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Major Article

A self-reported survey on the implementation of infection prevention and control elements in Indian hospitals, part of a HAI surveillance network: Results from 23 hospitals conducting a standardized IPC assessment

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Key Words:
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Background: Healthcare-associated infections (HAIs) are one of the most common adverse events in patient care that account for substantial morbidity and mortality. We evaluate the existing Infection Prevention and Control (IPC) practices in hospitals participating in the nationally representative HAI Surveillance network.
Methods: This cross-sectional survey was conducted in 23 hospitals across 22 states of India from October-2015 to September-2018 in the HAI surveillance network. The World Health Organization (WHO) IPC core components assessment tool for health-care facility level (IPCAT-H) was adapted from IPC assessment tool developed by US Centers for Disease Control and Prevention (US CDC) under the Epidemiology and Laboratory Capacity (ELC) Infection Control Assessment and Response (ICAR) Program. Mann–Whitney U test was used to calculate the significant difference between scores ($P < .05$).
Results: Amongst the participating hospitals, 7 were private sectors and 16 were public health care facilities. Infection IPCAT-H average score per multimodal strategy was less than 50% for programmed IPC activities (45.7); implementation of health care workers (HCWs) immunization programme (43.5%); monitoring and evaluation component (38.30%).
Conclusions: There is potential for improvement in Human Resources, Surveillance of HAIs as well as Monitoring and Evaluation components.

Up to 7% of patients in developed and 10% in developing countries will contract at least one healthcare associated infection (HAI). Many studies have found that poor infection prevention and control (IPC) practices contribute to the burden of HAIs.[1,2] However, little is known about a standard assessment for IPC programs in Indian Hospitals to compare results across studies. Different studies performed in Indian hospitals have used their own questionnaire.[3,4] Hospitals that identify IPC program gaps can make changes to reduce the risk of infections.[5] This comprehensive assessment of IPC programs of private and public hospitals participating in a nationally representative HAI surveillance network will identify common gaps in IPC programs so that improvements can be planned. Health care-associated infections (HAIs) are one of the most common adverse events in patient care and account for substantial morbidity and mortality. Recent studies indicate that up to 10%-70% of HAIs can be prevented by implementation of appropriate infection control protocols.

SUBJECTS AND METHODS

Twenty-three hospitals (16 public and 7 private sector hospitals) were asked by the All India Institute of Medical Sciences (AIIMS), New Delhi Healthcare Associated Infection (HAI) Network (www.haisindia.com/about) to participate in the study. The World Health Organization (WHO) IPC core components assessment tool for health care facility level (IPCAT-H) was adapted from IPC assessment tool developed by US Centers for Disease Control and Prevention (US CDC) under the Epidemiology and Laboratory Capacity (ELC) Infection Control Assessment and Response (ICAR) Program. This study was a part of the Global-health security agenda work being conducted across a network of hospitals.

Hospitals were enrolled in the study on a rolling basis. The initial 5 sites were trained to self-administer the tool in a biannual Principal Investigator (PI) meeting held at AIIMS, Delhi. As new sites joined the network, PIs at the sites were emailed the assessment tool with instructions on how to complete it.

The tool provides a systematic way for quantitative evaluation of 8 different components of IPC programmes that is, Organization of an IPC programme; Technical guidelines; Human resources; Surveillance of HAI; Microbiology laboratory support; Environment; Monitoring & Evaluation; Links with public health. All sites completed the assessment tool between October 2015 and September 2018 before starting HAI surveillance as part of the HAI network.

The filled assessment forms were sent by email or a hard copy to the central team of AIIMS, where it was entered into an excel database provided by the World Health Organization (WHO) with analytic capacity. For each answer, a score of 1 for a reply of "Yes" and 0 for "No" was given and the cumulative score for each category generated as average percentage of "Yes." Nonresponses were excluded from the percentage calculations. Following the model of the eight core components of IPC, the WHO infection prevention and control assessment tools for the health care facility level (IPCAT-H) was divided into 8 sections. For every core component the scores of the individual questions in each core component were aggregated. A maximum score per core component of 100 was possible. The final IPCAT-H score was calculated by adding the scores of the 8 core components.

Data analysis

The aggregated scores for all hospitals for each core component were averaged and an average score for all core components was calculated. Scores were also stratified and tested for significance by hospital category (private and public facilities) and bed strength. The coded data was analyzed using descriptive analysis. Descriptive analysis involved various measures of central tendency and frequency counts. The difference and significance in the scores for each core component individually was calculated by Mann-Whitney *U* test. The variability of the scores for each core component and total scores was examined using median scores and interquartile range.

