**RESEARCH**

# Evaluating curriculum for health informatics courses in India – A comparative analysis of the skills required by the industry and skills imparted by accredited courses using the Delphi approach

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The study addresses the necessity of informatics skills in the healthcare sector due to rapid technological advancements. It aims to establish a connection between skills taught in healthcare information technology (IT) courses and those required for health informatics jobs, offering solutions to bridge the skills gap. Job postings from Glassdoor, Indeed, and Monster in India from August to October 2022 were analyzed, yielding 926 initial posts. After refining, 44 jobs matched criteria. Details from postings, including organization nature, education, experience, skills, and software expertise, were collected. Analyst roles were common (53%), with IT service management systems prevailing (40%). Most jobs were full-time (98%) and mainly in Bengaluru (30%). Key skills were data modeling, data visualization, and Microsoft Office, along with programming languages like JAVA, Python, and SQL. Out of 77 colleges, only 18 met inclusion criteria. Recorded educational institution data encompassed healthcare IT management programs, course details, affiliations, and competency evaluation. In the evolving information society, creating a standardized health informatics curriculum is vital for India's skilled workforce.

**Keywords:** health informatics, healthcare IT management, health IT jobs, competencies, health informatics courses

## 1. Introduction

India's healthcare delivery systems traditionally relied on manual record-keeping despite a strong telecommunication infrastructure (1, 2). However, Indian policymakers now recognize the importance of health informatics, including telehealth, e-Health, and telemedicine, due to advancements in healthcare (3). To adapt, flexible syllabi are advocated for medical, paramedical, and healthcare management education, enabling professionals to use health informatics tools effectively (4, 5). The demand for evidence-based interventions in community health is increasing, driving the need for informatics skills among health professionals (3, 6, 7). Health organizations require skilled informaticians at different levels to implement effective health information

technology (IT) systems. Despite a surge in training programs, studies reveal gaps in the competencies of health informatics graduates, hindering their alignment with the dynamic healthcare workforce. Gap analysis is necessary to identify missing subjects in current curricula and promote professional acceptance of health informatics (2, 8, 9). India's health technology sector has grown significantly, with projections suggesting continued growth and potential for 40 million people employed in health technology by 2030 (6).

## 2. Methdology

The methodology was divided into three phases: job analysis, assessment of health informatics educational programs, and

the Delphi method for standardization. Each phase was executed simultaneously to extract and categorize skills based on their assigned categories. Subsequently, a comparative analysis was conducted to identify disparities between industry requirements and the health informatics course curricula offered by various institutes in India. The three phases are further discussed below.

## 2.1. Phase I – Job analysis

From August to October 2022, we conducted a content analysis of health informatics job postings in India using three job portals: Glassdoor, Indeed, and Monster. We used instant data scrapper, a Google chrome web tool to get job information from online portals.

Data were gathered from online job portals, focusing on health informatics-related postings. The extracted

variables included job title, categories, organization, degree, experience, salary, and location. The initial dataset contained 926 job postings. Exclusion criteria were applied in the third step, eliminating jobs that lacked complete descriptions, were duplicates, misaligned with health informatics, or required irrelevant skills. This whittled down the dataset to 44 relevant job postings.

