

Review Article

FibroScan as a recommended modality for diagnosis of non-alcoholic fatty liver disease at the district level: a SWOT analysis

Surbhi Negi¹, Aakash Sachdeva^{2*}

¹Department of Community Medicine and Family Medicine, All India Institute of Medical Sciences, Gorakhpur, Uttar Pradesh, India

²Department of Community Medicine, All India Institute of Medical Sciences, Rishikesh, Uttarakhand, India

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*Correspondence:

Dr. Aakash Sachdeva,

E-mail: aakashsachdeva542@gmail.com

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ABSTRACT

Non-Alcoholic Fatty Liver Disease (NAFLD), increasingly known as Metabolic Dysfunction-Associated Steatotic Liver Disease (MASLD), is the most common chronic liver condition both globally and in India. FibroScan (vibration-controlled transient elastography; VCTE) provides a non-invasive, rapid, and reproducible alternative to liver biopsy by simultaneously measuring hepatic steatosis through the Controlled Attenuation Parameter (CAP) and liver fibrosis via Liver Stiffness Measurement (LSM). This review article assesses the feasibility and implications of implementing FibroScan in district-level health facilities in India using a structured SWOT (strengths, weaknesses, opportunities, and threats/challenges) analysis. The key strengths of FibroScan include its proven diagnostic accuracy, patient acceptability, and alignment with national non-communicable disease priorities. However, its weaknesses encompass costs, operator dependence, and reduced accuracy in obese patients. Many challenges are faced in the implementation of FibroScan at the district level, including the lack of infrastructure, trained personnel and health care financing. But FibroScan also offers the possibility of earlier case detection, fewer liver biopsies, better public health surveillance, and better preventive lifestyle outreach. Strategic policy integration within the Ayushman Bharat framework and the development of models for public-private partnerships could be very useful in facilitating its decentralized adoption.

Keywords: FibroScan, NAFLD, MASLD, Transient elastography, District hospital, SWOT analysis, Noninvasive diagnosis, Primary care, India

INTRODUCTION

Non-alcoholic fatty liver disease (NAFLD) is defined as the accumulation of excess fat in the liver ($\geq 5\%$ of hepatocytes) in individuals without significant alcohol consumption and other secondary causes. It has become the leading cause of chronic liver disease worldwide. The recent international consensus (2023) has proposed

renaming the condition as Metabolic Dysfunction-Associated Steatotic Liver Disease (MASLD) to reflect its pathophysiological underpinning in metabolic dysfunction including obesity, type 2 diabetes mellitus (T2DM) and dyslipidaemia.¹ MASLD/NAFLD includes a histologic spectrum of simple steatosis to non-alcoholic steatohepatitis (NASH/MASH), progressive fibrosis, cirrhosis, and hepatocellular carcinoma.

The data from the Global Burden of Disease (GBD) 2021 show that the burden of NAFLD-related chronic liver disease and cirrhosis is the highest in India, versus China and the United States. These three countries account for about one-third of all DALYs and mortality attributable to NAFLD globally.² Overall prevalence estimates of NAFLD from Indian studies ranged from 9% to >53% in a systematic review and meta-analysis. Heterogeneity was driven by geography, dietary patterns and the soaring metabolic burden.³

Liver biopsy, the historical reference standard for staging NAFLD-related fibrosis, is invasive, expensive, subject to sampling variability and impractical for population-level screening. FibroScan (Echosens, Paris, France) is a prototype of a vibration-controlled transient elastography (VCTE) platform that simultaneously measures liver stiffness (a surrogate for fibrosis) and the Controlled Attenuation Parameter (CAP; a surrogate for steatosis) in a single outpatient encounter that takes less than ten minutes and is non-invasive. Major hepatology societies, including the American Association for the Study of Liver Diseases (AASLD 2023) and the European Association for the Study of the Liver (EASL 2021), have now endorsed VCTE/FibroScan as a first-line imaging-based tool for hepatic fibrosis assessment in high-risk individuals.⁴

In much of the country, especially in semi-urban and rural areas, district-level hospitals are the first point of contact for the population. Therefore, the feasibility and effectiveness of FibroScan integration at this level of care is of considerable public health significance. This review article employs a formal SWOT framework to evaluate the potential advantages, difficulties, barriers to implementation and opportunities of employing FibroScan at district hospitals in India.