ETHICAL CONSIDERATION

Ethical approval to carry out this research was obtained (IEC/NP-386/10.09.2015) from AIIMS, Delhi.

RESULTS

All 23 hospitals answered the entire survey in the IPCAT-H tool and provided data to AIIMS. The median IPCAT-H score for participating hospitals was 558 out of 800. The hospitals were located in 22 states across India. Demographics of participating hospitals showed that 5 (22%) hospitals had <500 beds and the remaining had between 500 and 4000 beds. Average daily bed occupancy was <60% in 8 (35%) hospitals and 80-100% in 15 (65%) hospitals. The average IPCAT-H Score for participating hospitals with bed strength of <500

beds was 582 (SD = 116) and hospitals with bed strength in the range 500-4,000 had an IPCAT-H score of 553(SD = 166; *P*-value = 0.717). Of the 23 hospitals, there were 16 Government/public hospitals with the average IPCAT-H score of 502 (SD = 145) and 7 private hospitals with an average score of 690 (SD = 82; *P*-value = .004).

Seven (30%) of the hospitals were located in the northern region, followed by 5 (22%) in the southern region, 4 (17%) in the western region, 3 (13%) in the eastern region, and 2 (9%) in the central and north-eastern regions. Though the eastern region had the highest average IPCAT-H score (630.3 [SD = 91.4]), the southern region had more variation in IPCAT-H scores (604.0 [SD = 222.6]).

Assessment of the core components

While all sites had qualified IPC leadership, budget support for IPC activities was a common concern 46 (SD = 49.8) and not present at 12 (52%) of the sites. When this subcategory was evaluated, it shows as significant difference between public/private facilities ($P < .01$; Table 2). Staff had access to most of the recommended IPC guidelines, but there was variability and low scores across sites for prudent use of antibiotics guidelines 57 (SD = 38.6). High and low, scores on guideline availability were present in private 52 (SD = 40.3) and public facilities 68 (SD = 34.5). Distribution of median/mean scores of participating hospitals per multimodal strategy for each core component is shown in Table 1. We found that training for IPC was available to hospital staff in the network, however specialized training for IPC professions was lacking 54 (SD = 41.7) and absent in 6 (26%) of sites. Furthermore, many sites scored poorly on staffing ratios 54 (SD = 33.1) and implementation of a HCW immunization program 44 (SD = 32.2). Seventeen (74%) of the hospitals practiced organization of surveillance, with an average score of 57.4 (SD = 21.9), which varied significantly between public/private hospitals ($P = .020$). Microbiological Laboratory Services and Environmental services were not a major concern except the hand hygiene facilities 73.9 (SD = 22.9). More than 50% hospitals did not have proper framework 39.1 (SD = 43.2), indicators definitions 37 (SD = 45.1) and data reporting system 39.1 (SD = 47.6) for monitoring and evaluation of IPC related activities. The majority of sites reported links with public health and other services 72 (SD = 28.5) and there was significant difference in the scores between public/private for the following subcategories: Links between HCF and other external services are established 71 (SD = 41.8) and Links with other existing programmes/services at HCF level having been established 74 (SD = 29.3).

Table 1
Distribution of median/ mean scores of the participating hospitals per multimodal strategy for each core component