Further steps involved reclassifying job titles into nine broader categories, simplifying analysis. Out of the initial 926 postings, 504 were excluded due to incomplete information, and 422 duplicates were removed. Technical skills were extracted, resulting in 21 distinct skills. These skills were matched with the remaining postings based on titles, location, and salary to identify common skill requirements. This process culminated in a final dataset of 44 job postings that adhered to criteria. The systematic procedure encompassed data collection, exclusion of irrelevant postings, job title reclassification, skills extraction, and skills-to-postings
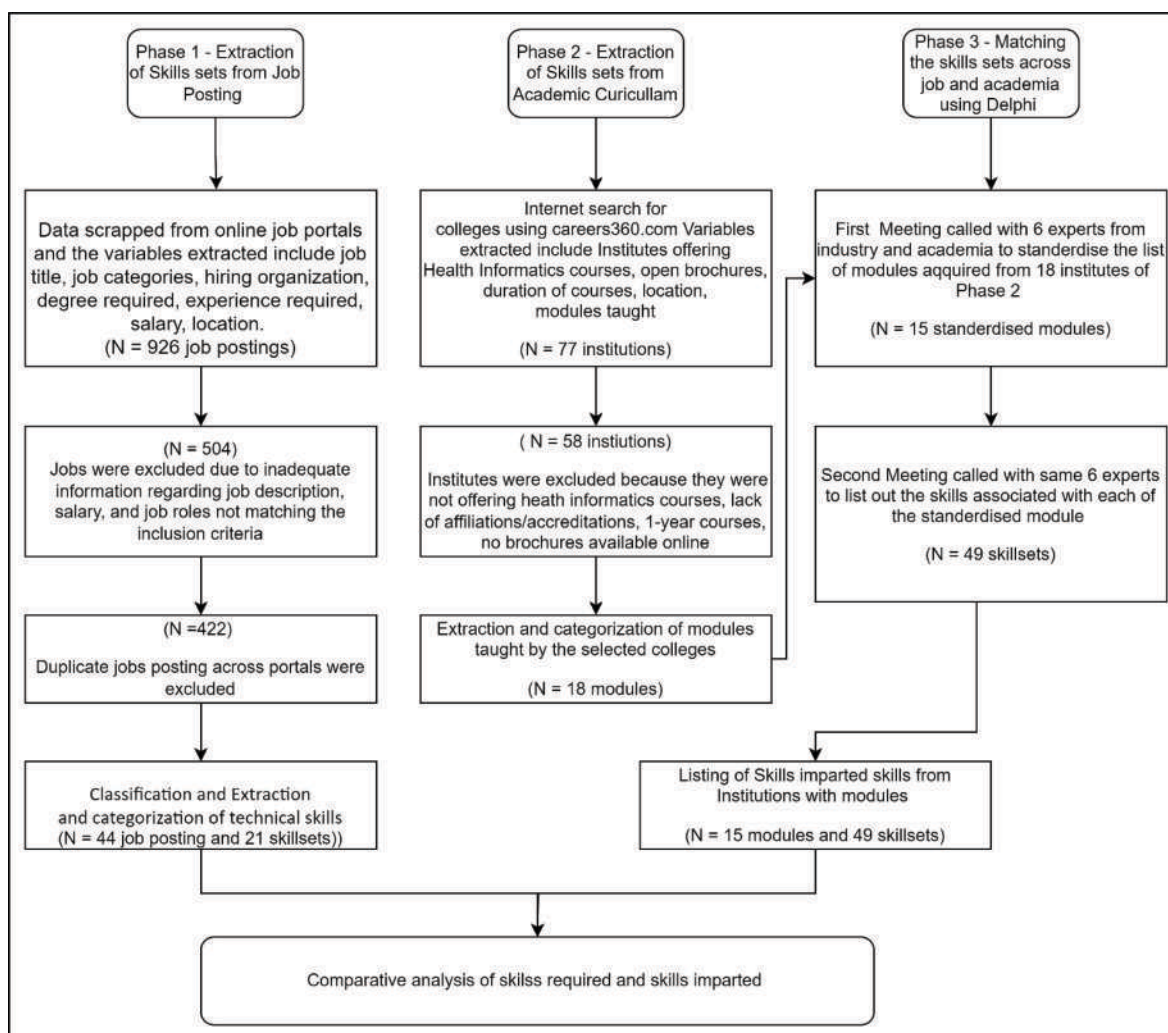


**FIGURE 1 |** Process flow of information across three phases of the study.

mapping, ultimately yielding a concise representation of 44 health informatics roles meeting defined criteria. Refer to **Figure 1**.

## 2.2. Phase II – Assessment of health informatics educational programs

We consulted Career360.com as a resource and looked for educational institutions offering health management courses in India. Our search results showed that there were 77 institutions offering health management courses, of which only 18 met the requirements. The selection criteria for the educational institutions based on our inclusion and exclusion criteria are shown in **Figure 1**.

## 2.3. Phase III – Delphi method for standardization

An online discussion was arranged to list the skills associated with the various modules. Based on the discussion with industry experts, a list of skills appending with each module was prepared. The ratio of the skills taught at the colleges to the skills required by the hiring companies is determined, and using the 80-20 rule, the correlation between the two variables is compared (Pareto principle). With the same methodology, we also evaluated the accessibility of job opportunities at universities offering healthcare management courses and locations.

## 3. Findings

### 3.1. Descriptive analysis of job postings

We categorized the job postings based on the job categories, hiring organization types, job types, qualifications and experience needed, and the range of salaries offered after analyzing the selected jobs. Based on the percentage of job postings that requested a role out of the total number of selected job postings ($N = 44$), the jobs that were produced were divided into nine categories (**Table 1**). The analyst position was the most in-demand position, followed by associate manager and manager. Approximately two-fifths of the recruiting organization, according to our analysis, were IT service management firms. For the selected job postings, all but a few companies offered full-time employment and no part-time positions. The majority of job postings required a bachelor's degree and at least 1 year of experience in the field of

