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Impact of Quality of Electricity Access on Health & Education Delivery

JHARKHAND

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Abbreviations

ANM- Auxiliary Nurse Midwife

CAPI- Computer Assisted Personal Interviewing

CHC- Community Health Center

DISE- District Information System for Education

DVDMS- Drugs and Vaccine Distribution System

EML- Essential Medicine list

eVIN- Electronic Vaccine Intelligence Network

ESMAP- Energy Sector Management Assistance Program

ICT- Information and Communication Technology

ILR - Ice Lined Refrigerator

MTC- Malnutrition Treatment Center

MTF- Multi- Tier Framework

NHM- National Health Mission

PHC- Primary Health Center

PMKVY - Pradhan Mantri Kaushal Vikas Yojana

PTR- Pupil Teacher Ratio

RHS- Rural Health Statistics

SDG- Sustainable Development Goal

SE4ALL- Sustainable Energy for All

SCR- Student Classroom Ratio

UNESCO- United Nations Educational, Scientific and Cultural Organization

WHO- World Health Organisation

1. INTRODUCTION

Energy plays a vital role in the national development programs and in achieving Sustainable Development Goals (Winkler et al., 2011). Access to energy for community services is linked directly to human development aspects such as education and health. Healthier and better educated people with access to basic community infrastructure have better chances of escaping the poverty trap (Cabraal, Barnes, and Agarwal 2005; White 2002). Adequate and reliable energy availability is a prerequisite for achieving the goal of universal health and well-being (SDG3) and obtaining a quality education (SDG4) for improving the standard of people's lives. Electricity isa critical enabling factor for modern health service delivery. Reliable access to electricity at schools may enable modern teaching-learning tools, ICT technologies and proper lighting-cooling facilitiesfor improved learning outcomes. These are being considered important sectors of public services for socio-economic development and poverty reduction. However, there exists inequality at interstate and intrastate levels in terms of the critical components of human development-health and education in India (Anand, 2014).

Poor health constitutes suffering and deprivation of the most fundamental kind. The high infant mortality rate in rural India, around 38 per 1000 live births (RHS, 2018) indicates the need of improving health care service delivery in the country. The literacy rate in India is only 74.04%, and there exists a gap of 16.6% between the male and female literacy rates (Census 2011). However, learning outcomes among children can get influenced by several factors. Literature envisages that access to modern education infrastructure and reliable electricity can facilitate learning among school students. This study tries to bring out the role of reliable electricity access for health care and education service delivery in Jharkhand and suggest policy measures to improve these services at public health centers and schools.

1.1 Critical link between access to electricity and healthcare delivery

WHO (2015) advocates the attainment of good health as a fundamental right of every individual, which requires skilled care, essential medicines, and modern medical technologies. A relation exists between electrification and improvements in health facilities, including access to health information and health services utilization. Many life-saving interventions in rural and small public facilities get impeded due to resource-constrained health facilities and unreliable electricity supply. Energy is required to pump water, control temperature, lighting, ventilation, and clinical processes. Besides the vital role in health care service delivery, rural health facilities with stable electricity options tend to attract and retain skilled doctors and other health workers (WHO, 2015).Lack of infrastructure in the primary and community health facilities putsadditional constraints on their capacity to provide well-timed and quality health care (Global Forum for Health Research, 2004). Despite the availability of modern equipment and health staffin public health centers, erratic electricity supply can adversely impact the overall services.

Ice lined refrigerators and deep freezers that store immunization kits require almost 20 hours of power supply (Banerjee, 2019) in a day and lack of which may lead to vaccine spoilage. With the changing disease pattern, the requirement for electricity increases for the prevention and treatment of non-communicable diseases (WHO, 2018). Munuswamy*et al*. (2011) reported that electricity availability was low, i.e., 30- 50 % in places with poor health index, while it was observed to be around 60-90 % in areas with better health indicators.

1.2 Role of electricity access as a significant facilitator of education services

Quality education enables self-reliance, boosts economic growth by enhancing skills, and improves people's lives by opening up opportunities for better livelihoods. SDG4 targets for ensuring the completion of primary and secondary education by all boys and girls and guaranteeing equal access to opportunities for access to quality technical and vocational education for everyone. India had made progress in universalizing primary education, with improvement in the enrolment and completion rates of girls in both primary and elementary schools. Several researchers, Ajayi

(2002), Hallack (1990), Kuuskorpiand Gonzalez (2011), have linked the availability of infrastructure facilities of the school and school efficiency in their studies.

Electricity accessibility can provide several services at schools. The provision of lighting can enable longer study hours as classes can be taught early in the morning or late at night. Better information and communication technologies like computers, the internet, telephones, projectors can find their way with the introduction of electricity in education institutes. According to a UNESCO report (2011), ICT enhances students' ability to learn and increases their efficiencies. Teachers with better training and new skills may find it difficult to apply their skill sets at schools deprived of basic facilities like electricity. Moreover, reliable electricity access may enable better working conditions and thereby may curb staff absenteeism at schools. In India, 63.14 % of schools have a power supply (DISE, 2018). Only 53% of total government schools, which form a majority of schools in rural India, have electricity connections. Only 28% schools (18% government schools) have a computer and 9% (4% government schools) an internet connection (DISE, 2017).

1.3 Rationale of the study

Reliable electricity services have roles to play in providing primary and community health delivery and education services delivery. It is critical to understand the status of electricity access in PHCs/CHCs and Schools with a focus on the quality and consistency of electricity supply.

The study brings out the status of electricity supply at PHCs/CHCs and schools in rural and peri-urban areas of Jharkhand regarding access, reliability, quality, convenience, and usage. The Jharkhand State has mandated provision of electricity and back-up facility for all public health care centres. Yet the reliability of supply varies, which provides an opportunity to assess how does it affect service delivery. We classify the quality of supply in terms of six tiers as per the multi-tier framework of the ESMAP and evaluate the availability of enabling infrastructure and equipment in PHCs/CHCs and schools using “tracer indicators". These are used to measure the level of satisfaction of patients, staff and students with the health and school services. The sources of electricity supply are also analysed to understand the role of renewable energy in meeting the electricity requirement of these facilities. The primary objectives of the study are as follows:

- To assess the quality of electricity supply at PHCs/CHCs and government schools using the multi-tier framework (MTF) of energy access.
- To study the reasons for inadequate electrification of PHCs/CHCs and schools, if any.
- To assess the service readiness of PHCs/CHCs and government schools in terms of infrastructure and equipment availability.
- To assess the impact of electricity access in PHCs/CHCs on health care service delivery; patients and staff satisfaction.
- To assess the impact of electricity access in schools on educational service delivery, students, and staff satisfaction.

2. Methodology

2.1 Study design

We have used a purposive sampling technique for this study. We selected district Ranchi, and being the state capital of Jharkhand, health centers, and government schools in this district may have more reliable access to electricity. Then the remaining districts of Jharkhand were categorised into two groups (i) aspirational districts as per the government of India and (ii) remaining districts. From each of these two groups, selected one district randomly, namely East Singhbhum from the list of aspirational districts and Deoghar from the remaining districts. Therefore, we have carried out this study in three districts (i) Ranchi, (ii) East Singhbhum, and (iii) Deoghar. Further from each of the selected districts, we randomly selected 5 blocks each. In each selected block we visited the PHC/CHC; in a particular block there is either a PHC or CHC. Discussion with officials from JREDA helped us in understanding the ongoing rooftop solarising scheme for CHCs and residential schools in the state. JREDA shared with us information regarding solarised residential schools which immensely helped in locating these schools. Based on the available secondary data and our knowledge gained during official visits, one government-run senior secondary school was selected from the rural/peri-urban area in each block to conduct the primary survey. The present study tried to adequately capture the geographical diversity and electricity access status at health centers and schools in the study districts of Jharkhand.

Across the three districts, the research team carried out data collection through the primary surveys in 15 PHCs/CHCs and 15 schools. Structured questionnaires were prepared separately for (i) PHCs/CHCs,(ii) schools, (iii) patients/non-patients visiting surveyed PHCs/CHCs and (iv) students at the surveyed schools. The structure of PHC/CHC and school questionnaires captured the availability of equipment, staff, and several attributes of energy access as per the multi-tier framework (MTF). The patients/non-patients and student questionnaires tried to gauge the perception regarding service delivery at health centers and schools, respectively. A pilot study was carried out in Ranchi to understand the response and improve the questionnaires.

2.2 Primary survey and Interviews

Head of the PHCs/CHCs, including relevant staff and headmaster of the schools, were primary respondents. Enumerators conducted physical verification of infrastructure and equipment to list their availability at health centers and schools. Since open discussion among interest groups increases the chance of obtaining credible and relevant information and challenges biased or incomplete answers by group dynamics. Thus, group discussions are considered important since it provides several perspectives about the same issue and situations, which includes gaining insights into people's shared understandings. Therefore, at a few PHCs/CHCs and schools, we conducted group discussions with facilities staff to gauge the status of electricity access, human resource availability, equipment procurement process, and their grievance redressal flow.

At each selected PHC/CHC, we selected 5 patients and 5 non-patients for the survey. The structured schedule collects preliminary information on the accessibility of health care services, comfort level during treatment, quality of routine services, information on the preference of patients for treatment at PHCs vis-a-vis other private health centers. Therefore, we surveyed 75 (15*5) patients and 75 (15*5) non-patients in Jharkhand across 15 PHCs/CHCs. At each selected school, 10 students were randomly surveyed to gauge the overall student's satisfaction level. The team surveyed a total of 150 (15*10) students. Through student survey study, we tried to understand teaching-learning resources, learning opportunities, assessment and feedback, academic support, water sanitation facility, comfort in the classroom. Few of the surveyed schools were exclusive for girls. However, in the co-education schools, students' survey was carried out in a gender-inclusive manner, as the male and female often have differing views and needs.

One-on-one interviews with government officials from the relevant departments were organised. Interviews were conducted with the government officials at the state level from the department of health, education, power, renewable energy, social welfare women, and child development to engage stakeholders so that their views can maximise the impact of policy research.

2.3 Data collection and analysis

The survey was conducted using the computer-assisted personal interviewing (CAPI) technique, where the enumerators used an electronic device to capture the response. Through formal training, the surveyors were made familiar with the data collection platform to save time on the field. With the web interface, the data collected on the field was securely uploaded and saved on the main server. The incoming data was monitored for quality checks and streamline the information flow.The primary surveys and group discussions generated quantitative and qualitative responses. Quantitative response produce data in the form of numbers whilequalitative data prodovided non-numerical responses. The quantitative data generated were analysed using MTF measurement and tabular analysis whereas qualitative data were analysed to interpret the pattern of respondentsperceptions. For this, we developed two different multi-tier frameworks based on the knowledge gathered from the field visits. The MTF analysis of data for PHC/CHCs and residential schools corresponded to Table 1 (see Appendix 1) with 24x7 energy requirements. Since the non-resiential schools are operational only during the day timings for a maximum of 6- 8 hours each day, we linked the MTF analysis for such schools to Table 2 (refer Appendix 1).The data analysis provided information to evaluate the existing sources of power supply at the PHC/CHC and school and the role of the electricity access in improving the quality of service delivery.

2.4 Data description

Delivery of health care in India comprises a three-tier structure of health services, including Sub-centre (SC), Primary Health Centre (PHC), and a Community Health Centre (CHC) as a referral center. The present study collected data from 2 PHC and 13 CHC/referral hospitals in three districts of Jharkhand. Tables 1, 2, and 3 summarise the infrastructure and service readiness of surveyed health facilities in terms of energy access, availability of essential equipment, and pathology services.

Table 1 Infrastructure and electricity access at health centers

District	Block	Service availability 24x7	Population covered (in '000')	No. of Beds	No. of Patient treated in previous calendar month#	Access to grid	Secondary source of electrical energy	Sufficient backup power from secondary source
Ranchi	Bero**	Y	180	30	2,350	Y	Rooftop solar	Y
	Bundu**	Y	100	6	2,146	Y	Rooftop solar	Y
	Itki*	N	60	4	29	Y	None	N.A.
	Mandar**	Y	147	30	1,059	Y	Rooftop solar	Y
	Nagri*	Y	76.4	6	341	Y	Inverter	N
Deoghar	Devipur**	Y	126	30	883	Y	Rooftop solar	Y
	Mohanpur**	Y	200	30	1,162	Y	Rooftop solar	Y
	Palojori**	Y	186.7	30	940	Y	Rooftop solar	Y
	Sarath**	Y	200	30	1,269	Y	Rooftop solar	Y
	Sarwan**	Y	188	30	1,982	Y	Rooftop solar	Y
East Singhbhum	Dhalbhumgarh**	Y	162	30	719	Y	Generator	N
	Dumaria**	Y	68	12	686	Y	Generator	N
	Ghatshila**	Y	190	30	611	Y	Rooftop solar	Y
	Musabani**	Y	117	30	604	Y	Rooftop solar	N
	Patamda**	Y	82.9	6	835	Y	Rooftop solar	Y

Y= Yes, N=No& N.A.=Not applicable.

* PHC **CHC/Referral hospital

Sum of patients treated in the past 30 days for emergency service, minor surgery, poisoning, fractures, wounds, ante-natal care, intra-natal care, post-natal care, new-borns, child-immunization and tubectomy/vasectomy.