Core components	Elements	Median score(IQR)	Mean (SD)
Organization (CC1)	Designated qualified IPC leadership is established	100(100,100)	93.5(21.6)
	The scope of IPC is defined and include	100(50,100)	78.3(33.8)
	There is a budget adequate to meet programmed IPC activities	0(0,100)	45.7(49.8)
	Administrative and IT support to the IPC team provided	75(0,100)	53.3(44.1)
	Total Score	75(56,94)	71.6(26.3)
Guidelines (CC2)	Adaptation of technical guidelines to the local level	100(60,100)	83.5(28.7)
	Guidelines on standard precautions developed and used	100(100,100)	97.4(5.1)
	Guidelines on how to apply isolation precautions developed and disseminated	100(100,100)	85.5(34.6)
	Guidelines on prevention of device-associated and site specific infections	100(80,100)	78.3(37.6)
	Guidelines on prudent use of antibiotics	75(25,100)	56.5(38.6)
	Total Score	88(76,100)	82.8(20.8)
Human Resources (CC3)	Training on IPC of all health care personnel is provided regularly	100(67,100)	85.6(26.2)
	Specialized training of IPC professionals (technical teams) is provided regularly	50(0,100)	54.3(41.7)
	Staffing ratios maintained	33(33,100)	53.5(33.1)
	Prevention and monitoring of occupational biological risks	86(43,100)	70.9(27)
	HCWs immunization programme is implemented	25(25,50)	43.5(32.2)
	Total Score	59(50,73)	59.3(21.9)
Surveillance (CC4)	Organization of surveillance	67(0,100)	57.4(41.2)
	Objectives of surveillance are defined, aligned with national objectives	100(50,100)	69.6(40.6)
	Priorities for surveillance are defined according to the scope of care	71(43,100)	62.1(37)
	Methods of surveillance are defined	75(25,100)	62(39.1)
	Information is analyzed and disseminated to all interested parties	80(40,100)	67(37)
	Total Score	70(35,87)	63.6(30.9)
Microbiology Laboratory (CC5)	Good quality and safe microbiological laboratory services are available	100(80,100)	91.3(14.6)
	Interaction between IPC activities and the microbiology laboratory	100(67,100)	82.7(31.6)
	The HCF has capability to identify pathogens most relevant for IPC	100(100,100)	91.3(19.4)
	The HCF is able to identify antimicrobial susceptibility of isolated pathogens	100(100,100)	97.8(5.9)
	Standardized techniques and procedures used for samples collection and transportation	100(50,100)	82.6(24.3)
	Total Score	95(85,100)	91.1(11.2)
Environment (CC6)	Water for consumption	100(100,100)	89.1(30)
	Hand hygiene facilities	80(60,80)	73.9(22.9)
	Environmental ventilation	100(50,100)	80.4(36.1)
	Patient placement in health care settings	100(50,100)	67.4(41.6)
	Medical waste management	100(100,100)	98.9(5.2)
	Other hygienic requirements	100(33,100)	63.7(42.6)
	Total Score	83(67,94)	80.4(15.8)
Monitoring & Evaluation (CC7)	M&E framework is established	25(0,75)	39.1(43.2)
	M&E indicators are defined and used	0(0,100)	37(45.1)
	Reporting of M&E data	0(0,100)	39.1(47.6)
	Total Score	20(0,80)	38.3(41.1)
Links with public health and other services (CC8)	Links between HCF and other external services are established	100(33,100)	71(41.8)
	Events of interest to link public health and HCF	75(25,100)	67.9(40.1)
	Links with other existing programmes/services at HCF level are established	78(67,100)	74(29.3)
	Total Score	81(56,94)	72(28.5)

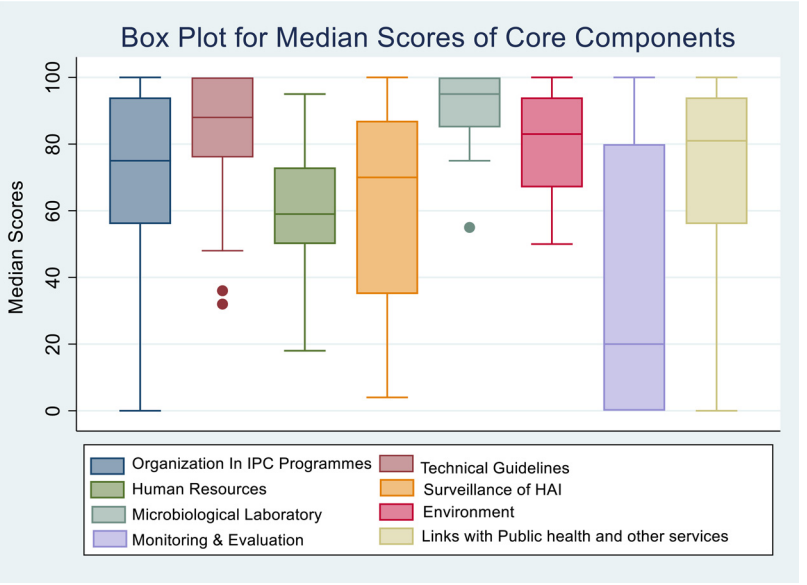

Fig 1. Box plot depicting Median scores and Interquartile range of each core component.

Overall average score per multimodal strategy from IPCAT-H core component was evaluated and determined with radar diagrammatic representation, as shown in Figure 1. Differences were found in the core component scores of private and public hospitals (Table 2). The organization of IPC, human resources, surveillance of HAI, environment and links with public health and other services was significantly better in private facilities compared to public facilities ($P < .05$).