**TABLE 1 |** List of variables assessed for the selected job postings.

| Variables assessed | $N = 44$ | |
| --- | --- | --- |
| Job categories | Frequency | Percentage |
| Analyst | 23 | 53% |
| Research analyst | 3 | 7% |
| Expert | 2 | 4% |
| Knowledge management associate | 1 | 2% |
| Associate manager | 5 | 11% |
| Manager | 4 | 9% |
| Consultant | 3 | 6% |
| Quality control executive | 1 | 2% |
| Data scientist | 2 | 4% |
| **Hiring organization type** | | |
| Health system | 12 | 27% |
| Consultancy | 8 | 18% |
| IT service management | 18 | 41% |
| Pharmacy | 4 | 9% |
| Academics | 2 | 5% |
| **Job type** | | |
| Full-time | 43 | 98% |
| Part-time | 0 | 0 |
| Internship | 1 | 2% |
| **Degree required** | | |
| Bachelor's and above | 25 | 56% |
| Master's and above | 13 | 29% |
| PhD/MD or equivalent | 2 | 4% |
| Not listed | 4 | 9% |
| **Experience required** | | |
| 1–2 years | 7 | 15% |
| 3–4 years | 8 | 18% |
| 5–7 years | 16 | 36% |
| 8–10 years | 4 | 9% |
| Not listed | 9 | 20% |
| **Salary** | | |
| $4,000-$8,000 | 10 | 23% |
| $8,000-$12,000 | 15 | 34% |
| $12,000-$16,000 | 1 | 2% |
| $16,000 and above | 2 | 4% |
| Not listed | 16 | 36% |

health IT management. **Figure 2** presents the city wise frequency of jobs.

## 3.2. Distribution of skills required for jobs

The skills required were segregated into 21 types. The skills were then matched with the jobs on the basis of job description provided. **Figure 3** presents the visualization of skills, data manipulation skills and data modeling skills were essential in 26 out of 44 job postings, followed by data visualization required in 24 out of 44 job postings. Microsoft Office was required in 16 out of 44 job postings, problem
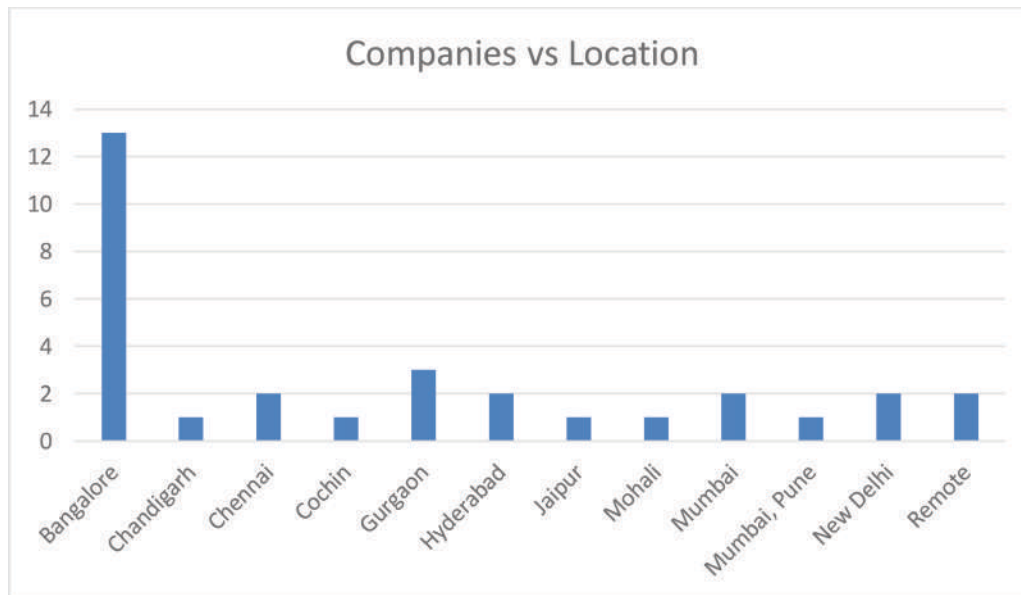
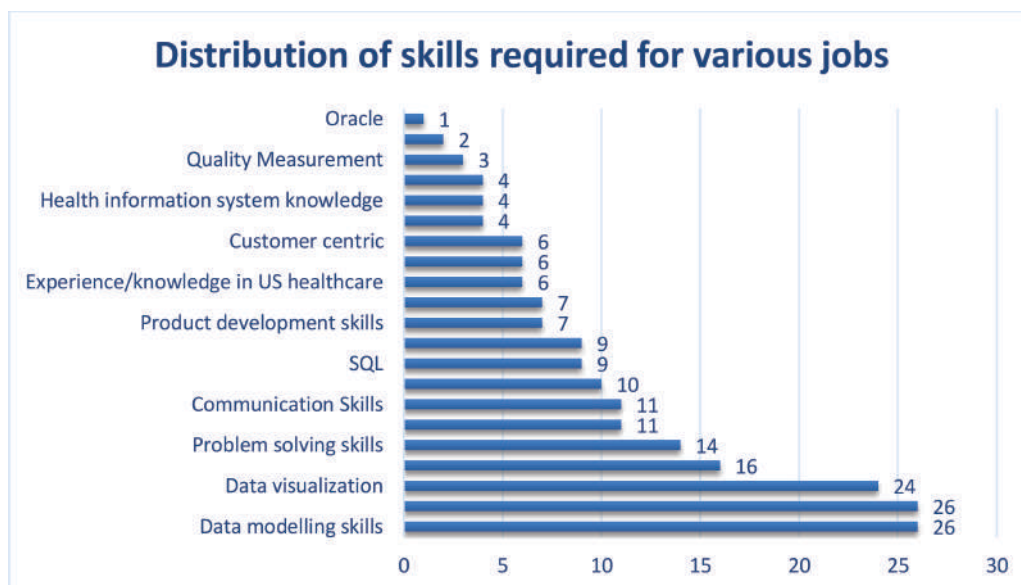**FIGURE 2 |** Geographical location of jobs.