Source: IRADe primary survey

Table 2 Availability and functioning of equipment at health centers

District	Block	Refrigerator		ILR		Oxygen cylinder		Baby warmer		Phototherapy unit		Suction machine		Computer		X-Ray machine		Ultrasound machine		ECG	
		A	F	A	F	A	F	A	F	A	F	A	F	A	F	A	F	A	F	A	F
Ranchi	Bero**	Y	Y	Y	Y	Y	Y	Y	Y	N		Y	Y	Y	Y	N		N		N	
	Bundu**	Y	Y	Y	Y	Y	Y	Y	Y	N		Y	Y	Y	Y	Y	Y	N		N	
	Itki*	N		N		Y	N	N		N		N		N		N		N		N	
	Mandar**	Y	Y	Y	Y	Y	Y	Y	Y	N		Y	Y	Y	Y	Y	Y	N		N	
	Nagri*	Y	Y	N		Y	Y	Y	Y	Y	Y	Y	Y	N		N		N		N	
Deoghar	Devipur**	Y	Y	Y	Y	Y	Y	Y	Y	N		Y	Y	Y	Y	N		N		N	
	Mohanpur**	Y	Y	Y	Y	Y	Y	Y	Y	N		Y	Y	Y	Y	Y	N	Y	N	N	
	Palojori**	Y	Y	Y	Y	Y	Y	Y	N	N		Y	Y	Y	Y	Y	N	N		N	
	Sarath**	Y	Y	Y	Y	Y	Y	Y	Y	N		Y	Y	Y	Y	Y	Y	N		N	
	Sarwan**	Y	Y	Y	Y	Y	Y	Y	Y	N		Y	Y	Y	Y	Y	N	N		N	
East Singhbhum	Dhalbhumgarh**	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N		N	
	Dumaria**	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N		N		N	
	Ghatshila**	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N		Y	Y	N	
	Musabani**	Y	Y	Y	Y	Y	Y	Y	Y	N		Y	Y	Y	Y	Y	Y	N		N	
	Patamda**	Y	Y	Y	Y	Y	Y	Y	Y	N		Y	N	Y	Y	Y	Y	N		N	

A=Available, F=Functioning,Y= Yes , N=No , Available but not functioning
* PHC **CHC/Referral hospital
Source: IRADe primary survey

Table 3 Availability and functioning of pathology services at health centers

District	Block	Pathology laboratory available	Adequate chemicals available	Blood test		Sputum test		Malaria test		Pregnancy test		HIV test		Dengue test	
				A	F	A	F	A	F	A	F	A	F	A	F
Ranchi	Bero**	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	
	Bundu**	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	
	Itki*	N													
	Mandar**	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	
	Nagri*	Y	N	N		N		N		Y	Y	N		N	
Deoghar	Devipur**	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Mohanpur**	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	
	Palojori**	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Sarath**	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	
	Sarwan**	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	
East Singhbhum	Dhalbhumgarh**	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	
	Dumaria**	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	
	Ghatshila**	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	
	Musabani**	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	
	Patamda**	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	

A=Available, F=Functioning, Y= Yes, N=No, Available but not functioning
* PHC **CHC/Referral hospital
Source: IRADe primary survey

The study covered a total of 15 higher secondary schools in 3 districts of Jharkhand. The survey focussed on the availability of infrastructure with particular emphasis on electricity supply in school, which supports education and adds to the convenience and comfort of students as well as other school staff. Table 4 below highlights the primary attributes of the surveyed schools, such as student classroom ratio (SCR), pupil-teacher ratio (PTR), and status of energy access. Table 5 summarises the facilities available for students in these schools.

Table 4 SCR, TPR and energy access status in schools

District	Block	Enrolled students	Classrooms in use	Dilapidated classrooms not in use	Student Classroom Ratio(Only for used classroom)	No. of teachers	Pupil-Teacher Ratio (PTR)*	No. of Desks & benches	Access to grid	Secondary source of electrical energy	Sufficient backup power from secondary source
Ranchi	Bero#	315	7	0	45	18	18	130	Y	Rooftop solar	Y
	Bundu	650	5	6	**130**	19	34	205	Y	None	N.A.
	Itki	156	7	4	22	8	20	90	Y	Generator	Y
	Mandar#	348	7	0	50	18	19	115	Y	Rooftop solar	Y
	Nagari	528	8	0	**66**	19	28	140	Y	None	N.A.
Deoghar	Devipur	1,457	8	2	**182**	44	33	190	Y	None	N.A.
	Mohanpur	1,696	6	6	**283**	15	**113**	300	Y	None	N.A.
	Palojori	698	24	4	29	18	**39**	260	Y	None	N.A.
	Sarath#	421	9	1	47	8	**53**	250	Y	Rooftop solar	Y
	Sarwan	2,000	8	0	**250**	15	**133**	150	Y	None	N.A.
East Singhbhum	Dhalbhumgarh	891	11	0	**81**	8	**111**	216	Y	None	N.A.
	Dumaria	619	16	0	39	19	33	200	Y	Inverter	N
	Ghatshila	250	13	5	19	5	**50**	120	Y	Inverter	N
	Musabani	291	14	4	21	7	**42**	80	Y	Generator	N
	Patambda	834	16	5	**52**	11	**76**	329	Y	None	N.A.

#Residential school

*The Right of Children to Free and Compulsory Education (RTE) Act, 2009, prescribes that the Pupil-Teacher Ratio (PTR) should be maintained at the school level at 30:1 and 35:1 at primary and upper primary level, respectively. The highlighted ratios represent schools with higher STR and PTR than the standard ratio provided by the government.

Table 5 Facilities for students in the schools

District	Block	Blackboards available in	Lights available in classrooms	Fans available in classrooms	No. of classrooms without fans	Functional library for students	Lights in library	Fans in library	Computers available for students	Computers functional	Computers connected to internet	Television for students	Functional science laboratory	Lights available in science	Fans available in library	Toilets for students	Lights in toilet
Ranchi	Bero#	Y	Y	Y	0	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y
	Bundu	Y	Y	Y	0	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y
	Itki	Y	Y	Y	0	Y	Y	Y	Y	Y	N	N	N			Y	Y
	Mandar#	Y	Y	Y	0	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y
	Nagari	Y	Y	Y	0	Y	Y	Y	N			N	Y	Y	Y	Y	Y
Deoghar	Devipur	Y	Y	Y	0	N			Y	Y	Y	Y	Y	Y	Y	Y	Y
	Mohanpur	Y	Y	Y	0	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Palojori	Y	Y	N	4	Y	Y	Y	Y	N	N	N	Y	Y	Y	Y	N
	Sarath	Y	Y	Y	0	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Sarwan	Y	Y	Y	0	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	
East Singhbhum	Dhalbhumgarh	Y	Y	Y	0	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Dumaria	Y	Y	Y	0	Y	Y	Y	N			Y	N		Y	Y	Y
	Ghatshila	Y	Y	Y	0	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
	Musabani	Y	Y	Y	0	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N
	Patambda	Y	Y	Y	0	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y

Y= Yes, N=No, Blank=Facility absent

#Residential school

2.5 Limitations of the study

Even with the planned efforts, lack of administrative information and missing update at some community health centers and schools inflict limitations on the approach undertaken for the study. Service readiness of the PHC/CHCs and schools depends on three crucial factors- availability of energy, essential/desirable equipment and services, and availability of sanctioned manpower at the facilities. Therefore, under this study it is difficult to calculate the net impact of electricity access on service delivery at health centers and schools. Furthermore, the data captured in the service satisfaction surveys is based on the experience and perceptions of the respondent.

3. Multi-Tier Framework (MTF) assessment

Estimating energy supply and demand must be multi-dimensional (Bhatia & Angelou, 2014) to assess the different levels of energy access. Data aggregation into key attributes of energy access is essential to derive a profile of electricity access at community institutions, households(*ibid*). The detailed profile of energy access can identify the gaps and needs of the institution precisely and can support strategies, policy formulation, recommendations that would best serve to impact the energy access positively (WHO, 2015).

In this section, the multi-tier framework approach developed by ESMAP under the SE4ALL initiative is adopted to analyse energy access for community infrastructure energy uses, including the health and education facilities (Sustainable Energy for ALL,2013). MTF recognizes that electricity access is based on a grouping of several attributes of energy access spread over a six-tiered spectrum ranging from Tier 0 (minimum access) to Tier 5 (maximum access) (ibid.). Apart from having an electric connection at the community infrastructure, this approach also considers various characteristics beyond mere access, such as legality, reliability, affordability, etc. The higher tiers in the framework correspond to better conditions of energy availability in terms of the eleven attributes considered for the study, suggesting improved service delivery with each progressive tier at the institution. Facilities have diverse energy needs based on the availability of the equipment, services, and the population covered. Multiple appliances can swiftly run at facilities occupying higher tiers of energy access.

Every attribute is assessed separately to compile the electricity access tier at each health and education facility. All the functional primary and secondary sources of electricity at the facility were considered while calculating the tiers of energy access. The data collected using MTF approach is used for the disaggregated analysis that provides a diagnostic of electricity access (WHO, 2015).This study undertook an analysis of the various key indicators such as daily supply, frequency of interruptions, maintenance budget, etc. in relation to a set of factors including available technologies, facility size, location, services, and outcomes. This type of interpretation provides a better understanding of the situation and highlights the areas of improvement to enhance the energy supply. Data collected during the facility surveys provided information on the following key indicators through the use of the MTF approach:

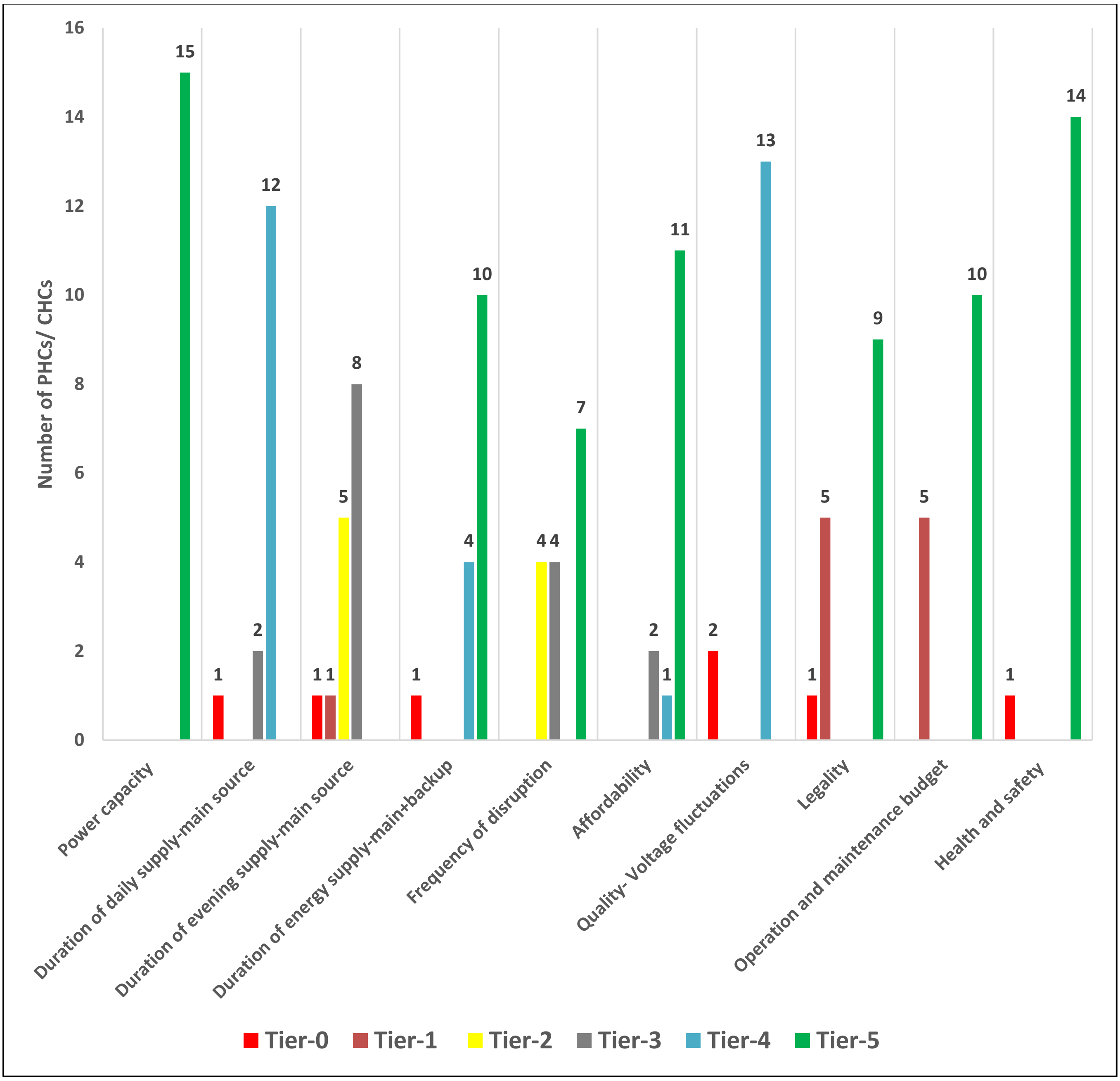
- Fraction of facilities with minimum or limited access to energy supply
- Fraction of facilities with adequate daily supply including the evening service hours from the primary source of energy
- Fraction of facilities with an improved daily supply using a durable back up source of electricity
- Fraction of facilities with reliable ad unreliable energy supply
- Fraction of facilities with affordable energy supply
- Fraction of facilities with reported voltage fluctuations
- Fraction of facilities with illegal connections
- Fraction of facilities with an allocated operation and maintenance budget and
- Fraction of facilities with reported casualties due to electricity

3.1 Energy supply status at health centers

A Survey of fifteen health facilities to determine the status of energy access formed the basis of the detailed assessment of this study. All the surveyed PHCs/CHCs were connected to grid. Duration of daily supply from the main source (grid) fell under tier 4 for most surveyed health facilities. Primary and secondary sources, when taken together, showed an improvement in the availability of the energy supply; 10 out of 15 (66.6%) facilities occupied tier 5 with the availability of 23- 24 hours of power supply.

The team considered reliability in terms of unscheduled disruption due to grid outages or breakdown of the secondary source delivering energy and voltage fluctuations. Facility heads from 2 centers reported the problem of voltage fluctuations that could potentially damage the equipment. Electricity supply without interruptions is considered reliable and healthcenters with a reliable source of energy supply may achieve better health outcomes. JREDA has covered the state CHCs under the rooftop solarising scheme and installed 10kW rooftop plants. Unlike the expensive fuel (2 times the grid tariff) for the generators, energy from the solar rooftop is affordable. To repair and maintain the supplied equipment, an electricity fund is available at 10 facilities. Monitoring accidents like electrocution burns measured the safety attribute and explosion risk for the past year; based on these criteria;the data reported no serious accidents at 14 health facilities. Figure 1 below presents PHCs/CHCs in various MTF category(Refer Appendix 1).