There were differences in the scores of the individual core components (CC). Figure 1 illustrates the median, first and third quartile for the scores of each individual CC. The box plot representation of Median scores with the limits indicated as 25th and 75th percentile, whiskers extending 1.5 times the Interquartile range from the 25th and 75th percentiles and outliers are represented by dots. CC7 with its emphasis on monitoring and evaluation had the lowest median score (20) and mean score (38). Microbiology had the highest median (95) and mean (91) scores. The range of scores per component was widest for monitoring and evaluation (CC7) and narrowest for the component on Microbiological laboratory (CC5) and narrowest for human resources (CC3) and Microbiology (CC2).

DISCUSSION

Improvement in IPC at health care facility level is critical to prevent HAIs and contain AMR infections. Given the limited availability of evidence-based guidance for IPC, the WHO has emphasized on effective implementation of core components of IPC both at national and faculty levels. Considering the high prevalence of HAIs in LMICs,[6] it is important that facilities in these countries assess their core competencies in various aspects of IPC and work toward addressing gaps in the various core components.

The IPCAT-H tool was one of the first comprehensive tool developed by WHO, to assess the core competencies in IPC at hospital level. We initiated a HAI surveillance network in India in 2016, starting from a small number of hospitals across the country and expanding it to 23 hospitals within a year.[7] The tool was administered to 23 hospitals at the beginning HAI surveillance. It was largely a self-reported assessment, with data entered on excel sheet at the coordinating center of AIIMS.

Before initiating trainings on HAI surveillance and working toward evidence-based IPC, we delivered the IPCAT-H tool to all

Table 2
Difference in the median/ mean scores of government and private health care setups for each core component

Core component	Administrative status	Government (n = 16)	Private (n = 7)	Asymp. Sig. (2 Tailed)*
Organization In IPC Programmes	Median (Q1, Q3)	66 (47,81.5)	94 (81,100)	0.010
	Mean (SD)	63 (26.8)	91.1 (10.1)	
Technical Guidelines	Median (Q1, Q3)	88 (64,96)	88 (88,100)	0.200
	Mean (SD)	78.5 (23.5)	92.6 (7.1)	
Human Resources	Median (Q1, Q3)	52.5 (38.5,61.5)	82 (64,90)	0.000
	Mean (SD)	50.9 (19.6)	78.4 (13.5)	
Surveillance of HAI	Median (Q1, Q3)	58.5 (24,85)	83 (70,100)	0.050
	Mean (SD)	54.7 (32.2)	84 (14.7)	
Microbiological Laboratory	Median (Q1, Q3)	90 (82.5,97.5)	100 (95,100)	0.060
	Mean (SD)	88.8 (11.9)	96.4 (7.5)	
Environment	Median (Q1, Q3)	72 (64,89)	94 (89,100)	0.000
	Mean (SD)	74.3 (14.8)	94.3 (6.5)	
Monitoring and Evaluation	Median (Q1, Q3)	15 (0,55)	80 (0,100)	0.100
	Mean (SD)	27.5 (35.3)	62.9 (45.4)	
Links with Public health and other services	Median (Q1, Q3)	69 (53,88)	88 (81,100)	0.030
	Mean (SD)	64.1 (30.5)	90.1 (9.5)	

*The difference and significance in the scores for each core component individually was estimated by Mann-Whitney *U* test.

these hospitals, in order to understand their baseline level of preparedness toward the 8 core components provided in the tool.

To our knowledge, this survey represents the first use of a standardized IPC assessment in a nationally representative group of hospitals in India. All 23 hospitals fully completed the IPCAT-H tool and provided data to AIIMS, Delhi (Response rate 100%). The participating hospitals were well known organizations in the respective states of India and are good representative medical colleges and hospitals. As per the feedback from participating hospitals, the tool was easy to understand. The source of data collection and verifiers for each broad category of assessment was clearly mentioned in the tool.

There was similar study done in the HAI surveillance using the IPCAF tool (3). The IPCAF tool is a much more extensive tool, in which additional components of built environment structure and workload are included, which are often not under the control of IPC practitioners. For example, the spacing, procurement, staffing and environmental control are most often under administrative control and which will take years to rectify considering the economics and logistics involved. Therefore, if assessment is repeated using IPCAF tool, the scores will often not reflect improvement.

Therefore, for Developing countries, the IPCAT-H tool is more realistic, simple and would provide good information (both baseline and improvements) over time, which can be worked upon by individual hospitals. For centers that are very good in their IPCAT H scores and have good administrative support, assessments should be based on IPCAF tool, which is more updated and has more elements to score.