**FIGURE 3 |** Distribution of skills required for various jobs.

solving skills were required in 14 out of 44 job postings, communication and project management skills were each required in 11 out of 44 job postings, Python was required in 10 out of 44 job postings, and Tableau and SQL were each required in 9 out of 44 job postings.

## 3.3. Skills required in relation to experience

The skills required were then classified on the basis of experience required as per the job description as presented in

Table 2. The experience required was divided into 1–2 years, 3–4 years, 5–7 years, and 8–10 years.

## 3.4. Skills required for various job positions

The required skills were then segregated into various job positions. **Figure 4** the job positions that were divided as analyst, expert, associate, consultant, data scientist, research analyst, knowledge management associate, manager, and quality control associate and mapped against the skillsets.

**TABLE 2 |** Skills required in relation to years of experience.

| Skills required | Years of experience | | | |
| --- | --- | --- | --- | --- |
| | 1–2 years | 3–4 years | 5–7 years | 8–10 years |
| Data modeling skills | 1 | 1 | 1 | 1 |
| Data manipulation skills | 1 | 1 | 1 | 1 |
| Data visualization | 1 | 1 | 1 | 1 |
| Microsoft office | 1 | 1 | 1 | 1 |
| Problem solving skills | 0 | 1 | 1 | 1 |
| Project management skills | 0 | 1 | 1 | 1 |
| Communication skills | 0 | 1 | 1 | 1 |
| Python | 0 | 1 | 1 | 1 |
| SQL | 1 | 1 | 1 | 1 |
| Tableau | 0 | 1 | 1 | 1 |
| Product development skills | 0 | 0 | 1 | 1 |
| Decision support skills | 0 | 0 | 1 | 1 |
| Experience/knowledge in US healthcare | 0 | 0 | 1 | 1 |
| Knowledge of EMR/HER | 0 | 0 | 1 | 1 |
| Customer-centric | 1 | 0 | 0 | 0 |
| SAS | 0 | 1 | 1 | 0 |
| Health information system knowledge | 0 | 0 | 0 | 1 |
| Biomedical/clinical experience | 0 | 0 | 0 | 1 |
| Quality measurement | 0 | 1 | 0 | 0 |
| JAVA | 0 | 0 | 1 | 1 |
| Oracle | 0 | 1 | 0 | 0 |
| **Total** | **6** | **13** | **16** | **17** |

## 3.5. Salaries with respect to skills required

The salary bracket provided by the companies was converted into US dollars from Indian rupee. The salaries were then segregated based on the skills required and presented in **Figure 5**.

Data analysis skills, Python, SQL, Tableau, decision-making skills, product development skills, and knowledge of EMR/HER were listed as desirable skills for a salary bracket of >16,000 USD.

## 3.6. Descriptive analysis of educational programs

We created a unified framework of modules based on our analysis of the core competencies demanded by the hiring firms after examining the modules of each college offering health informatics courses. **Table 3**

presents the classification of skills and corresponding modules. Core management skills such as human resource management in healthcare, financial management for healthcare, marketing management, healthcare operations management, supply chain management in healthcare, and strategic management in healthcare were found to be the most often offered modules. Technical skill modules made up only 3% of the program. The remaining modules concentrated on developing organizational skills.

## 3.7. Percentage of colleges offering the following modules

The modules were grouped according to the competencies listed in the job postings, and the number of institutions offering these fundamental skill sets was compared and presented in **Figure 6**. IT in Health Management was offered by 79% of the colleges, Analytics for Healthcare was offered by 68% of the colleges, and Hospital Information System was offered by 63% of the colleges.

## 3.8. Location-wise classification of colleges

A density plot is presented in **Figure 7** to explain the density of colleges across the Indian States. Maharashtra and Delhi had the largest concentration of colleges offering health informatics programs, with Karnataka closely following them.