Figure 1 Distribution of PHCs/CHCs according to MTF attributes



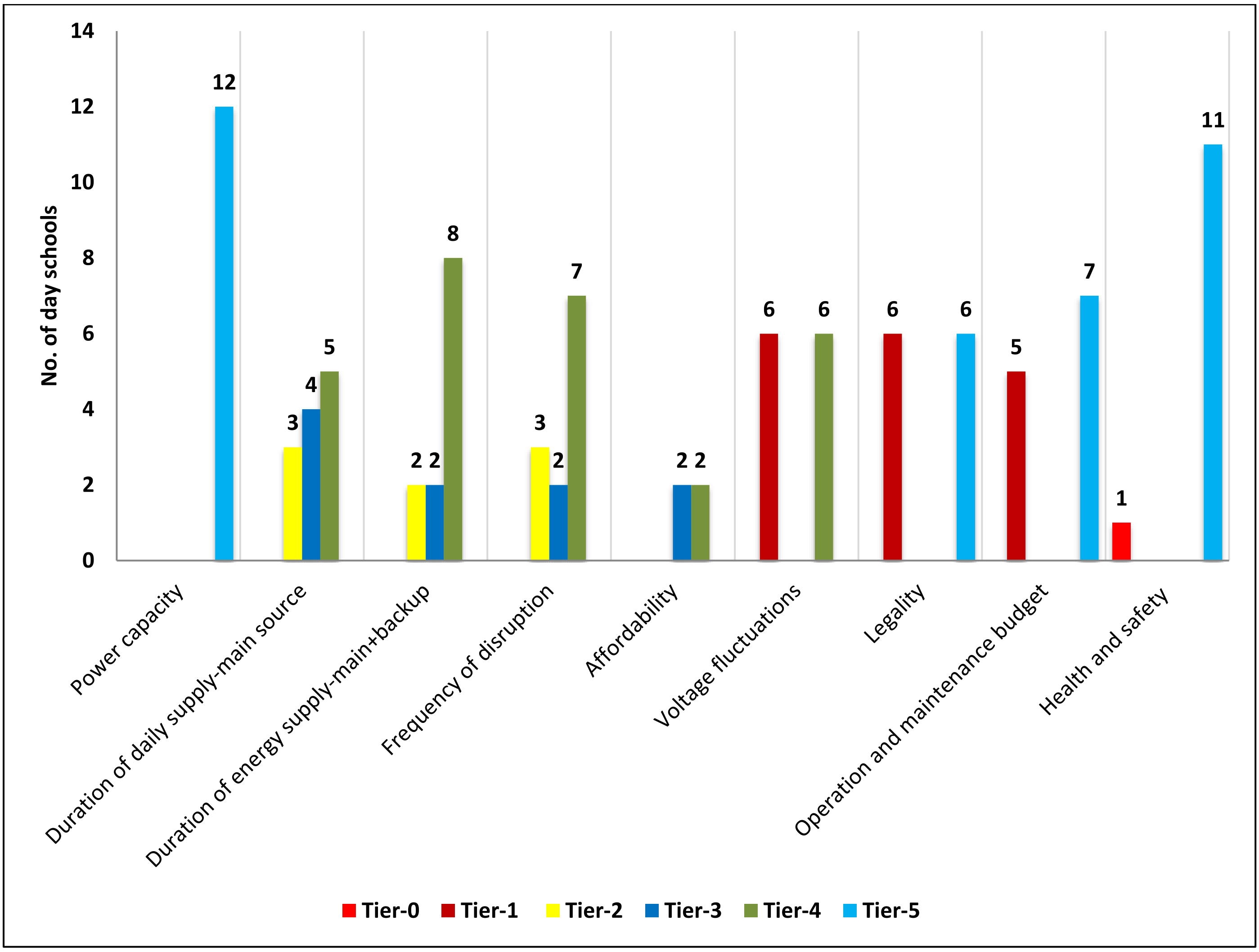
Source: IRADe primary survey

3.2 Energy supply status at schools

Multi-tier analysis for energy supply in schools corresponds to thedifferent multi-tier frameworks for day and residential schools, respectively (refer to Table 1, 2 in Appendix I). The analysis team analysed first-hand data collected on electricity connection and related aspects from fifteen schools. All the surveyd schools, both non-residential and residential, were connected to grid. JREDA covers the government-run residential schools of the state under the umbrella scheme of solarising government buildings. We took three residential schools as a part of surveyed facilities to understand the impact of solarization in their service delivery. The remaining twelve schools were non-residential schools/ day schools usually open from 9 a.m. to 3 p.m. (6 hours a day only), after which the students return to their home.

The daily energy requirement is diverse for residential and non-residential schools. Residential schools have hostel facilities for students, working staff, and comparatively larger campus than the day schools. Unlike day schools, which operate for 6 hours during the day-time, residential schools require 24x7 access to reliable electricity. Thus, we performed the MTF analysis for the non- residential and residential school separately.

Figure 2 Distribution of non-residential schools according to MTF attributes

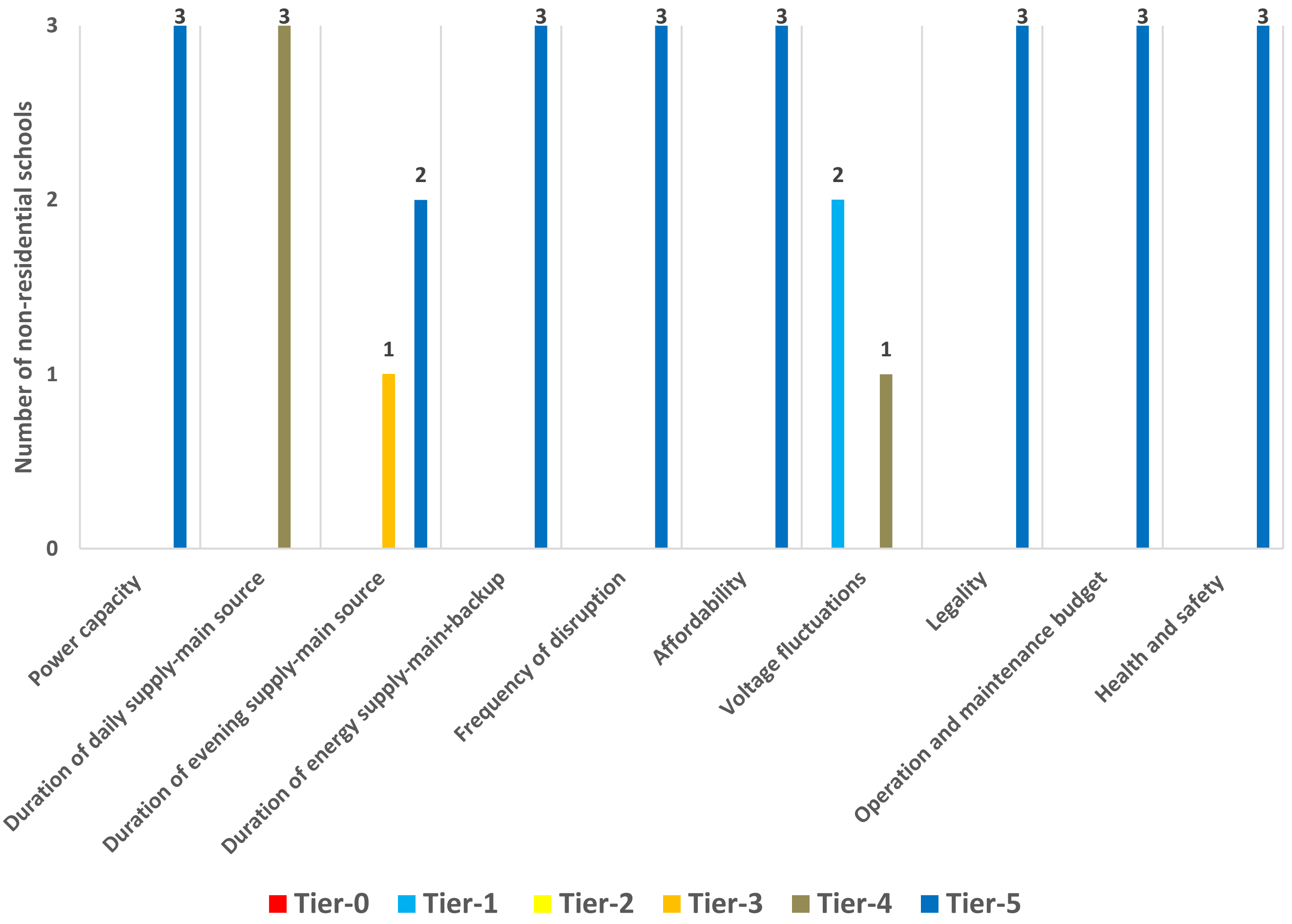


Source: IRADe primary survey

Figure 2 above presents the distribution of non-residential schools in various MTF category (Refer Appendix 1) . The non-residential schools reported an average daily availability of electricity for 3 to 5 hours during the working hours. Some of the non-residential schools have inverters as a secondary source of electricity supply. During power-cuts, electricity supply through inverters is insufficient to cater to the entire power demand in these schools. Therefore, electricity usage is limited to carrying out administration work and running computer labs. Health and safety attributes for 11 out of the 12-day schools occupied tier 5. The data reported no serious accidents in the past 12 months due to electricity in the school campus.

Residential schools show better availability, reliability, affordability, legality of power supply as all the three schools fall under tier 4 or tier 5,displaying advanced access (Fig 3). Additionally, these schools have sufficient funds to pay for electricity bills, fuel, and maintenance costs. However, the issue of voltage fluctuations was reported by two out of the three residential schools. Figure 3 below presents the distribution of residential schools in various MTF category (Refer Appendix 1).

Figure 3 Distribution of Residential Schools according to MTF attributes

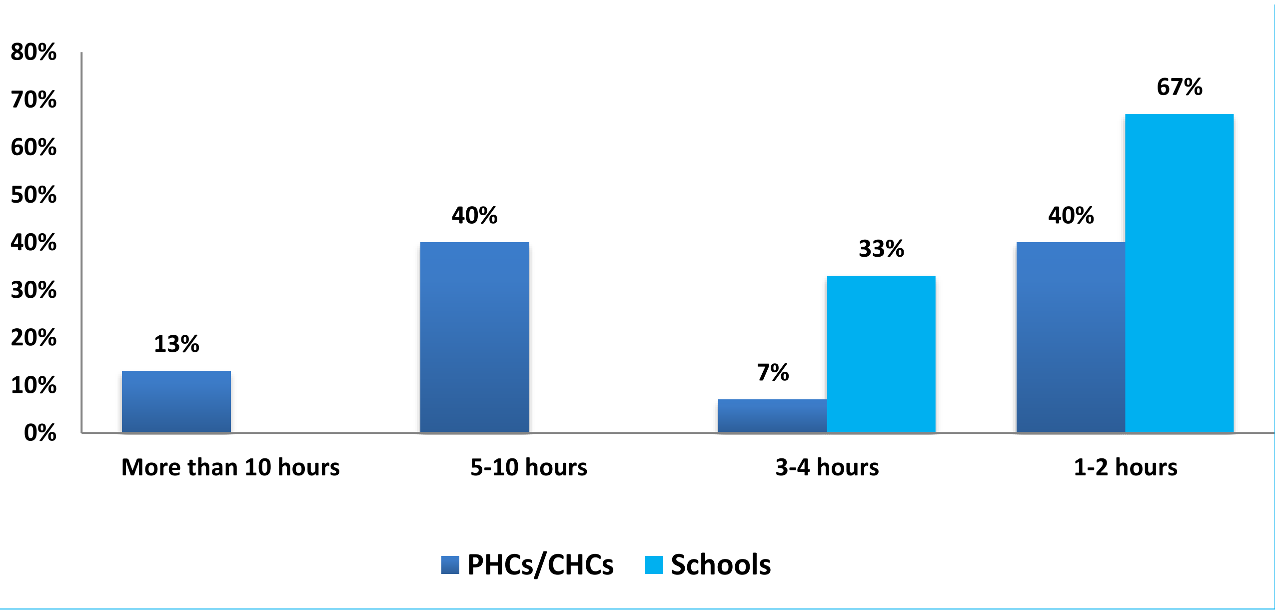


Source: IRADe primary survey

4. Understanding need of reliable electricity access

The facility surveys revealed that 93% of PHCs/CHCs and all the schools had access to electricity. Despite having access to electricity, reliability remains an issue. Figure 4 presents the percentage distribution of surveyed PHCs/CHCs and schools according to power interruptions, from the main source, during working hours. 67% of connected schools reported power interruption for 1-2 hours during the working hours (Fig. 4). 40% of the surveyed PHCs/CHCs facilities reported 5- 10 hours of power disruptions from the grid source daily. These facilities had access to grid electricity as their main source of electricity. Though, PHC Itki is consuming grid electricity to meet its electricity requirements during the working hours (9 am- 4 pm). However,this healthcenter is running without legal metered electricity connection and does not have any secondary source available for electric power. This suggests that there may be several health centers in the state lacking access to reliable and uninterrupted supply of electricity. The lack of sufficient electricity could hinder their ability to provide quality service delivery.

Figure 4 Distribution of PHCs/CHCs and schools according to power interruptions during working hours



Source: IRADe primary survey

Participants reported the absence of immediate response to grid failures, more during monsoon seasons, and technical faults at the facilities during the group discussions. Further, theavailability of electricity has a seasonal dimension: better availability during winters while the summer season witness extended hours of power cuts. The respondents of group discussions highlighted thelack of adequate maintenance budget for repairing electrical wiring, switches, fans, and replacing lights as a challenge to run the services at PHCs/CHCs and schools.In absence of secondary source of electric power in day schools, students complained that it becomes unbearable for them to sit in the class during power cuts in summer season. They also find it difficult in the classroom to read and write in low light conditions and suffers from eyestrain. During the group discussion, teachers complained that students find it difficult to focus on study during power cuts on those days when natural light is inadequate or the day temperature is high.

The availability of a secondary source of electricity improves the reliability of the power supply at the PHCs/CHCs and schools. Electricity in some residential schools is supplied by diesel-powered generators, which cannot be operated throughout the power cut duration, due to limited budget and expensive fuel. Some surveyed school authorities also reported worn-out batteries due to excess usage of inverters.Generators, without self-starter, at health centers impede the services as it does not provide instant lighting needed duringan emergency. Several past instances were reported by the CHCs group discussion participants, where patients were undergoing surgery in operation theatre or women were delivering a child in the labor rooms, and there was a sudden power cut. They had to use battery-operated torch during such situations until the operators starts the generators. However, the JREDA solar rooftop scheme at CHCs has been a respite to such problems. All the three residential school surveyed under this study were Kasturba Gandhi Balika Vidyalaya (KGBV). In KGBV, it is mandatory that not only students but also the teaching and non-teaching staffs should be female. Prinicipals of these schools reported that JREDA rooftop solar scheme had eased their life enormously,as operating generators during power cuts in evening hours or night-time was not only difficult for female staffs but also expensive.

Integration of energy access in improving life saving service at Malnutrition Treatment Center (MTC)

***"Whenever there is power in the center, the first thing we do is charge the battery-operated torch. Sometimes, we even spend the entire night in darkness,"* says the attendant at the center.**

Under the National Health Mission, the Jharkhand government has established around 88 0MTCs, which admits children with acute malnutrition for extensive care as per the admission criteria. After admission, they look after the child's feed according to the medical condition. MTC provides a liveable atmosphere with particular attention to nutrition until the child gets discharged. A caregiver accompanies the child (mostly their mother). The provision of funds for the caregiver is available (Rs 100/ day) to meet their daily needs. Apart from the therapeutic food and medical personnel, the infrastructure, hygiene, and other facilities provided at the MTC largely determine the successful treatment at the MTC.