METHODS

We conducted an extensive narrative review of published literature in the PubMed/MEDLINE, Scopus and Google Scholar databases. The search strategy was performed using the combination of the following MeSH terms and free-text keywords: “FibroScan,” “vibration-controlled transient elastography,” “VCTE,” “Non-Alcoholic Fatty Liver Disease,” “NAFLD,” “MASLD,” “controlled attenuation parameter,” “liver stiffness measurement,” “noninvasive diagnosis,” “district hospital,” “primary care,” “SWOT,” and “India.” Inclusion criteria: articles published in English and indexed in PubMed from January 2018 to June 2026. Case reports, editorials and studies with less than 50 participants were excluded. When original data were not available high-quality systematic reviews, meta-analyses and international endorsed clinical practice guidelines were used. A qualitative synthesis of relevant data, thematic findings and evidentiary statements were arranged under the four components of the SWOT framework: strengths, weaknesses, threats and opportunities.

RESULTS

The following section outlines the objective clinical, technical, and epidemiological findings extracted from the literature regarding the use of transient elastography.

Noninvasive nature and reproducibility

FibroScan (transient elastography) is a completely non-invasive, pain-free alternative to traditional liver biopsy that quickly measures liver stiffness without the risk of bleeding or hospitalization. It shows a good intra- and inter-observer reproducibility. The results are highly reproducible and reliable even if the examinations are performed by different healthcare providers. This combination of safety and precision makes it a perfect, easily repeatable tool for monitoring liver disease progression and treatment response longitudinally over time.⁵

Simultaneous quantification of steatosis and fibrosis

FibroScan provides a complete hepatic evaluation in a single visit, simultaneously measuring hepatic fat content (via CAP) and liver stiffness (via LSM), unlike traditional ultrasound or serum biomarkers. The 2023 AASLD Practice Guidance recommends CAP as a point-of-care tool for steatosis detection and VCTE as the most widely used and validated method for liver stiffness assessment, including secondary triage after an elevated FIB-4 index (>1.3). This dual modality capability is especially relevant for district level facilities where MRI and liver biopsy are generally not available.⁴

Guideline endorsement and growing evidence base

In both the AASLD (2023) and EASL (2021) international guidelines, VCTE is the preferred imaging-based test for staging liver fibrosis in NAFLD, especially in high-risk individuals, such as those with T2DM or medically complicated obesity. FibroScan is also recommended as the preferred tool for further workup when the FIB-4 score is indeterminate or high, as per the 2022 AACE clinical practice guidelines. This strong guideline endorsement provides clinical legitimacy to implementation at the district level as part of formal screening algorithms.⁴

Operator dependence and technical limitations in obesity

Results of FibroScan depend on operator’s training and experience. Reliability indices – inter-quartile range to median LSM ratio (IQR/M <0.3) and number of valid shots (≥10 of 10 attempts) – should be routinely monitored to ensure validity of results. Critically, a systematic review and meta-analysis showed that unreliable measurements are independently associated with BMI ≥30 kg/m² and that 83% of patients with morbid obesity who could not be measured with the

standard M-probe required the XL probe. This is a major practical limitation in district level facilities where access to XL probe may be limited given the high prevalence of obesity and metabolic syndrome in Indian patients presenting with NAFLD.⁶

Reduced discriminative accuracy for intermediate fibrosis stages

Although FibroScan reliably rules out cirrhosis and advanced fibrosis at the extremes of the fibrosis spectrum, its performance to discriminate intermediate fibrosis stages (F1 vs. F2) is much lower with AUROC values falling to 0.69–0.73 for lower-grade steatosis detection (S1). False positive in LSM can also be observed in the setting of comorbidities that increase liver stiffness per se such as right heart failure, acute hepatitis, cholestasis and significant hepatic inflammation especially in post-COVID or polycomorbid patients at district level.⁷