### 3.8.1. Percentage-wise classification of modules offered by the colleges

General management made up 94% of the curriculum that the colleges provided, followed by quality management in healthcare (84%). Technical skill modules made up 79% of the IT management in healthcare and 68% of the analytics for healthcare. **Figure 8** presents the mapping of courses covered by various colleges.

## 3.9. Percentage-wise classification of skills required by the hiring firms

Microsoft Office was a must for every position, and it ranked above other skills including data analysis (67%), general management (61%), and communication (56%). **Figure 9** presents further details on skills required by hiring firms.
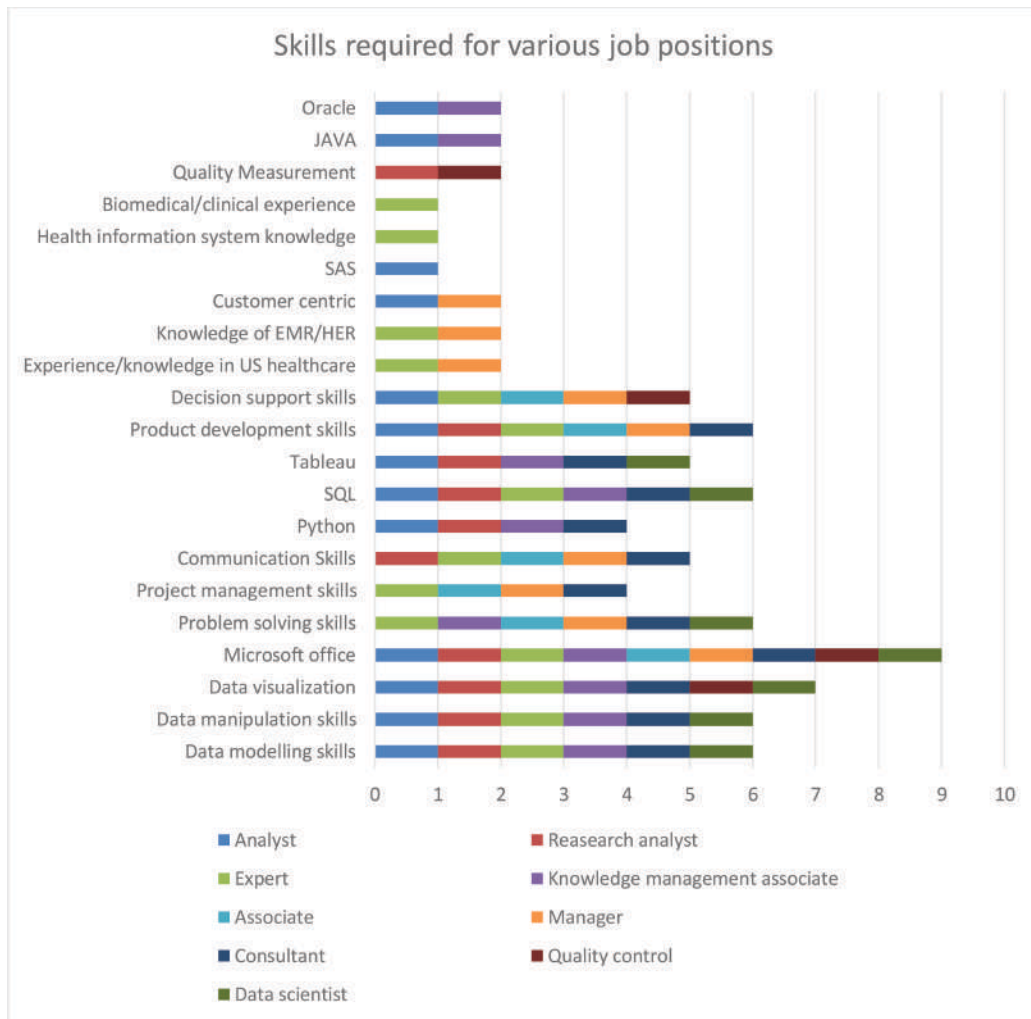
**FIGURE 4 |** Skills required for various job positions.