The picture alongside depicts the plight of the staff at one of the MTCs visited. This particular MTC runs in a dilapidated building with a lack of regular electricity. The staff, as well as the inpatients, reported difficulties in performing everyday activities. Battery operated torch is the only backup source available during the long and frequent power cuts. The staff has to be quick enough to charge the batteries as soon as the power interruption restores. Besides the operational inconvenience, the lack of adequate light also endangers the security of in-house mothers and children.

5. Service readiness of health and education facilities

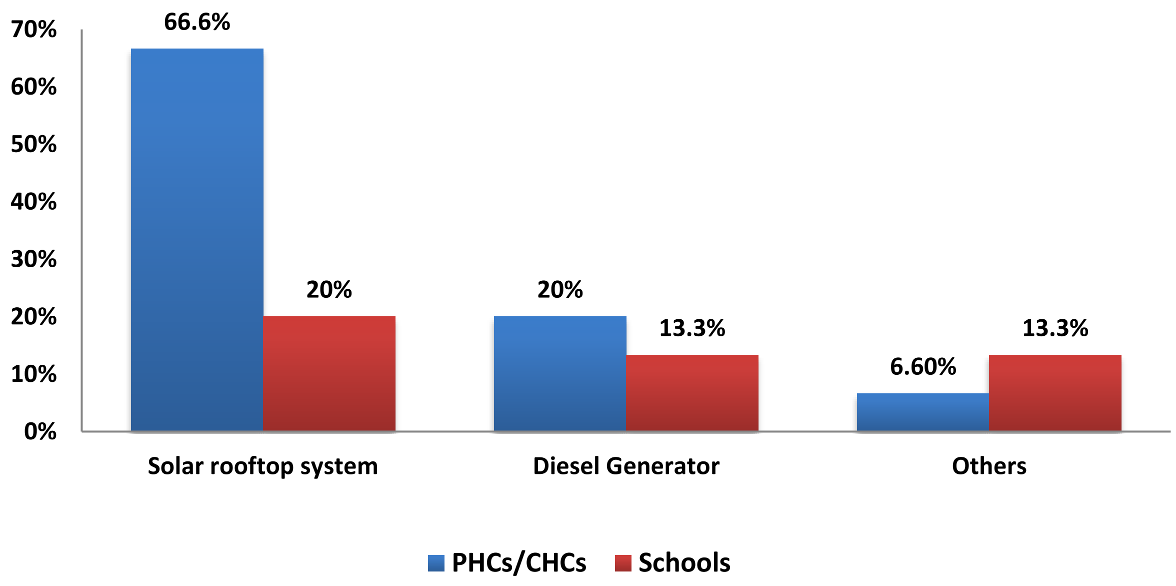
Service readiness is increasingly considered as a key to improving the outcomes of the facility. Particularly for the health facilities, Service Availability and Readiness Assessment (SARA) mainly focuses on the infrastructure, essential equipment, diagnostic capacity, trained healthcare personnel, and aspects of service utilization (WHO, 2013). Similarly, the availability of physical facilities encompassing electricity facility and infrastructure facilities in schools has a significant impact in providing a conducive learning environment for students (Bandhopadhyay, 2009).The study survey included these tracer indicators and their relationship concerning the availability of electricity or the lack of it.

5.1 Modes of secondary energy at the facilities

As highlighted in the MTF section, the PHCs/CHCs and schools are connected to the grid as the primary source of electricity. For quality service delivery, equipment providing secondary electricity becomes vital in the facilities with interrupted and insufficient access to grid energy. The provision of electricity backup has supplemented the existing hours of daily power supply.

To meet the electricity deficit,93% of surveyed health facilitieshad access to backup options,out of which 66% have solar rooftop systems installed in the facility campus, 20% rely on diesel-powered generators, and 6% have other options like inverters. On the contrary, only 47% of the surveyed schools were equipped with backup options; 20% are solar-powered, 13% have a generator, and 13% have lead-acid battery inverter connections as power supply backup.

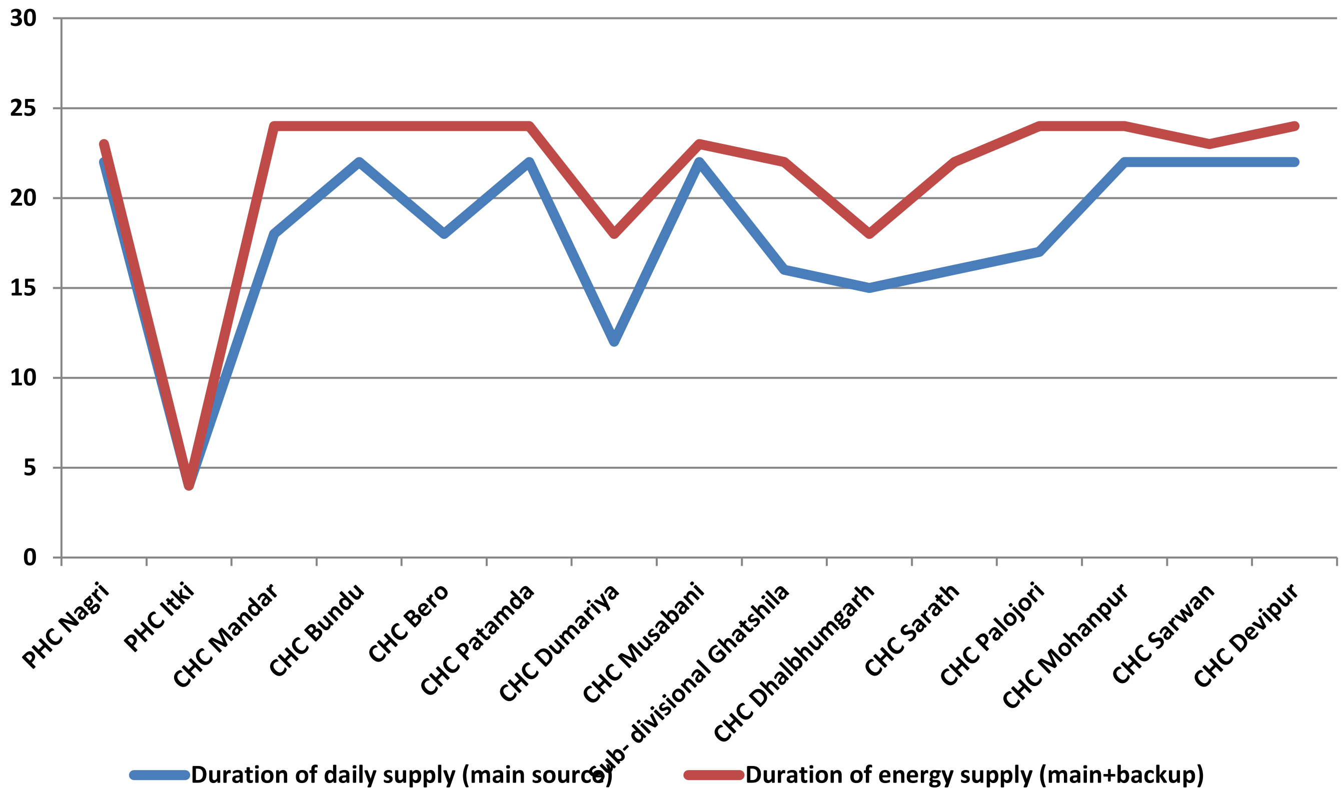
Figure 5 Availability of backup sources



Source: IRADe primary survey

The proportion of PHCs/CHCs with intermittent electricity has improved over the years owing to the availability of secondary sources, especially solar power. JREDA has played a pivotal role in achieving the target of nearly 24x7 power in almost 50% PHCs/CHCs through the state's solarising scheme. The energy from inverters cannot provide for all the electrical needs of the facilities. Back up options like generators have significant cost implications. Still, it provides electricity for the essential services, such as electricity for running the cold chains, labour rooms, patient wards in health centers and computer labs, smart classes in schools.

Figure 6 Improvement in the daily power supply at health facilities



Source: IRADe primary survey

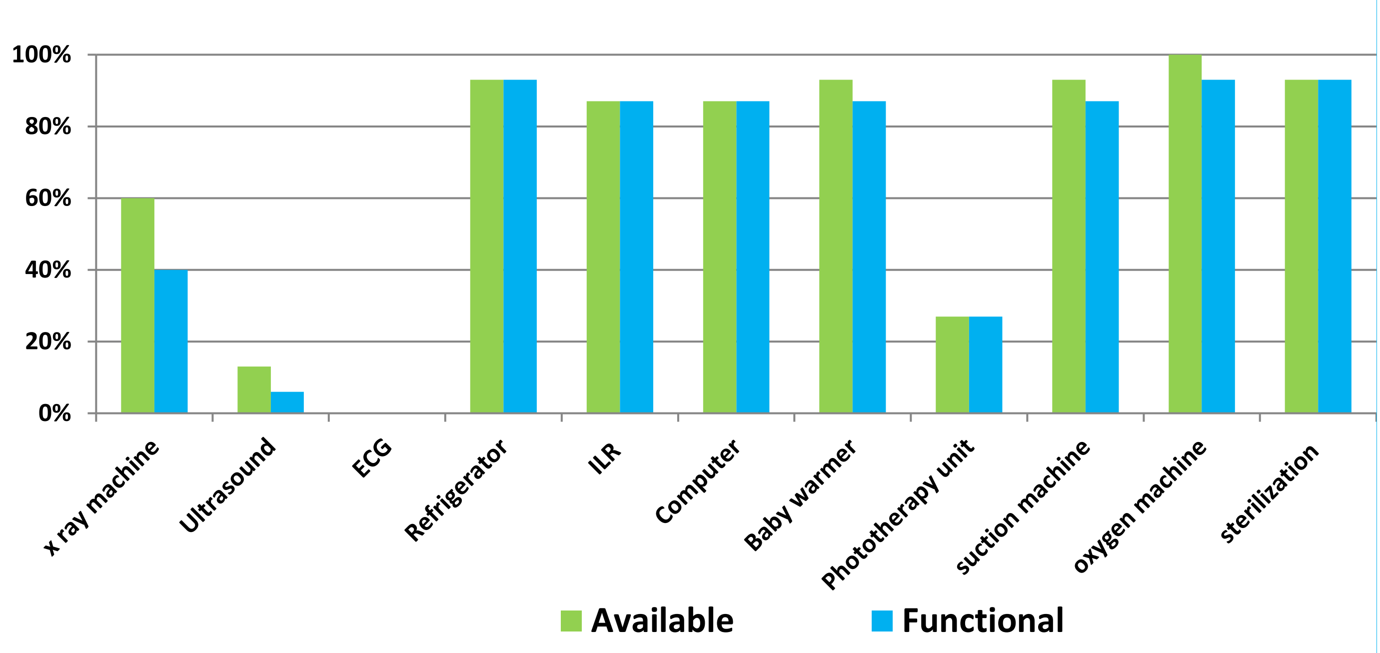
Figure 7 : Secondary sources of electricity at health centers and schools

Source: IRADe primary survey. a) solar rooftop on the upper panel, b) diesel generator on left-side of lower panel, c) solar rooftop batteries in middle of the lower panel d) inverter on right-side of lower panel

5.2 Availability of essential/desirable equipment and services

The essential equipment to deliver the assured services of the PHCs/CHCs should be available in adequate capacity and also be functional (IPHS,2011). For the functioning of some essential equipment, regular electricity with a reliable backup source is a must.The pivotal role of these health centers is to provide services for the betterment of maternal and child healthcare; thus, the availability of necessary equipment for maternal and newborn care is essential.

Figure 8 Percentage of PHCs/CHCs with fully functional essential electrical equipment



Source: IRADe primary survey

Essential electrical equipment is available at the centers with an adequate supply of electricity and reliable backup in rooftop solar panels or battery-operated invertors.However, at 34% CHCs with 24 x7 electricity (Tier 5), some necessary services like an X-ray machine, ECG, Ultrasound machine, Phototherapy unit was not available.To avail such health services, patients had either visit the nearby private hospitals or government district hospitals in the town.The study found that several CHCs, having X-rays and ECG machines, cannot provide these services to the patients due to the vacant technician post. This highlights that to improve the service readiness of health centers, availability of essential equipment and trained manpower is prerequisite.

"X-ray machine and ECG machine is available at the facility but not functioning due to lack of technician. These two machines came nearly 6 years ago, but technicians never allocated to operate these machines. Online asset/equipment register and complain register for damaged equipment is needed. This will help in mapping the facilities lacking human resources for available equipment."

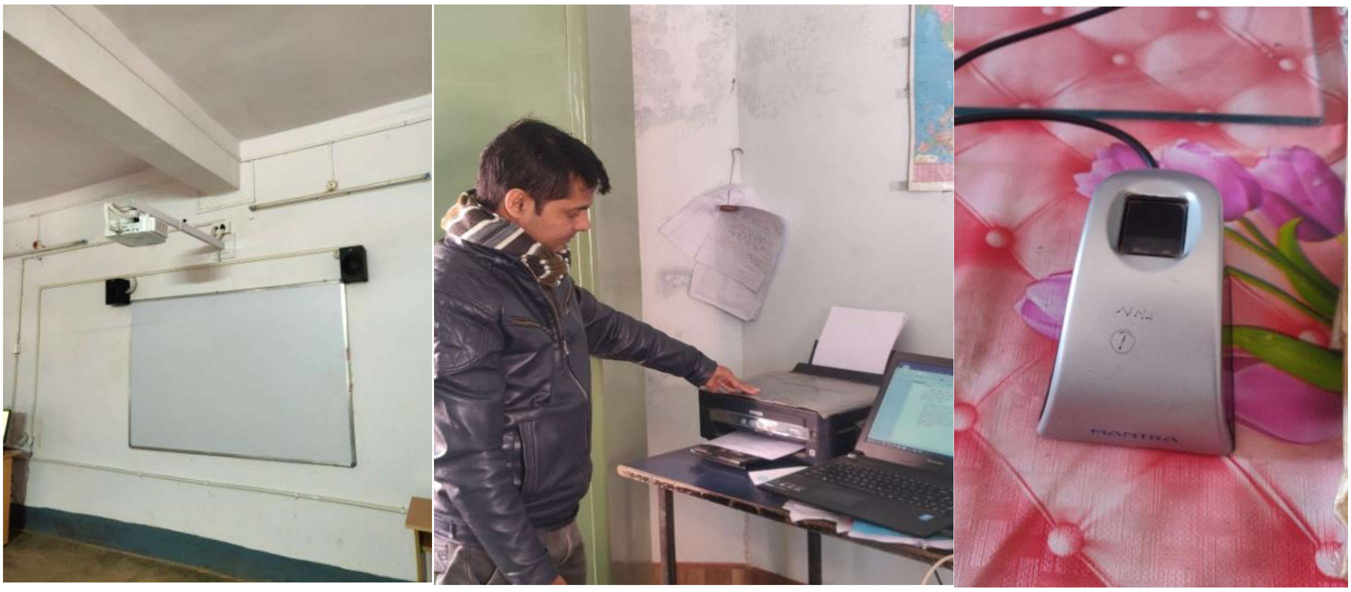
Participant at CHC Bero, Ranchi

Figure 9 a) Baby warmer right-panel b) Cold chain at CHC left-panel

Source: IRADe primary survey

In the context of education, secondary education is a crucial stage in the hierarchy as it prepares the students for their future endeavors in the world of work. Apart from having the necessary facilities, including effective cooling, lighting installed in the classroom for making the atmosphere student-friendly, it has become increasingly important to focus on the technological advances to improve and strengthen the knowledge imparted to the students.The study found that 73% and 87% of schools have computer facilities for the teachers and students, respectively. However, only 47% of schools have internet connectivity, and 53% of schools have available projectors and screens for conducting interactive audio-visualclasses.A substantial amount of schools, 87%, have a working science laboratory.