Cost and maintenance burden

Although significantly cheaper than liver biopsy, MRI-elastography, or liver biopsy with hospitalization, FibroScan devices carry a procurement cost of approximately USD 25,000–45,000 per unit internationally, with recurring costs for consumables, calibration, and maintenance. In settings where public sector district hospitals in India operate under budgetary constraints, this initial capital investment and recurring service costs may be prohibitive without dedicated programmatic funding. Cost-comparison analyses in high-income settings have shown FibroScan-based algorithms to reduce unnecessary specialist referrals and long-term secondary care costs, generating substantial savings per 1,000 patients referred, but analogous data from Indian district-level settings remain absent.⁸

Metabolic comorbidities affecting diagnostic accuracy

NAFLD's strong association with T2DM, obesity, and metabolic syndrome directly compromises FibroScan's technical performance. A systematic review confirmed that for obese patients (BMI ≥ 30 kg/m²), higher CAP diagnostic thresholds and XL probe utilization are required for accurate steatosis quantification, but calibration and consensus on cut-offs for Indian populations are currently lacking. The conditions common at district-level presentations including uncontrolled diabetes, hepatic congestion, and acute exacerbations of chronic liver disease may inflate LSM readings and generate false-positive advanced fibrosis diagnoses.⁶

DISCUSSION

Translating the reviewed clinical evidence into practice reveals critical operational avenues and systemic hurdles for deploying this technology in primary and secondary care environments.

Patient acceptability and workflow integration

FibroScan is well received by patients and can be easily integrated into the outpatient setting for non-communicable disease clinics (diabetes, hypertension, obesity) allowing opportunistic screening for liver disease without the need for dedicated hepatology services. A large multicentre MAP study in 105 Indian diabetes and endocrine clinics showed the feasibility of large-scale MASLD assessment by FibroScan (LSM and CAP) and highlighted its utility in busy clinical settings.⁹

Early case detection and biopsy avoidance

Early identification of significant hepatic fibrosis (F ≥ 2) allows for timely lifestyle and pharmacological interventions that can arrest disease progression, reduce the risk of cirrhosis and hepatocellular carcinoma, and prevent liver-related mortality. Integration of FibroScan within established NCD clinics (diabetes, hypertension, obesity) at district hospitals creates a sustainable pipeline for opportunistic NAFLD screening. Given that India harbours the highest NAFLD-attributable DALYs globally and NAFLD prevalence in north Indian T2DM patients approaches 72%, even a modest district-level FibroScan programme could identify thousands of high-risk individuals annually who would otherwise remain undiagnosed until symptomatic liver disease develops.²

Integration with sequential algorithms to optimize cost-effectiveness

Both AASLD and EASL support sequential diagnostic pathways starting with cheap and easily accessible serum-based markers such as the FIB-4 index (based on age, AST, ALT and platelet count) to filter patients in the first line followed by FibroScan only in those with FIB-4 > 1.3 and significantly decrease the number of patients needing elastography.⁴

Lifestyle counselling and community awareness

Clinical evidence shows that informing patients about their liver fibrosis status using FibroScan enhances their adherence to lifestyle modification programs. Patients who are aware of significant hepatic steatosis or fibrosis are more likely to engage in dietary changes, participate in physical activity counseling, and manage non-communicable diseases (NCDs). This engagement leads to a meaningful public health benefit that goes beyond the device's diagnostic capabilities. FibroScan-based screening programs in district hospitals can be combined with community awareness campaigns that focus on the risk factors for non-alcoholic fatty liver disease (NAFLD), such as metabolic syndrome, type 2 diabetes mellitus (T2DM), obesity, and sedentary lifestyles. These issues are increasingly prevalent in both urban and peri-urban areas of India due to changes in nutrition.

Ayushman Bharat Policy Integration and Public-Private Partnerships

India's Ayushman Bharat Pradhan Mantri Jan Arogya Yojana (AB-PMJAY) establishes a policy and financing framework aimed at improving access to diagnostic services for economically disadvantaged populations at the district level. The inclusion of FibroScan under the non-communicable diseases (NCD) component of Health

and Wellness Centres (HWCs), or through public-private partnerships with telemedicine providers capable of remote interpretation of FibroScan results, could significantly lower per-patient costs while enhancing equitable access to these services. India's MAP study, which involved 105 clinics across six geographic zones with extensive deployment of FibroScan technology, demonstrates that such programmatic rollouts are operationally feasible.⁹