**FIGURE 5 |** Salaries with respect to skills required.

**TABLE 3 |** Classification of modules based on a specific skillset.

| Classification based on skills | Modules |
|---|---|
| Technical skills | **IT in healthcare management** |
| | Healthcare IT standards |
| | EMR, EHR, Interoperability |
| | Java, SQL |
| | **Analytics for healthcare** |
| | MS Excel |
| | **Hospital information system** |
| | **Quality management in healthcare** |
| | Quality and safety |
| | Quality assurance |
| | Quality improvement tools |
| Management skills | **Financial management for healthcare** |
| | Healthcare cost and equity |
| | Budgeting and investment |
| | Accounting principles |
| | **Human resource management in healthcare** |
| | Job analysis |
| | Human resource planning |
| | Pay benefits and incentives |
| | **Strategic management in healthcare** |
| | Strategy formulation |
| | Strategy implementation |
| | Environment analysis |
| | **Healthcare operations management** |
| | **marketing management** |
| | Marketing in healthcare |
| | Understanding consumers |
| | Pricing and project strategy |
| | **Supply chain management in healthcare** |
| | Inventory management |
| | Transport |
| | Drugs and medicines |
| | **Project management in healthcare** |
| Organizational skills | **Organizational behavior** |
| | Emotional intelligence |
| | Problem solving |
| | Leadership style |
| | **Business communication** |
| | Interpersonal communication |
| | Non-verbal communication |
| | Communication skills |
| Others | **Global health systems** |
| | US healthcare system |
| | Singapore healthcare system |
| | UK healthcare system |
| | **Health insurance** |
| | Health insurance in India |
| | Community health insurance |
| | Private health insurance |

### 3.9.1. Comparative analysis: Percentage of jobs requiring a skill versus percentage of colleges offering that skill

We discovered that the most requested competence, Microsoft Excel, was not provided by any of the colleges when we compared the percentage of skills provided by the colleges and those needed for the job posts, **Figure 10** presents the comparison. 97% of institutions offered general management training, which 61% of occupations required. 64% of institutions offered the data-related abilities that 63% of firms requested. Only 38% of companies asked for programming languages as a necessary talent, despite the fact that 79% of institutions offered programming courses.

## 4. Discussion

Health informatics is a new, unique, and necessary profession in today's evolving healthcare industry, which uses knowledge and skills from the sciences of computer science, information and organizational sciences, and public health to develop important information systems that provide the data and information used by other public health professionals in their work (10, 11). Health informatics provides expertise in public health, information, and IT and uses technological advances to improve health IT. The proposed program in the previous study addressed the challenges of integrating health information systems into public health functions, developing descriptive knowledge and procedural skills in health information systems through a balance between lectures and simulation courses and allowing the pursuit of specialized courses. Given the rapid change in public health practice, public health research, information, and IT, courses must evolve to meet changing needs (12). This development should be guided by partnerships with practitioners, other disciplines of public health, healthcare managers, and public health researchers to ensure that health information is well designed and developed to meet the needs of those who are working to improve the health of the population. Health management institutions, both in practice and in academia, must take action to support the development of a strong health information workforce (11). Health informatics curriculum designed and developed should take into account various available program-specific competencies and integrated knowledge, skills, and expertise based on the analysis of the job positions. Academicians have also been discussing the integration of skills training into the health informatics curriculum for a long time (12). Faculty members who work in academic institutions, health informatics departments, and programs expected to follow up on the changing
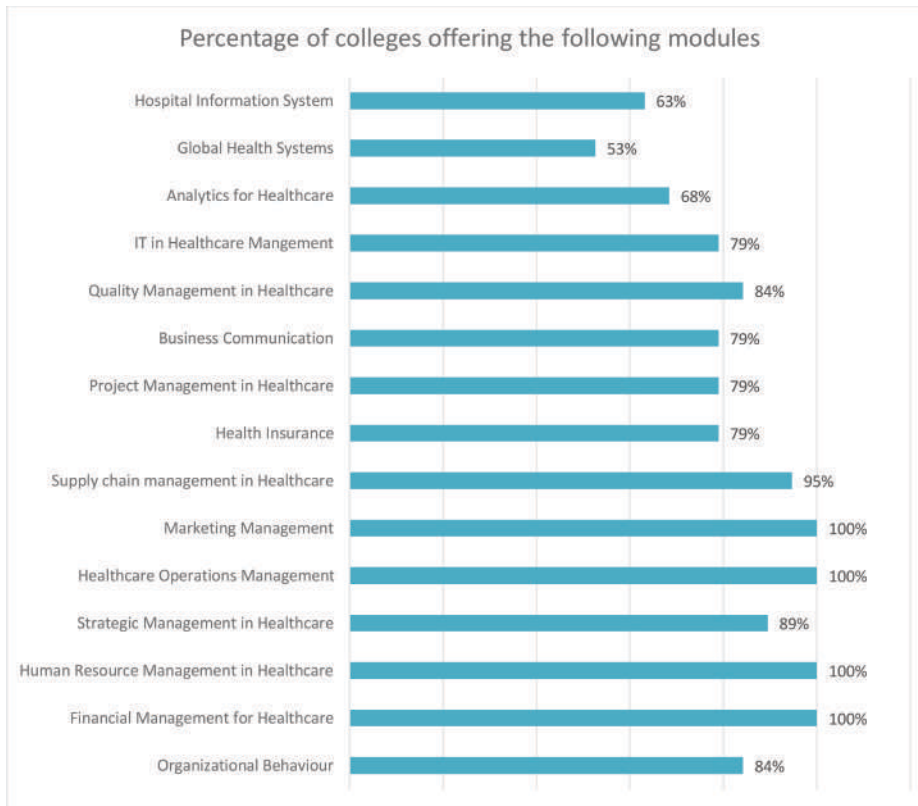
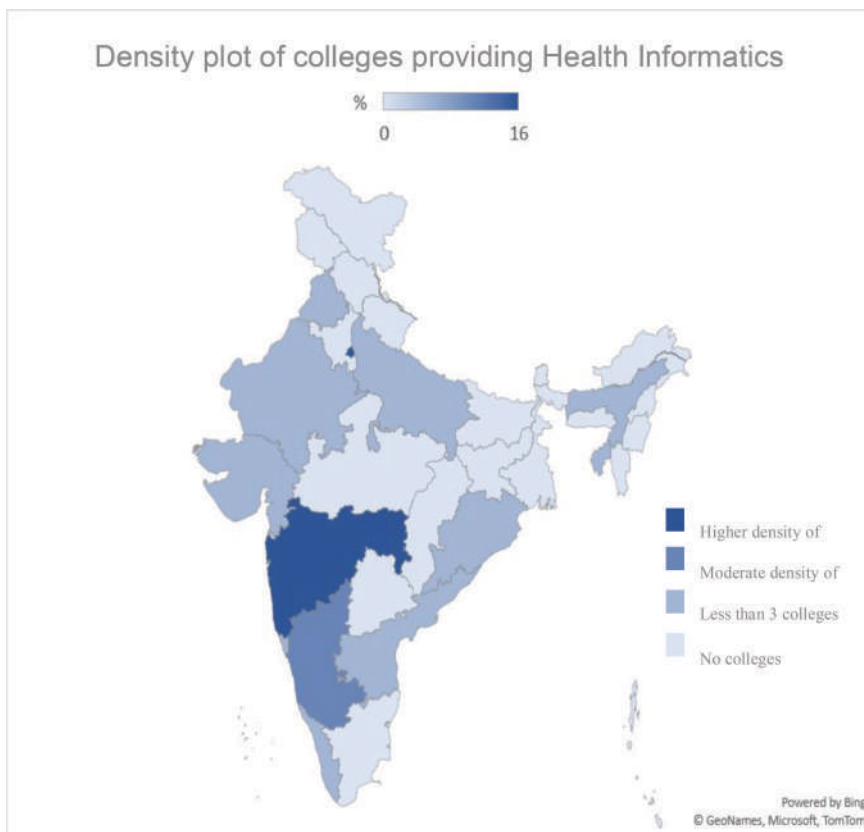**FIGURE 6 |** Percentage of colleges offering the following modules.



