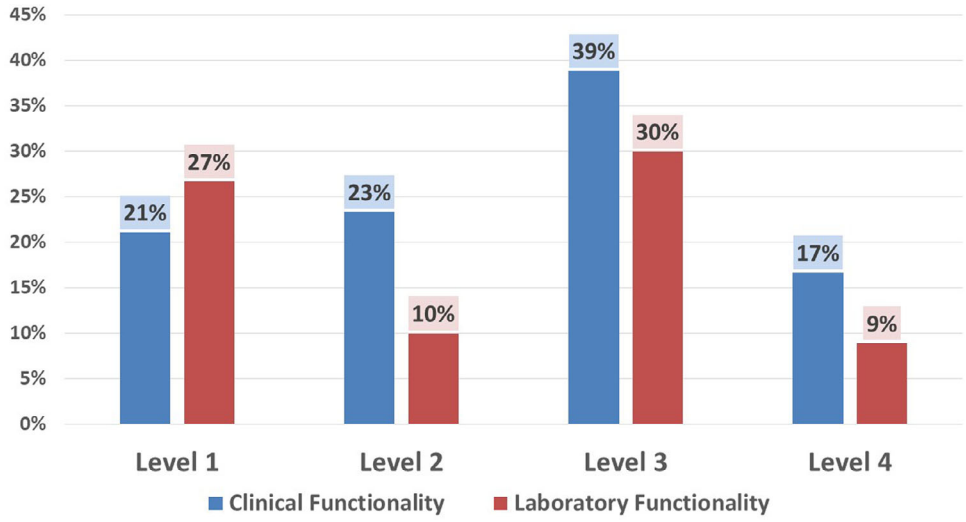

FIGURE 4 | Variation in clinical and laboratory functionality levels in Haemophilia Treatment Centers. (22 (24%) HTCs did not have laboratory services).

4.3 | Future Directions

Similar surveys in other low- and middle-income countries could validate the tier definitions and facilitate an eventual global consensus list of minimum service indicators. Such evaluations done every 3–5 years will help us monitor the Haemophilia care trajectory in the country.

5 | Conclusion

Rigid adoption of European HTC definitions leaves more than half of Indian centres unrecognised and potentially un-resourced. A pragmatic, four-level stratification grounded in minimum safety standards and progressive capacity building more accurately reflects reality and provides a roadmap for universal, comprehensive care.

Author Contributions

All authors contributed significantly to the study. M.J.J., C.S. and T.A. were responsible for conceptualisation and study design. Data collection and survey implementation were conducted by N.S., R.S., S.A. and A.A. Data analysis and interpretation were performed by M.J.J. and T.A. and drafted the manuscript, while A.S., N.G, N.S. and R.S. critically reviewed and revised it. All authors have approved the final manuscript and agreed to be accountable for all aspects of the work.

Acknowledgements

The authors would like to thank all the participants who responded to this survey and Mr. Markas Masih, who helped in contacting the various centres, and Mr. Marimuthu, biostatistician at CMC Vellore, who helped with the analysis.

Ethics Statement

The study, as an audit, analysed aggregate data without collecting sensitive or identifiable information or involving interventions on humans or animals, ensuring no privacy risks. Consent from participating centres ensured transparency, and the nature of the work aligns with ethical standards for audits, obviating the need for formal ethics committee approval.

Consent

As this study involved surveys of institutions and did not involve individual patients, patient consent was not applicable. Institutional consent was obtained from participating centres.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

All relevant data underlying the findings of this study are included in the manuscript. Additional details about the data sets generated and analysed during the study can be provided at request to the corresponding author.

References

1. World Federation of Hemophilia. *World Federation of Hemophilia Report on the Annual Global Survey 2022*, https://wfh.org/. (October 2023).

2. A. Srivastava, A. K. Brewer, E. P. Mauser-Bunschoten, et al., "Guidelines for the Management of Hemophilia," *Haemophilia* 19, no. 1 (2013): e1–47.