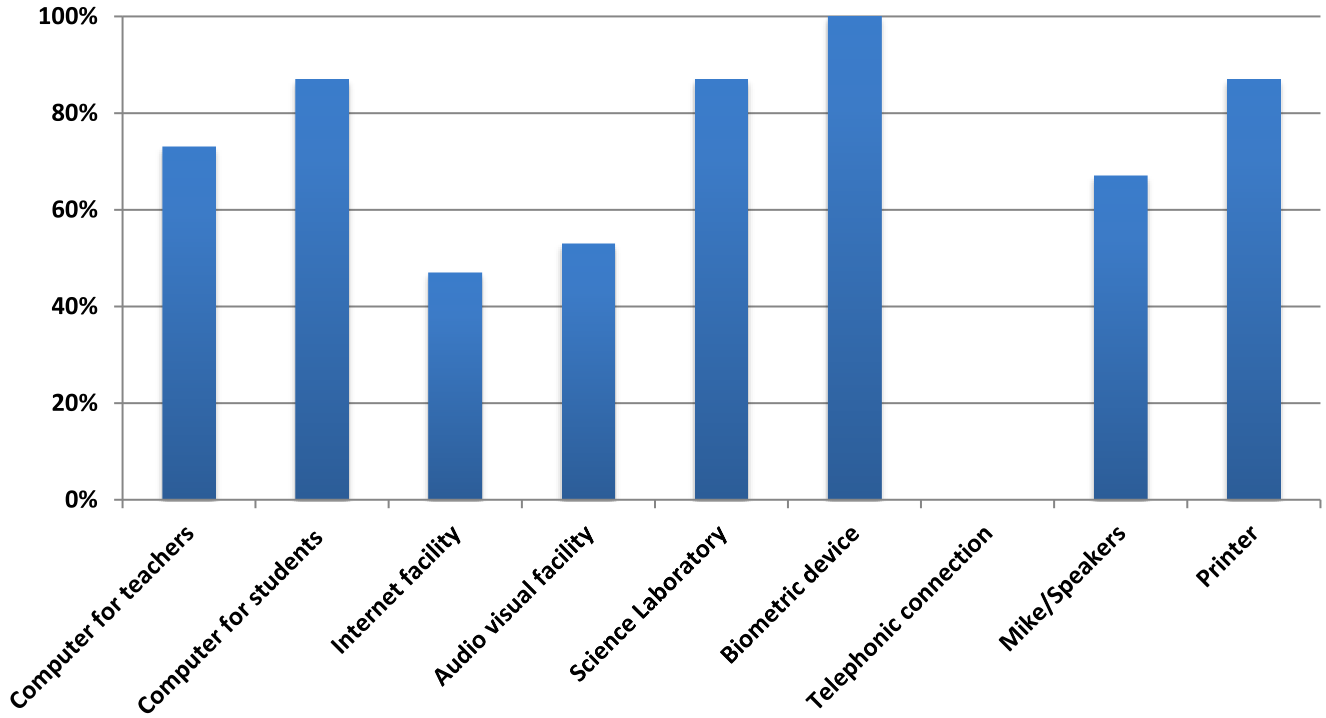
Figure 10 a) Biometric device rig-panel b) Projector center panel c) Printer at School left-panel



Source: IRADe primary survey

Although100% of schools have a biometric device installed for marking the attendance of the staff, there were instances of discharged devices at a few schools due to the absence of regular electricity. The proportion of schools with equipment for making announcements, including the mike and the speaker sets,was 67%.

Figure 11 Percentage of Schools with functional electrical equipment

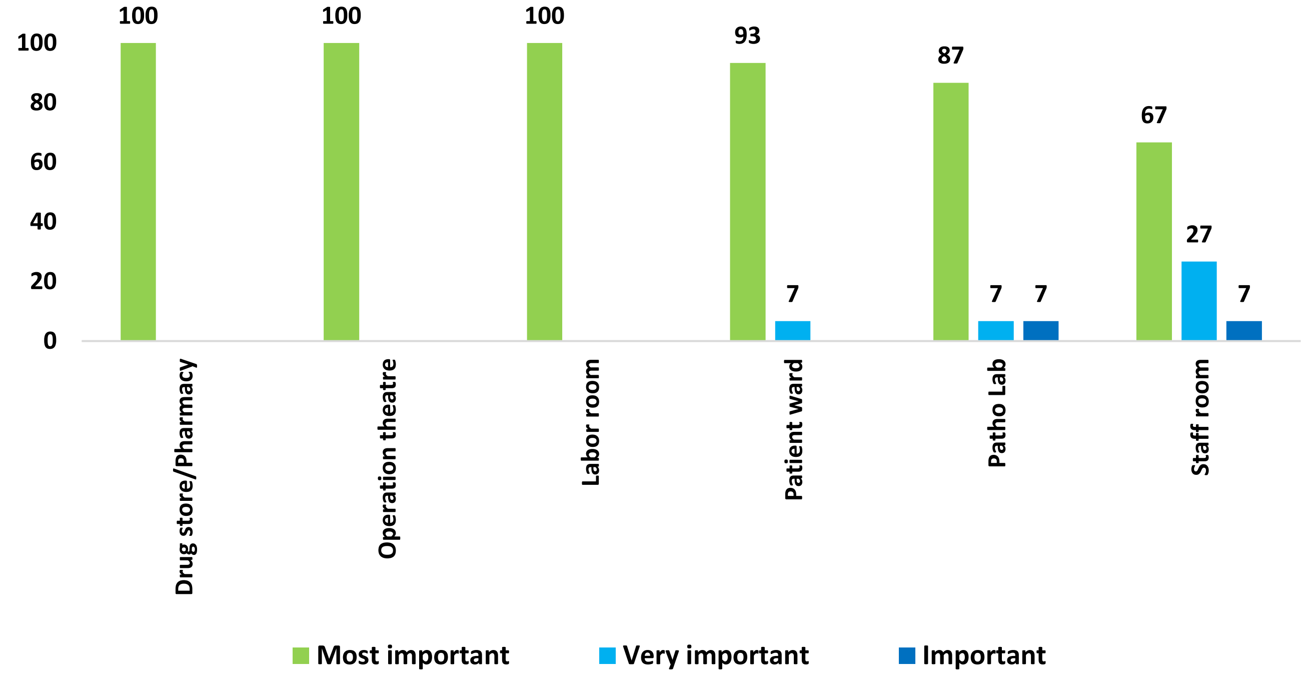


Source: IRADe primary survey

5.3 Access to electricity for the functioning of essential equipment and services

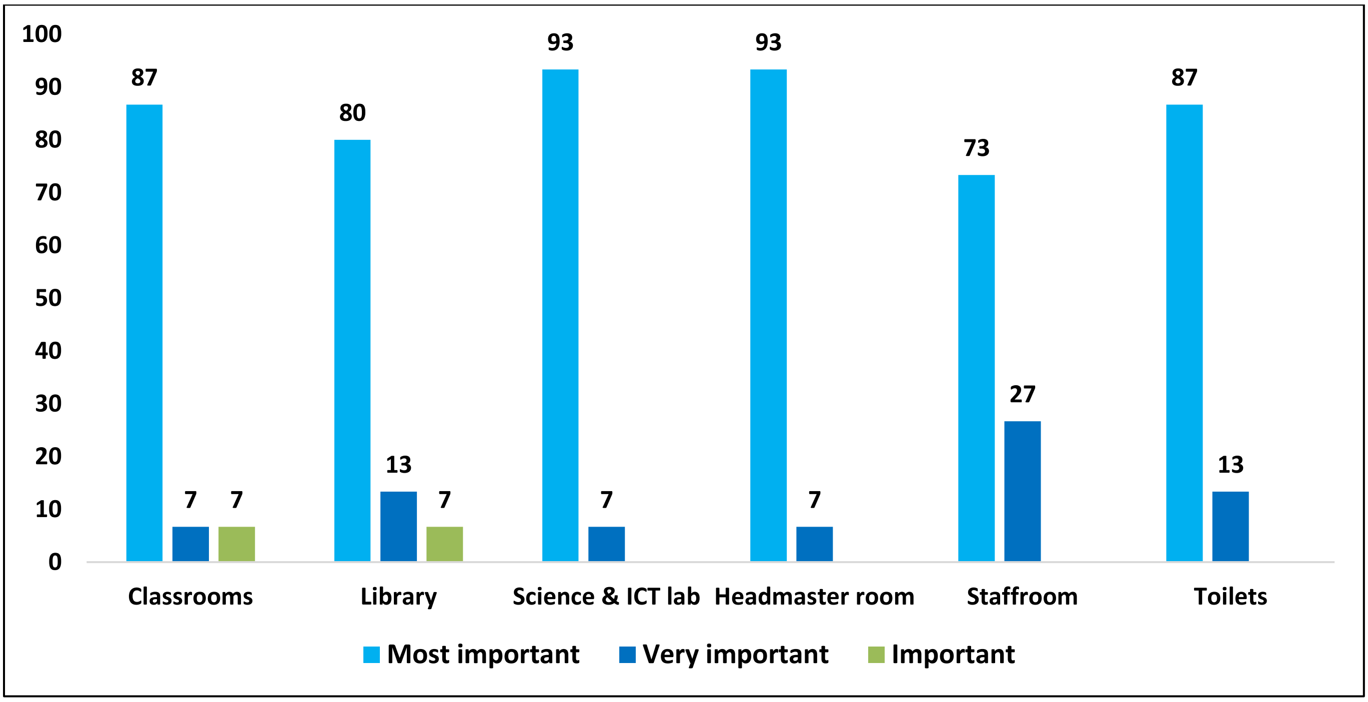
Matrix ranking to reveal the importance of regular electricity on a scale of one to five, with progressive significance to the top, showed that access to electricity is essential for the effective use of the equipment and enhanced service delivery. At the PHCs/CHCs, regular electricity to maintain the cold chain system and run the new born care is essential. Access to a steady electricity supply has improved since the installation of solar rooftop systems in 2019. Group discussions highlighted that solar power provided for the immediate power backup during the operations, which considerably reduced the chances of errors due to power cuts. However, the electricity generation from installed 10 kW capacity of solar panels at some CHCs, with an extensive cold chain system, fall short in meeting the essential energy demand. Therefore, the solar rooftop system and the diesel generators are used simultaneously to maintain the cold chain system and deliver key services. All the PHC/CHC heads unanimously agreed that access to reliable electricity is very important for drug store, operation theatre and labor room (Fig. 12a).

Figure 12aPHC/CHC heads perception about requirement of electricity for different purposes



Source: IRADe primary survey

Figure 13 b School heads perception about requirement of electricity for different purposes



Source: IRADe primary survey

The head in the surveyed schools ranked the need for electricity for different educational activities in the school. Most headmasters perceive reliable electricity access most important in classroom teaching, library, science and ICT laboratories, staff room, headmaster room, and the school toilets.The computer-aided learning process through the introduction of the ICT in schools scheme has provided students with opportunities in the secondary stage of their education to build up their knowledge in an interactive way. Requisite infrastructure to impart computer-aided literacy includes a reliable electricity connection for the smooth functioning of smart classes.

Still rely on fire to keep babies warm

Source: IRADe primary survey

Two women sitting with their babies near the fire during cold weather at the MTC

The visited MTC had two baby warmers in place, but the administration reported that the lack of regular power supply left them less worthy. Unfortunately, the attendants had to arrange alternatives to keep the in-house babies warm during the harsh winters.

Jaya, the mother of one of the admitted babies at the MTC, says, "In the presence of electricity, we could have stayed indoors and kept ourselves, and the babies warm using the heaters". "The fire does keep us warm, but it is not a solution for the entire night. On rainy days, keeping a fire going becomes very difficult."

The wet kindle gives off smoke in large quantities, which is harmful both for the child and the mother. Power supply with a reliable backup would solve the problems and keep the child thermos-regulated.