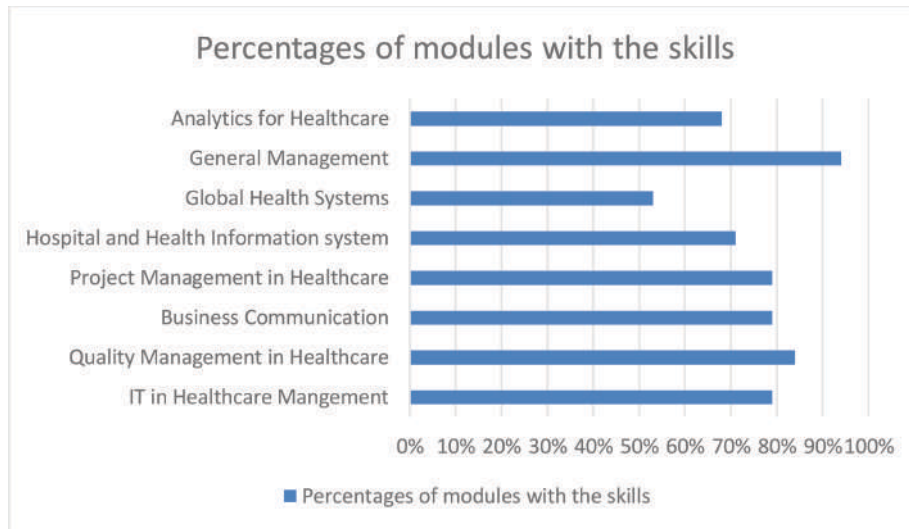**FIGURE 7 |** Density plot of colleges across India.

**Percentages of modules with the skills**

FIGURE 8 | Percentage wise modules covered by colleges.