3. P. H. Levine, B. A. McVerry, A. E. Segelman, et al., "Comprehensive Health Care Clinic for Hemophiliacs," *Archives of Internal Medicine* 136, no. 7 (1976): 792–794.

4. A. Srivastava, E. Santagostino, A. Dougall, et al., "WFH Guidelines for the Management of Hemophilia, 3rd Edition," *Haemophilia* 26 (2020): 1–158.

5. B. T. Colvin, J. Astermark, K. Fischer, et al., "European Principles of Haemophilia Care," *Haemophilia* 14, no. 2 (2008): 361–374.

6. P. Giangrande, G. Calizzani, I. Menichini, et al., "The European Standards of Haemophilia Centres," *Blood Transfusion* 12, no. S3 (2014): s525–s530.

7. P. S. Smith and P. H. Levine, "The Benefits of Comprehensive Care of Hemophilia: A Five-Year Study of Outcomes," *American Journal of Public Health* 74, no. 6 (1984): 616–617.

8. K. Fischer and C. Hermans, "The European Principles of Haemophilia Care: A Pilot Investigation of Adherence to the Principles in Europe," *Haemophilia* 19, no. 1 (2013): 35–43.

9. *Indian Association of Haemophilia and Allied Disorders—IAHAD* (IAHAD, 2020).

10. American Academy of Pediatrics Committee on Fetus and Newborn, "Levels of Neonatal Care," *Pediatrics* 130, no. 3 (2012): 587–597.

11. S. L. Goel, *Health Care System and Management: Health Care Organisation and Structure* (Deep and Deep Publications, 2001).

12. T. Torrey. How the 4 Levels of Medical Care Differ.

13. P. Isarangkura, "Haemophilia Care in the Developing World: Benchmarking for Excellence," *Haemophilia* 8, no. 3 (2002): 205–210.

14. M. J. John, N. Kakkar, A. Mathew, et al., "Hemophilia Treatment Center: A Stratification Model for Developing Countries: A Pilot Study From India," *CHRISMED Journal of Health and Research* 4 (2017): 253–258.

15. G. Eysenbach, "Improving the Quality of Web Surveys: The Checklist for Reporting Results of Internet E-Surveys (CHERRIES)," *Journal of Medical Internet Research [Electronic Resource]* 6, no. 3 (2004): 3–9.

16. Humanitarian Aid. *World Federation of Hemophilia* (January 2022).

17. *Ministry of Health, Family Welfare-Government of India*. (Home:: National Health Mission).

18. S. Waibel, J. Williams, Y. Tuff, et al., "Development of the Tiers of Service Framework to Support System and Operational Planning for Children's Healthcare Services," *BMC Health Services Research [Electronic Resource]* 21, no. 1 (2021): 693.

19. R. Tossaint-Schoenmakers, A. Versluis, N. Chavannes, et al., "The Challenge of Integrating eHealth into Health Care: Systematic Literature Review of the Donabedian Model of Structure, Process, and Outcome," *Journal of Medical Internet Research [Electronic Resource]* 23, no. 5 (2021): e27180.

20. M. Khalifa and P. Khalid, "Developing Strategic Health Care Key Performance Indicators: A Case Study on a Tertiary Care Hospital," *Procedia Computer Science* 63 (2015): 459–466.

21. F. Candura, I. Menichini, G. Calizzani, et al., "The Methodology for Defining the European Standards for the Certification of Haemophilia Centres in Europe," *Blood Transfusion* 12, supplement, no. S3 (2014): s519–s524.

22. P. M. Mannucci and I. Menichini, "A Certification/Accreditation Model for Haemophilia Centres in Italy," *Blood Transfusion* 12, supplement, no. S3 (2014): s505–s509.

23. A. Boban, F. Baghaei, F. Karin, et al., "Accreditation Model of European Haemophilia Centres in the Era of Novel Treatments and Gene Therapy," *Haemophilia* 29, no. 6 (2023): 1442–1449.