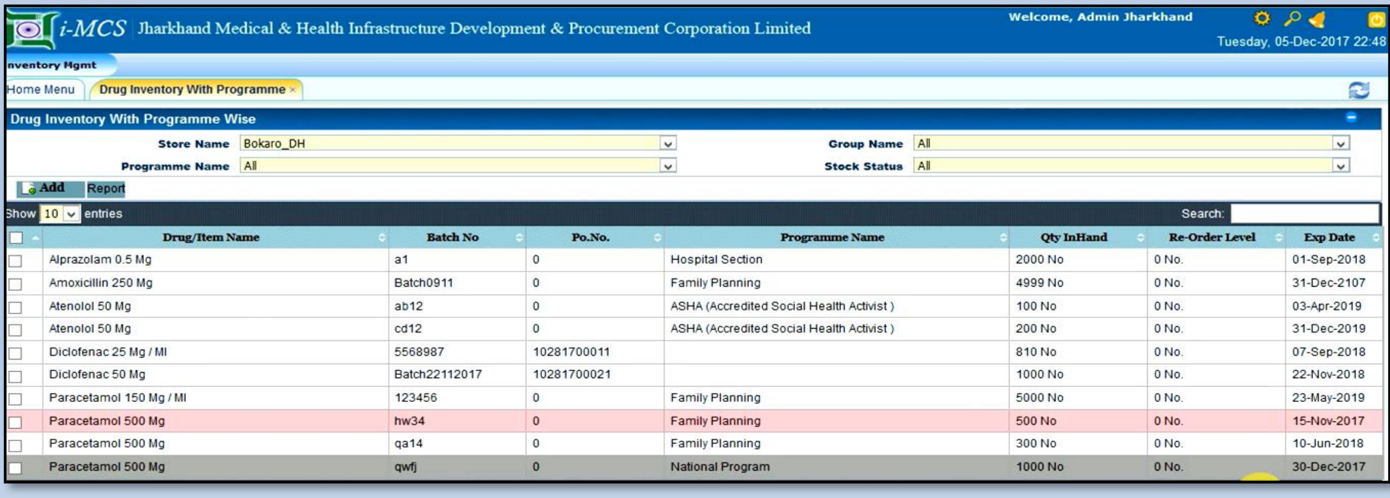
5.4 Procurement of electrical equipment and supplies at the facilities

A dedicated procurement cell, along with the IT department at the state NRHM office, manages the procurement of different supplies at the district level. The inventory list of essential medicines (EML) is updated online to handle the available medicines and vaccines through online platforms such as E aushadi and the eVIN platform.PHCs submit a request application to the parent CHCs for the procurement of electrical equipment. Similarly, the CHC facility head writes to the Sub-divisional hospital about their equipment needs. In schools, the purchase request for equipment in the classes or laboratories is made to the education department via the district administrative officer in writing. No online portal is available for the purchase of electrical equipment at the health centers and the schools. Much can be achieved on this front, as online platforms reduce the processing time and track the real-time needs of the institution.

E- Aushadi: electronic medicine Inventory

NRHM launched E- Aushadi in the year 2018. The software platform DVDMS (Drugs and Vaccine Distribution System) has automated the activities under the drug supply chain. The platform manages the purchase order, distribution, receipt, quality control, etc. Indent of essential drug list updated online, and the state distributes the medicines as per the requirement. This platform has made the purchase of drugs hassle-free.

Mr. Avanindra Singh, head of the procurement department NHM explains, "The platform for E- Aushadi is available at all the CHCs in the state." "It is in the initial phase, and the government plans to cascade it to lower levels of health centers, including the primary health center and the sub-centers."



i-MCS Jharkhand Medical & Health Infrastructure Development & Procurement Corporation Limited

Welcome, Admin Jharkhand
Tuesday, 05-Dec-2017 22:48

nventory Mgmt

Home Menu | Drug Inventory With Programme

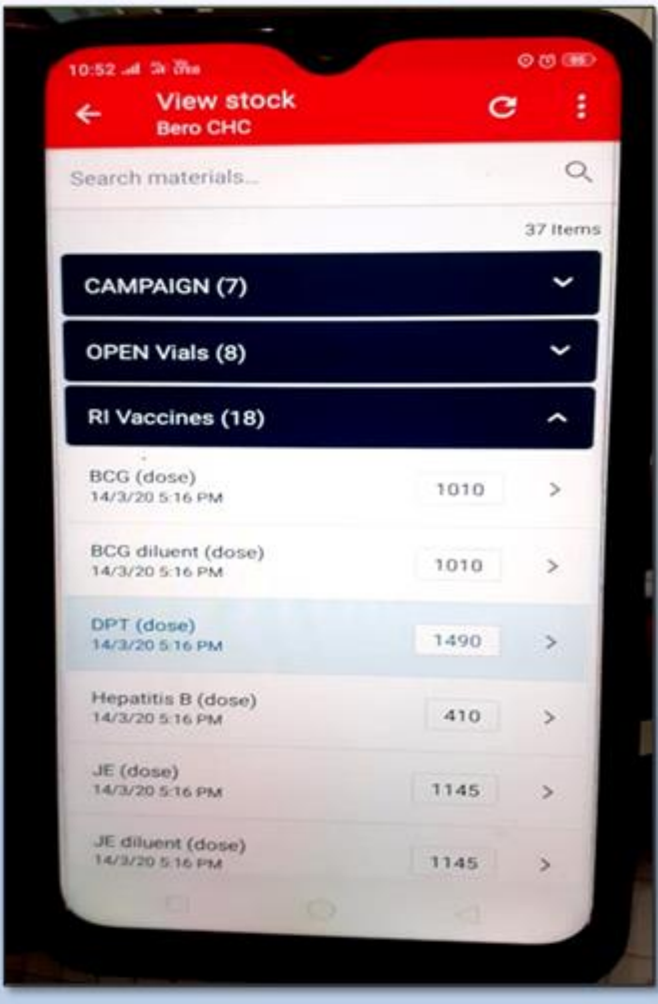
Drug Inventory With Programme Wise

Store Name: Bokaro_DH
Programme Name: All
Group Name: All
Stock Status: All

Add | Report

Show 10 entries | Search:

Drug/Item Name	Batch No	Po.No.	Programme Name	Qty InHand	Re-Order Level	Exp Date
Alprazolam 0.5 Mg	a1	0	Hospital Section	2000 No	0 No.	01-Sep-2018
Amoxicillin 250 Mg	Batch0911	0	Family Planning	4999 No	0 No.	31-Dec-2107
Atenolol 50 Mg	ab12	0	ASHA (Accredited Social Health Activist)	100 No	0 No.	03-Apr-2019
Atenolol 50 Mg	cd12	0	ASHA (Accredited Social Health Activist)	200 No	0 No.	31-Dec-2019
Diclofenac 25 Mg / Ml	5568987	10281700011		810 No	0 No.	07-Sep-2018
Diclofenac 50 Mg	Batch22112017	10281700021		1000 No	0 No.	22-Nov-2018
Paracetamol 150 Mg / Ml	123456	0	Family Planning	5000 No	0 No.	23-May-2019
Paracetamol 500 Mg	hw34	0	Family Planning	500 No	0 No.	15-Nov-2017
Paracetamol 500 Mg	qa14	0	Family Planning	300 No	0 No.	10-Jun-2018
Paracetamol 500 Mg	qwfj	0	National Program	1000 No	0 No.	30-Dec-2017



Online platform of E-Aushadi

The installed eVIN mobile application in the smartphone of the cold chain handler provides for the digitalization of the vaccine inventory. vaccine after the immunization activity each day. The updated cloud server can be viewed and analyzed by programme managers at the district, state, and center.

eVIN application has created a platform for emergency management, route planning, and stock reallocation of vaccines and has significantly curtailed facilities reporting stock-outs.

"The app is manually updated; as a result, there is a reduction in the number of missed opportunities due to lack of vaccines." explains a participant during the focus group discussion. He also presses on the importance of electricity as he exclaims, "Electricity is the backbone of all the digitalization processes, and it is only through the stable power that integration of technologies at the health centers can be successful."

6. Electricity access and community service delivery

6.1 Better service delivery with improved access to electricity

Although multiple factors, such as medical staff, equipment, medicines are necessary for adequate delivery of health services, energy plays a critical role in strengthening healthcare service delivery and improving health outcomes prolonged opening hours with improved emergency surgical services are among the potential impacts of access to reliable energy. PHCs/CHCs, having emergency service facility, reported access to uninterrupted 24x7 electricity as a critical component for handling of emergency cases. The pace of solar electrification of the health centers (CHCs) has increased in the across Jharkhand in the last 6 to 8 months. Solar rooftop systems offered greater reliability; 81% of the solar equipped health centers reported that they had electricity available throughout the day for the last 7 days before the survey day. The enhanced power supply of about 4 to 6 hours daily has provided for better emergency care (meaningless mortality during birthing complications), management of vaccine and drug storage.

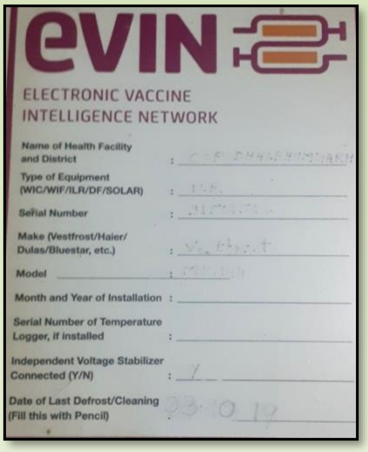
The state government has come up with digital dispensaries for providing medical treatment. By leveraging the IT, the health department has adopted technology to enable quality healthcare in the nook and corner of the state. Digital dispensaries have proved to be a success with satisfactory treatment results from the locals. Needless to say, the backbone of digital interventions remains quality and stable electricity provision. State health department officials reported that they had to shut down digital dispensary at few locations due to unavailability of reliable grid electricity.

Digital dispensary: A boon for rural India

Digital dispensary or telecommunication centers are an initiative taken up by the Jharkhand government in February 2019. The initiative is in close association with the Apollo Hospital Enterprises Ltd for telemedicine services. At the digital dispensary patients are diagnosed and treated for various diseases via video conferencing with the doctors. A panel of 30 doctors stationed at Hyderabad and Chennai related to general medicine, gynaecology, paediatrics, and dermatology take up cases of the registered patients daily between 10 am to 4 pm (excluding Sundays). A lab technician and an auxiliary nurse midwife (ANM) are deputed in every digital dispensary. Vital tests for height, weight,blood pressure, sugar level, and body temperature are performed by the ANM and the lab technician. Besides this, critical tests for pregnancy, malaria, typhoid, dengue, and urine analysis are also conducted at these centers. Medicines are made available free of cost to the patients at the centers.

The digital dispensaries are mainly launched in the PHCs where doctor availability is negligible. The daily target set for each center is at least 10 patients. This target is easily achieved with the count of female patients being higher than the male patients. The backbone of such service is electricity. The digital dispensaries would be non-operational in the absence of a power source backed up by a reliable secondary source for uninterrupted functioning.

Vaccine storage made intelligent- eVIN



Developed by the Ministry of Health, Government of India, and implemented by UNDP, the Electronic Vaccine Intelligence Network (eVIN) is an immunization strengthening measure; it digitilizes the vaccine storage and monitors the real-time temperatureof the cold chain through a smartphone application.

"*eVIN is playing an essential role in the efficient management of vaccine supply, monitoring, and supervision. It has brought significant changes in the areas of vaccine spoilage, utilization, and wastage.*" Manoj Jhalani, Additional Secretary and Mission Director (NHM)

Vaccines need to be stored at a recommended temperature to ensure their effectiveness. This necessitates attention to temperature monitoring and the health of the cold chain. This is successfully achieved by the eVIN devices (SIM-enabled temperature loggers) that capture temperature information through a sensor connected to the ice-lined refrigerators. eVIN machine captures the data every ten minutes, and the same is updated every sixty minutes on the server. In case of temperature fluctuation beyond the desired range, the device alarms and sends an alert to the cold chain handler.

"*I get a message on my phone immediately if the temperature is not under the range of 2-8◦C,*" says the ANM, who also works as the cold chain handler.

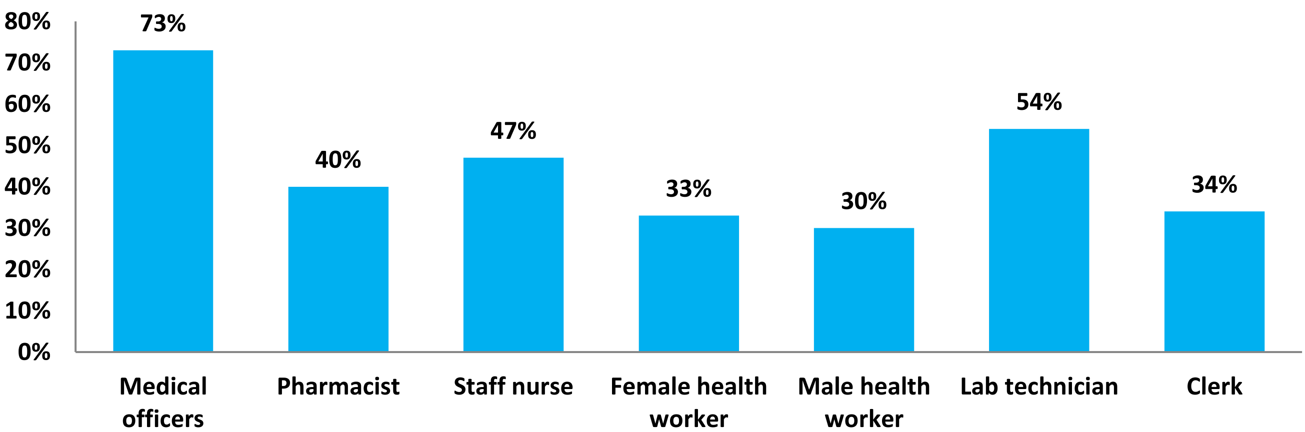
a) ILR connected to eVIN machine b) SIM-enabled temperature logger

Figure 14 a) Smart classroom at b) Computer laboratory at KGBV

6.2 Availability of manpower at the facilities

Workforce availability is a critical factor in providing satisfactory service delivery at the health centers.The facility surveys captured data on the availability of specific electrical equipment and medical services in health facilities.The analysis revealed that even if the infrastructure was in place, it did not necessarily translate into service provision. Lack of qualified doctors and medical staff attributed to this underutilization of resources. Figure 15presentsthe number of vacant positions for medical staff at CHCs/PHCs. The lack of the requisite number of doctors in the centers increases the patient load on the present doctors. Despite the availability of equipment like X-ray machine, health centers cannot provide the required tests in the absence of lab technicians. The staffs at the PHCs/CHCs complained about poor infrastructural problems such as inadequate security, lack of water supply, lack of reliable electricity which dissuades them from living in the allotted quarters. The health centre staffs prefers to work in locations having access to quality and reliable electricity. Health centre staffs reported that absence of reliable quality electricity affects their efficiencies and thereby service deliveries.

Figure 15 PHCs/CHCs with vacant positions for medical staff



Availability of dedicated principals, teachers, and assisting staff is necessary to impart quality education. With the increasing number of student enrolments, laws requiring small class sizes, the schools need to attract more teachers. However, the survey revealed that 75% of the schools reported a shortage of teachers. The teaching staff of the day schools in the rural areas of Jharkhand generally travel from the cities and return home. Teachers prefers to work in urban or peri-urban locations where electricity supply is more reliable compared to rural areas. In absence of power backup, many teachers complained that erratic power cuts create discomforts for both teachers and students. The frequency of power cuts increases during the summer season thus hampering teachers efficiency and students interest in classroom learning. The presence of electricity at night in the school campus becomes more crucial for the residential schools. Teachers revealed that they are more willing to teach at schools having reliable electricity during the working hours.