**Percentages of skills required by hiring firms**
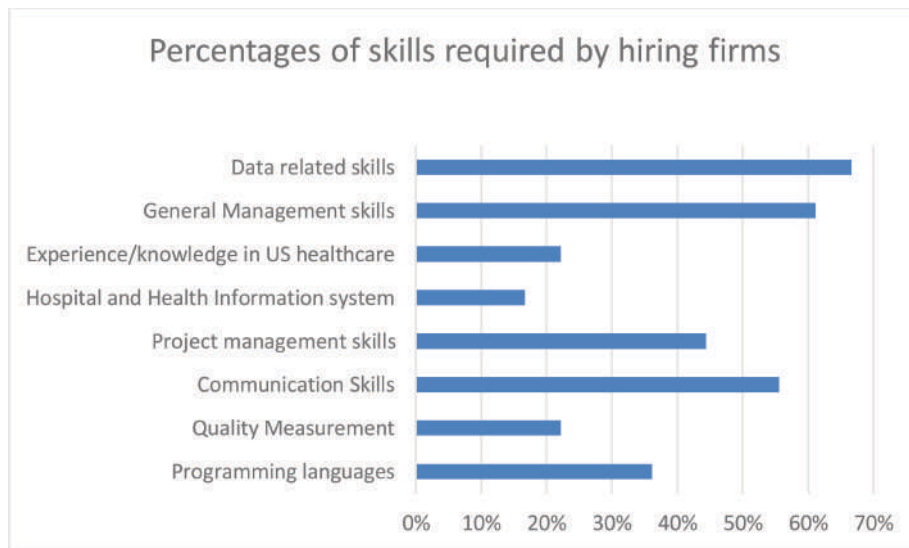
FIGURE 9 | Percentage of skills required by the hiring firms.
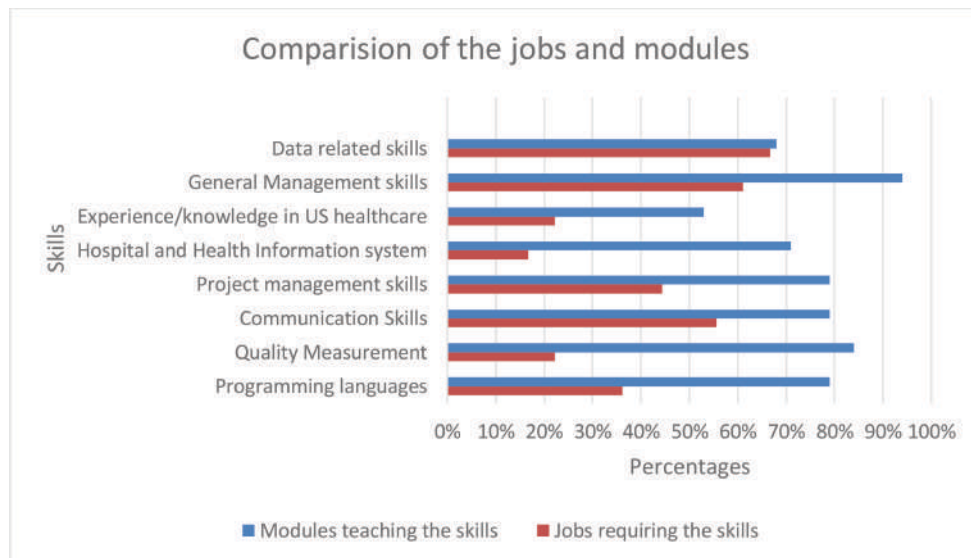
**Comparision of the jobs and modules**

FIGURE 10 | Comparing the percentage of jobs requiring the skills vs. the percentage of colleges offering those skills.

requirements and update the content of their curriculum continuously (12).

# 5. Conclusion

Health informatics programs are growing in number in India, but there are significant distinctions between them in terms of their academic levels and areas of specialization. Curriculum changes over time due to the field's novelty and the necessity to adapt to the labor market. Since the pandemic hit, there has been a rising need in India for health informatics specialists as well as for well-designed health information systems and the individuals responsible for their development and administration. Since no prior studies have examined the essential abilities needed for health informatics positions in India, this study represents the first of its kind. According to the results of our study, healthcare management institutions are offering more than what the health care industry requires. We learned via a conversation with industry specialists that academicians, program directors, health researchers, and other pioneers in this sector discussed how far the Indian healthcare education system has come in terms of creating healthcare professionals who are prepared for the workforce. Analysis of the patterns in the development and demand for health informatics in the developed nations as well as their acceptance of the Indian health workforce has ensured that the courses are well equipped for both theoretical and practical learning. In India, the market for health informatics jobs is still in its infancy, but we have already started preparing our health workers to be the health informatics industry's leader by anticipating future needs. The results of our analysis also indicate that Bengaluru, which is sometimes referred to as the health-tech capital of India and is a hotbed for start-ups and advances in the field, is home to the majority of recruiting corporations and healthcare management institutions.

# Author contributions

PP was involved in the development of the manuscript along with data acquisition and analysis. SB and UB worked on data analysis and visualizations. AP provided the oversight and guidance along with a framework for the manuscript. All authors contributed to the article and approved the submitted version.

# Conflict of interest

The authors are students and faculty of one of the institutions engaged in training of health management professionals.

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