STRENGTHS	WEAKNESSES
• Noninvasive nature and reproducibility • Simultaneous quantification of steatosis and fibrosis (CAP & LSM) • Guideline endorsement (AASLD 2023, EASL 2021) and growing evidence base • Patient acceptability and workflow integration into NCD clinics	• Operator dependence and technical limitations in obesity • Reduced discriminative accuracy for intermediate fibrosis stages (F1 vs F2) • Cost and maintenance burden (USD 25,000–45,000/unit)
OPPORTUNITIES	THREATS
• Early case detection and biopsy avoidance • Integration with sequential algorithms (e.g., FIB-4) for cost-effectiveness • Lifestyle counselling and community awareness • Ayushman Bharat (AB-PMJAY) policy integration and public-private partnerships	• Infrastructure deficits and human resource constraints • Metabolic comorbidities affecting diagnostic accuracy • Absence of validated Indian cut-offs and SOPs • Therapeutic gap and referral pathway limitations

Figure 1: SWOT analysis: FibroScan for NAFLD at the district level.

Infrastructure deficits and human resource constraints

Many district hospitals in India do not have specialized departments for gastroenterology or hepatology. Additionally, the current medical and paramedical staff have limited training in transient elastography. To operate a FibroScan device effectively, it is essential to have a trained operator, preferably a physician or sonographer, who has completed a minimum of 100 to 500 supervised examinations to ensure competence. A quality reporting environment is also necessary. For sustainable deployment of this technology, it is important to implement structured training programs, competency certification, and institutional protocols for quality control. All of these initiatives require an initial investment in human resource development.

Metabolic comorbidities affecting diagnostic accuracy

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that for obese patients (BMI ≥ 30 kg/m²), higher CAP diagnostic thresholds and XL probe utilization are required for accurate steatosis quantification, but calibration and consensus on cut-offs for Indian populations are currently lacking. The conditions common at district-level presentations including uncontrolled diabetes, hepatic congestion, and acute exacerbations of chronic liver disease may inflate LSM readings and generate false-positive advanced fibrosis diagnoses.⁶

Absence of validated Indian cut-offs and standard operating procedures

The majority of the validated major FibroScan diagnostic cut-offs have occurred in Western and East Asian cohorts. Systematic differences exist in the demographic content of Indian patients and their body composition, dietary patterns with higher trans fats and carbohydrates; genetic susceptibility with reference to PNPLA3 and TM6SF2 variants; and the phenotype of "lean NAFLD". There is a risk of considerable diagnostic misclassification in the

absence of validation studies in the Indian context and the development of standard operating procedures at the level of the districts. Therefore, research programmes that develop Indian-specific FibroScan reference data are a prerequisite for the intended safe deployment at the district level.

Therapeutic gap and referral pathway limitations

A worthwhile district-level FibroScan program must include functional referral pathways. Beyond diagnosis, those with significant fibrosis should have access to specialist care. District hospitals in India currently have major issues developing and sustaining such referral pathways. Without them, identifying advanced liver disease with no therapeutic options may increase patient anxiety with no clinical gains. Because of this, your district level FibroScan program should include a structured referral pathway developed with the appropriate tertiary care health partners who will manage your liver patients and a policy outlining referral criteria.

CONCLUSION

FibroScan could be a realistic tool for NAFLD/MASLD screening and staging with promising accuracy and less constraint at the district-hospital level across India. Non-invasiveness, dual output, and extensive endorsement and performance in multi-center studies across India provide evidence that supports the movement of hepatic diagnostics beyond tertiary institutions. However, before implementation, operator training, the purchase of XL probes, and creating specific threshold diagnostics for the Indian population and appropriate specialist referral pathways must be established.

We propose a phased and pilot-oriented implementation of the following: the use of FibroScan in district hospitals linked to the medical colleges and their gastroenterology units; inclusion of FibroScan in the NCD clinics using a cost-effective two-step FIB-4 - FibroScan screening method; a development of a FibroScan database at a district level to create normative data for India and; utilization of public-private partnerships and telemedicine to address the shortage of specialists. With the proper use of planning and resources, FibroScan would drastically change the current state of advanced NAFLD in India and allow for timely diagnosis and treatment.

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