6.3 Patients satisfaction in healthcare services

Patient satisfaction largely depends on the medical services or the treatment provided at the health center and contributes to the positive influence on health. 48% of patients and non-patients respondents had to travel more than 5km to reach their nearest PHC/CHC. Inquiries about the waiting at the health centers revealed high satisfaction concerning waiting time less than 30 minutes (62%) and waiting room (90%). The study found 82%of respondents were satisfied with the supply of drinking water at PHCs/CHCs and 74% of respondents reported water availability in the toilets. 92% of respondents at PHCs/CHCs suggested that adequate vaccination is available at the health centers. Figures 13 and 14 highlights the distribution of respondents who visited the nearby private hospitals or government referral hospitals (RIMS) other than the nearest PHC/CHC for medical treatment and test, respectively.

Figure 16 Distribution of the respondents who visited other private or government hospitals

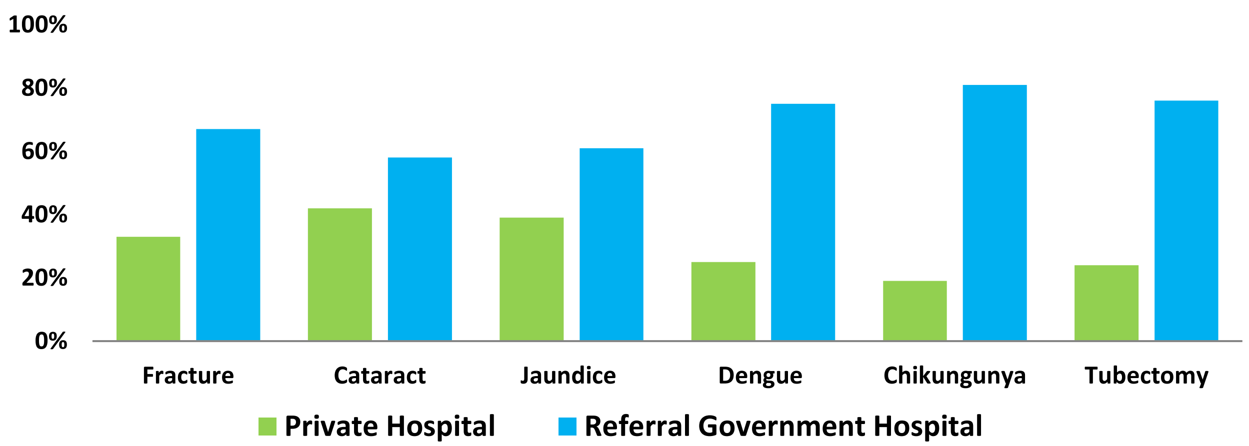
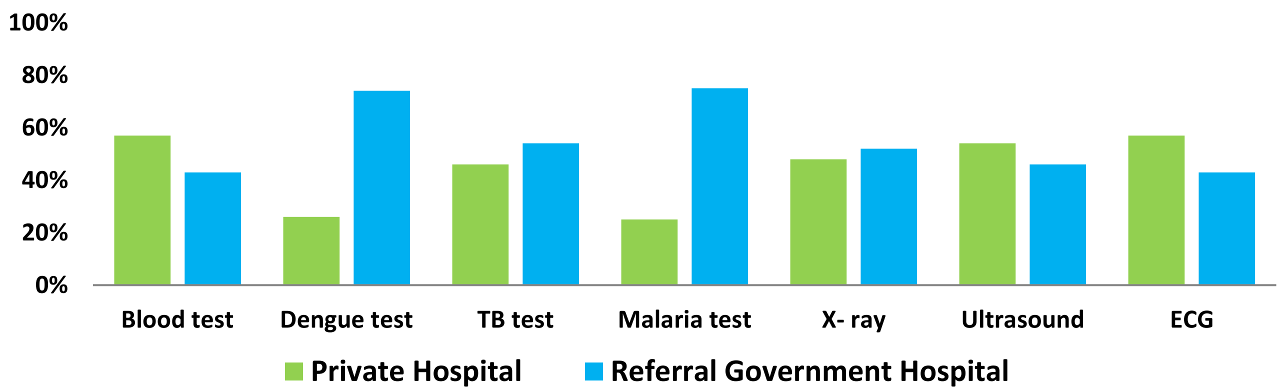


Figure 17 Distribution of the respondents who visited other private or government hospitals for medical tests



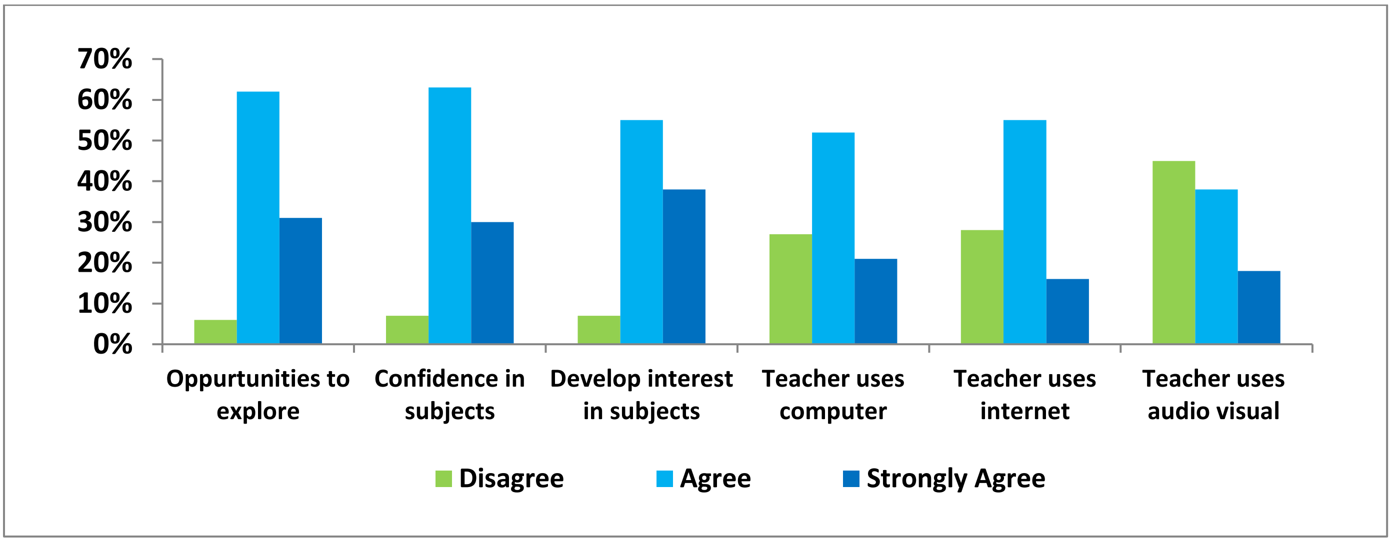
The team noted the respondent's opinion on the cleanliness, lighting, and cooling facilities ranging from good to poor. A satisfactory proportion of respondents gave positive feedback for lighting facilities in the premises (62%), wards(80%), labour room (72%), operation theatre(53%),OPD (86%), toilets(43%).

Though the proportion of respondents who were not satisfied with the healthcare service delivery for the lack of lighting were less, the lack of doctors, staff, and medical treatment emerged as a primary concern for service delivery at PHCs/CHCs. A fraction of respondents complained about energy-related issues such as lack of safe drinking water and communication technologies.

6.4 Student satisfaction in Schools

Student satisfaction is the thought review of his/her learning environment at the school; it serves as an essential tool to measure performance and the relationship that exists between the infrastructure and the academic performance of the students. 33% of students covered a distance of more than 5 km to reach their school. Based on the responses of student's satisfaction with the facilities across the fifteen schools, it is evident that 62% of students agreed that their schools provide them opportunities to explore new ideas, and they have confidence in their subjects (63%). Considering the energy-related facilities, students agreed that teachers use a computer (52%), internet (55%), and audio and visual devices (38%) for teaching in the classrooms. 45% of schools do not seem to command great satisfaction as far as the use of audio-visual devices is concerned for the students. Students agreed unanimously that having access to computer-aided teaching and computer lab with internet will improve their knowledge.

Figure 18 Student satisfaction with classroom facilities



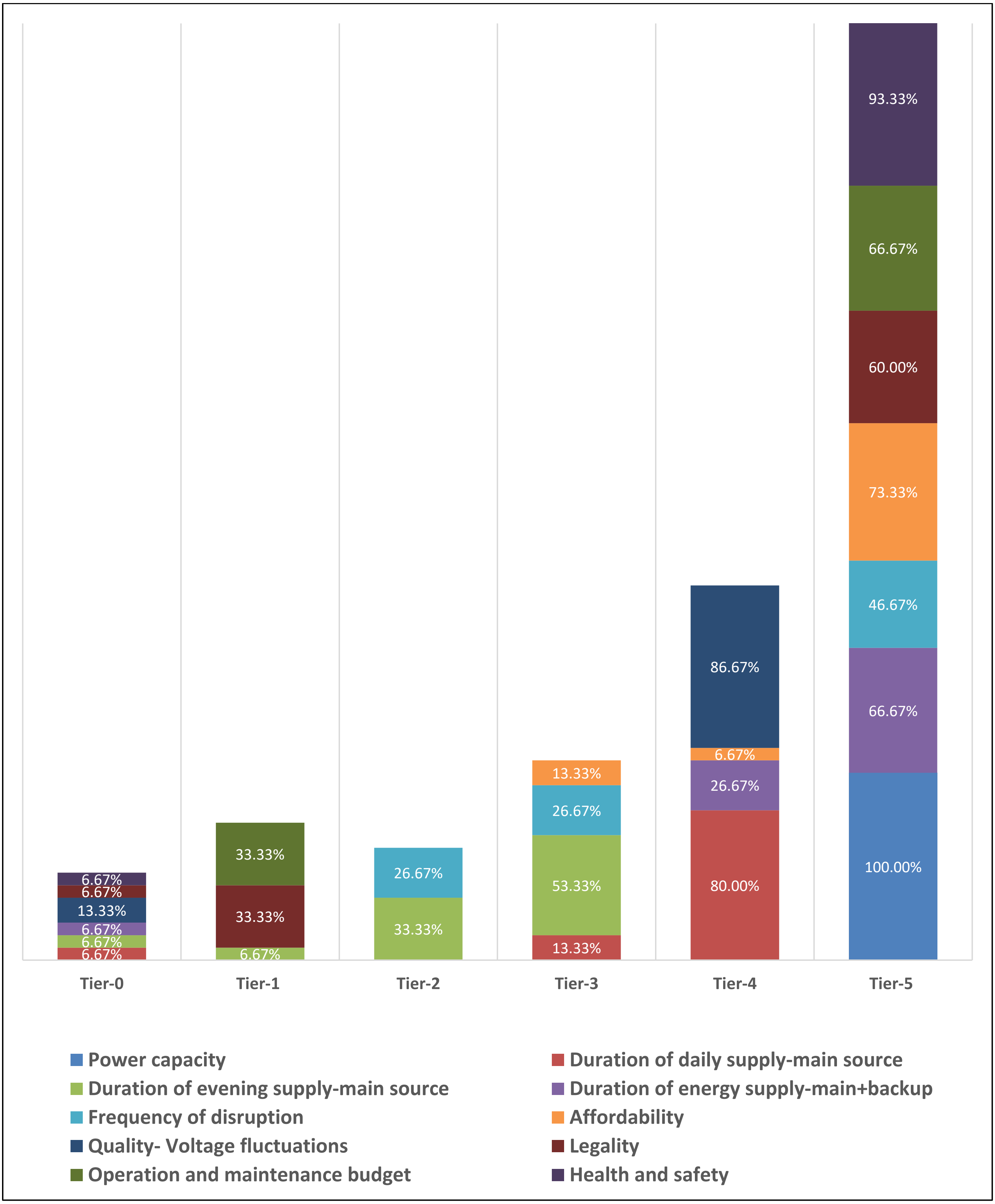
Student's opinion on the cleanliness, lighting, and cooling facilities was recorded using a good to poor range. Students who responded positive for lighting facilities in the premises (52%), classroom (83%), library (74%), laboratory(69%), and toilets(41%) are not of top satisfaction. 12% of students do not feel safe to use the toilets in their campus. Priority given to the improvement of this facility could prompt efficient infrastructure.

Power cuts during the school hours were reported by 80% of the students, mainly during the monsoon and summer seasons. Heavy rains and the delay in getting the broken wires repaired after the heavy rains can attribute to these power cuts. The students reported the average duration of power cuts during the monsoon, summer, and winter season as 1.5 hours, 1 hour,and 40 minutes, respectively. Reduced visibility in the dark classrooms and heat appeared to be the major problems due to these power cuts.The absence of water supply in the toilets was informed by 29% of the students. 93% of the students believe that provision of regular electricity would solve all the energy-related problems at their school.

6.5 Targeting electricity access interventions in health centres and schools

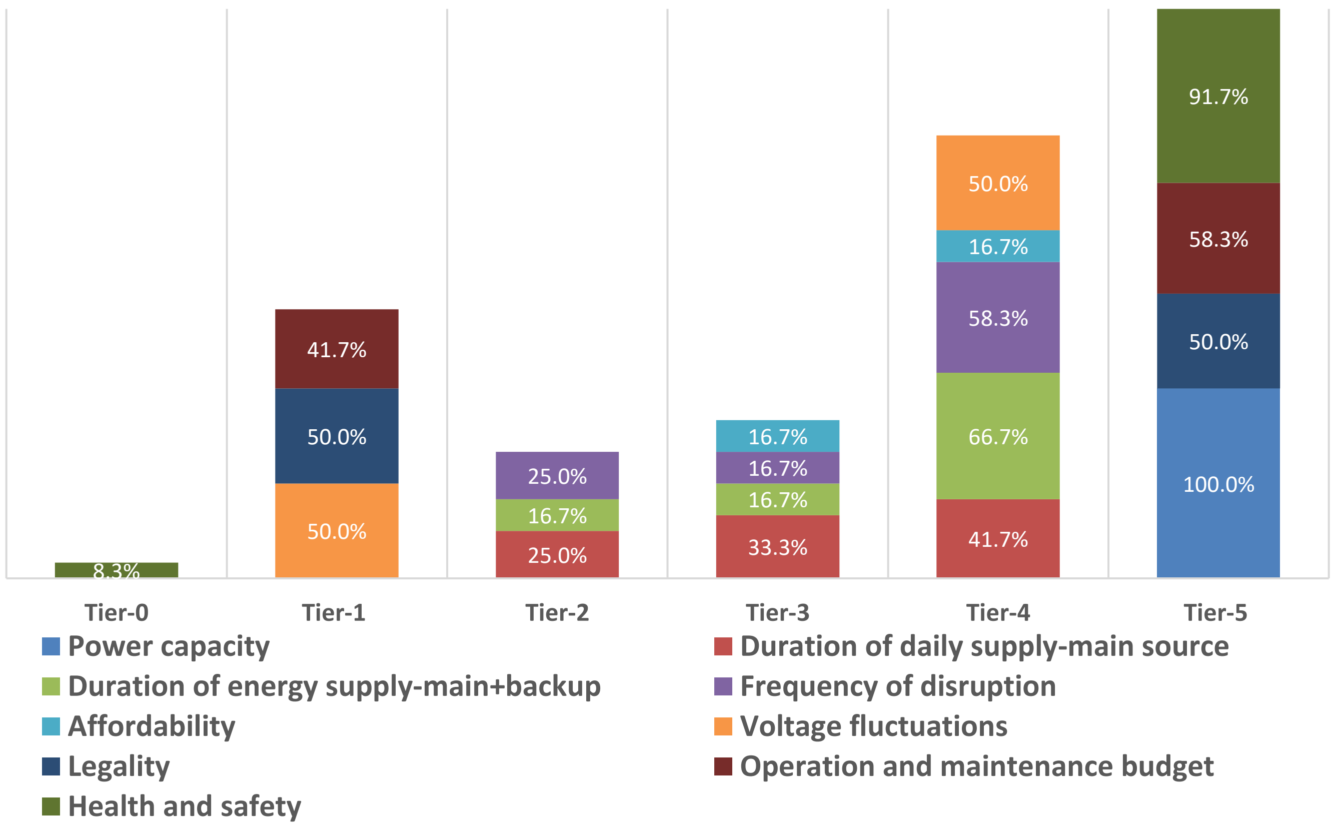
The MTF approach can beused by policymakers to understand the prevailing status of electricity access at community infrastructure. The tier-wise disaggregated resultsof current status of electricity access at health centres and schools, for each attributes of MTF,has been presented from Fig 19-21. These results can be helpful in informed decision making on electricity access interventions. The policymakers can formulate strategies to ensure that alreadygrid connected health centers and schools have electricity access at levels that satisfy the benchmarks of tier-5for all the attributes of MTF measurement.

Figure 19Tier-wise distribution of PHCs/CHCs based on MTF attributes



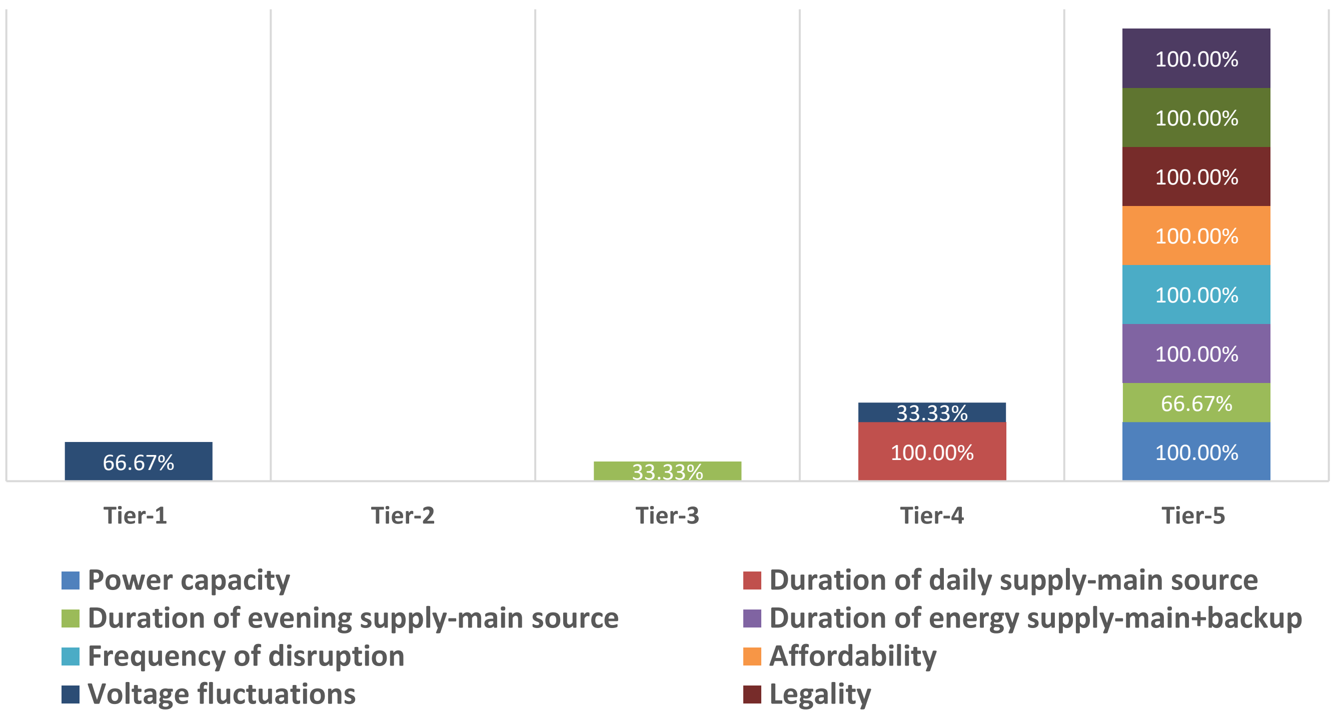
Source: IRADe analysis

Figure 20 Tier-wise distribution of non-residential schools based on MTF attributes



Source: IRADe analysis

Figure 21 Tier-wise distribution of residential schools based on MTF attributes



Source: IRADe analysis

7. Conclusion and Policy Suggestion

Electrification of health and educational institutions can bring several social and economic benefits. Access to electricity and more so qualities of electricity supply for commercial uses in public institutions – school and health facilities – are either missing or not getting adequate attention in policy discourse. The flagship electrification programme SAUBHAGYA (Pradhan Mantri Sahaj Bijli Har Ghar Yojana) provides electrify to the households. There is hardly any national or state level programme for electrifying essentials social infrastructure facilities such as health and education institutions.

This report highlights the importance of electricity in health and education facilities, describing the current state of electricity supply and its implication on service delivery abilities and quality of service delivery. The study highlights emerging options for reliable and affordable electricity supply, especially solar energy systems. The multi-tier framework methodology followed for the analysis identifies electricity supply deficiencies that directly affect the delivery of services offered by health and education facilities. Potential links between electrification and health and educational outcomes are also analyzed. The primary surveys (one-on-one interviews and group discussions) forms the basis of the analysis of the data collected from health and education centers and patients and students attached to those respective facilities.

7.1 Health Sector

Reliable electricity supply can be of immense importance in improving the operational capacity of PHCs. PHCslacked access to reliable electricity; patients cannot get optimal care, as many life-saving interventions are not accessible. We observed significant progress towards ensuring reliable electricity supply in health facilities, especially CHCs, through a rooftop solar scheme run by JREDA. However, there exists considerable room for improvement. Based on our analysis, we have the following suggestions to improve the ability and quality of service delivery of the PHCs/CHCs through reliable and sustainable electricity access.

Policy Synergies: The health care department and energy department of the state government should cooperate to bring policy synergy for better understanding the health sector energy needs for providing reliable electricity supplies to PHCs/CHCs. Energy security and health security have high degree of interfaces and interconnections. Modern hospital cannot operate without secure electricity supply and efficient cold chains are essential for storing vaccines. The two policy fields must be designed and interlinked in such a way that they contribute to health security. For example under National Health Mission (NHM) components of strengthening health system, financial support is provided to States to strengthen the public health system. High focus States can spend upto 33% and other States upto 25% NHM funds on infrastructure. Renewable electricity especially solar electricity can be a viable and inexpensive alternative source of electricity to ensure uninterrupted energy supply to health care facilities. Renewable electricity sources could be included in the list of infrastructure facilities to strengthen health system under NHM.

The current flagship rural energy access programme (Saubhagya) aims to provide electricity to the households only. Enhancing the ambit of rural household energy access programme to important community facilities such as health centers would ensure accessible, effective and affordable healthcare to rural people for improving health outcomes.

Matching supply with demand (electricity access gap): Three main energy types: grid- and off-grid electricity panel and battery storage system and diesel generator sets are used as primary or back-up sources. However, a lack of reliable and adequate electricity supply affects health facilities and service delivery in many health facilities of the state. There is a need to track the electricity demand side of health services. We propose an electricity demand audit of the health care facilities in the state. It will help in ascertaining the energy thresholds for the health facilities in energy-constrained settings. Customized solar rooftops, as per the energy need of the health center, can help in reducing the running time of diesel generators.

Energy efficiency: It observed that there is a need to give adequate attention to energy efficiency aspects in the health sector. The health department, in consultation with the department of energy, must prepare a guideline prescribing energy efficiency standard for future purchase of electricity-driven medical equipment and electric appliances. This will help in reducing the existing energy demand.

Financial Capacity-strengthening: Several surveyed health facilities havea huge electricity bill due payable to DISCOMs. In case of wear and tear of electronic instruments, they lack fundsand have to follow a long,time-taking process to get it released from the higher authorities. There is a need for financial capacity-strengthening to enable health facilities to manage their energy resources and sustain them efficiently.

7.2 Education Sector

Reliable electricity supply to educational institutions has many well-established benefits. Electricity can enable classes to be taught early in the morning or late at night to optimize the scarce educational infrastructure available. Electricity enables modern mass media tools in the classroom, which has become an integral part of the modern education system. Electrified schools have better staff retention and outperform non-electrified schools on many vital educational indicators. The challenges identified in our study are not insurmountable; a series of policy measures will overcome them.

Policy Synergies: The solarised residential schools in the state have gained immensely, in terms of electricity access, from JREDA rooftop scheme. Such schemesshould also leverage the vast availability of non-residential schoolsrooftops. This will improve the electricity access inthe schools on one hand and on the other hand surplus electricity from these non-residential rooftop solar plants can be supplied to the grid.Bundling the government building rooftop scheme with the householdenergy access will ensure local community benefiting from the on-going government schemes for renewable energy. Further, solar rooftops with battery back-up canprovide lighting in schools during the evening hours and therefore in the evening hours schools infrastructure can be used to runcommunity training programs linked to skill India mission (PMKVY).

Electricity access gap: Like PHCs/CHCs, electricity demand audits or setting up standard electricity demand threshold for different levels of schools in the state will have long-term implications in ensuring adequate and reliable electricity supply in the schools.

Energy-efficient equipment: Installation of energy-efficient appliances will cut the power consumption and therefore reduction in electricity bills, leading to savings for education department. The education department can disburse thesesavings to schools for operation and maintenance of electricity related work, which gets neglected due to budget constraints. Promotion of online portals for the procurement of equipment at the health and education centers can save time, money, and improve the supply chain, thereby making the process hassle-free.

There is an increasing awareness of the energy access gap and its implication on the ability and quality of service delivery of health and education facilities. There is a need for better tracking of energy access in the health and education centers. Moreover, the energy profile of the centers should move the ladder up, which includes attributes of available energy supply such as reliability, power capacity, etc., which are vital to assessment and planning of improvements. An overarching message of this report is the need for closer cooperation between the health and energy sectors, education, and energy sectors at all levels for the broader social and economic development of communities.

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Appendix- I

Table 1 Multi-tier measurement approach of electricity supply in health and education facilities (residential schools)

Attributes	Tier 0	Tier 1	Tier 2	Tier 3	Tier 4	Tier 5
Power capacity (in Watts/kW)	<3 W	≥3 W	≥ 50 W	≥200 W	≥800 W	≥ 2 KW
Duration of daily supply (main source) Hours per day	<4 hours	≥4 hours	≥4 hours	≥8 hours	≥16 hours	≥23 hours
Duration of evening supply (main source) Hours per day	<1 hour	≥1 hour	≥2 hours	≥3 hours	≥4 hours	≥4 hours
Duration of energy supply(main+ backup) hours per day	<4 hours	≥4 hours	≥4 hours	≥8 hours	≥16 hours	≥23 hours
Reliability- Frequency of disruption*	>14 disruptions			14 disruptions	>3-14 disruptions	≤3disruptions
Affordability#	-	≤ 5 times grid tariff	≤4 times grid tarrif	≤3 times grid tarrif	≤2 times grid tariff	Government funded
Quality- Voltage fluctuations	Fluctuations that damage appliances			No fluctuations		
Legality	Illegal connection		Legal connection-No bill payment for the energy use		Legal connection-Bill paid to the utility	
Operation and maintenance budget	No budget available			Adequate budget available		
Health and safety ##	Serious accidents due to electricity			No accidents due to electricity No accidents		

*Frequency of power disruption in the last 7 days (both from main and backup sources)

Average cost per kilowatt-hour as compared to grid electricity

Any incidents of accidents over the past year that required professional medical assistance

Source : Bhatia & Angelou, 2015.

https://mtfenergyaccess.esmap.org/methodology/electricity

Table 2 Multi-tier measurement approach of electricity supply in day schools

Attributes	Tier 0	Tier 1	Tier 2	Tier 3	Tier 4	Tier 5
Power capacity (in Watts/kW)	<3 W	≥3 W	≥ 50 W	≥200 W	≥800 W	≥ 2 KW
Duration of daily supply (main source) Hours per day	<1 hour	≥2 hours	≥3 hours	≥4 hours	≥5 hours	≥6 hours
Duration of energy supply(main +backup) hours per day	<2 hours	≥2-3 hours	≥3-4 hours	≥4-5 hours	≥5-6 hours	≥6hours
Reliability- Frequency of disruption*	>14 disruptions			14 disruptions	>3-14 disruptions	≤3 disruptions
Affordability#	-	≤ 5 times grid tariff	≤4 times grid tariff	≤3 times grid tariff	≤2 times grid tariff	Government funded
Quality- Voltage fluctuations	Fluctuations that damage appliances			No fluctuations		
Legality	Illegal connection		Legal connection-No bill payment for the energy use		Legal connection-Bill paid to the utility	
Operation and maintenance budget	No budget available			Adequate budget available		
Health and safety ##	Serious accidents due to electricity			No accidents due to electricity No accidents		

*Frequency of power disruption in the last 7 days (both from main and backup sources)

Average cost per kilowatt-hour as compared to grid electricity

Any incidents of accidents over the past year that required professional medical assistance