The overall median score for participating hospitals was 558 out of 800. Four hospitals (public facilities) had less than 50% (<400 scores) total IPCAT-H scores. The primary conclusion we can draw from the data received is that in general, IPC structures and activities are better established in private sectors of India and there is certain degree of heterogeneity and a potential for improvement in public sectors.

With regard to the individual components of the IPCAT-H, we found substantial differences between the respective scores. An in-depth look at the IPCAT-H dataset for patterns yielded varied results. We have chosen areas that had lower scores and large variability between hospitals were chosen for highlighting in this study.

The first core component (CC1) focuses on the organization of an IPC program. The median score of 75 revealed inadequate budgets to meet programmed IPC activities and lack of administrative and IT support. While all sites had qualified IPC leadership, budget support for IPC activities was a common concern (mean 46) and not present at some sites. When this subcategory was evaluated, it showed a significant difference ($P = 0.01$) between public/private facilities.

Despite having designated qualified IPC leadership, awareness regarding various IPC aspects is required across the country. Budget allocation for dedicated IPC activities should be made by the government. A step toward this is the establishment of National Programme on AMR containment in India.[8]

In a semi structured survey on IPC conducted for participants from several SAARC (South Asian Association for Regional Cooperation) countries. It was found that IPC guidelines was present in only 53% hospitals, and coordination of HIC personnel with different support service was limited. This study used their own questionnaire which did not conform to the WHO's standard core IPC assessment format.[4] In another study conducted in 823 hospitals of Japan, it was found that more than half of middle scale hospital had implemented same kind of IPC measures but reported shortage of infection staff.[9] A questionnaire-based study conducted in 57 hospitals of Thailand found that although most hospitals had infection control committee (ICC) and infection control nurse (ICNs), they required more training. There was lack of knowledge, material support and also paucity of proper surveillance. All these studies used their own questionnaires; therefore, the results cannot be compared across studies.

Scores for IPC guidelines (CC2) were generally high with few exceptional improvements in guidelines on prudent use of antibiotics. A study conducted in Egypt reported the lack of availability of the IPC guidelines, education and training as a major issue in public sector hospitals.[10] Antimicrobial-resistant HAIs are a global challenge due to their impact on patient outcome. Implementation of antimicrobial stewardship programmes (AMSP) is needed at institutional and national levels. Assessment of core capacities for AMSP is an important starting point to initiate nationwide AMSP. The development of national AMS programme will aid in advancing stewardship activities, which can be incorporated in the national action plan with the scope of allowing local flexibility. However, the most important determinant of a successful AMS programme in India will be the hospital leadership support.[11]

In a survey on baseline AMSP conducted by the Indian Council of Medical Research in 20 hospitals of India, Walia et al. reported that written documents were available in only 40% of hospitals, whereas antimicrobial usage data was being analyzed only by 25% hospitals.[12] Subsequent to this, the ICMR initiated several AMSP activities across these 20 hospitals to strengthen stewardship and control AMR.

In the third component (CC3) which focuses on human resources, least scores were obtained for implementation of Immunization programmes like immunization policies for hepatitis B, Influenza, Rubella etc. The staffing ratios were also not maintained. Remarkably, many hospitals, reportedly, were not conducting a staffing needs assessment using national standards and had no system in place to react to a change in the demand for staff. These findings confirm the previously described shortage of qualified staff for patient care in Indian hospitals. This was completely implemented by only 4 (17.4%) hospitals of the network.

There is evidence that all health care facilities must have IPC professionals (ICPs) and should have access to a trained IPC physician as well as administrative support staff appropriate to the IPC program. In addition to a trained ICP, there is evidence that establishing a relationship with IPC champions in clinical programs and departments aids the IPC team in carrying out their mandate.[13]

Seventeen (74%) of the hospitals are practicing Surveillance (CC4) with a total median score of 70. Since this tool was filled by the network before starting the HAI surveillance as a baseline assessment of the facility, hence priorities and methods of surveillance were not clearly defined during that stage.

Efforts to build comprehensive HAI surveillance symptoms should be prioritized in LMICs.[14] Many LMICs are developing plans in line with the global action plan on Antimicrobial resistance (GAP-AMR) that addresses issues of HAI surveillance.[15] India is also moving toward development of national/state level networks on AMR and HAI-IPC.[11,16]

Scores for Microbiology Laboratory activities and services (CC5) and Environmental facilities (CC6) were generally high. All the network hospitals had microbiology laboratory support. 100 % score was observed for the availability of good quality and safe microbiological services among the network. Potential for improvement, however, can be found with reference to the methods applied to hand hygiene practices. In India, although hand hygiene is imbibed as a custom and promoted at school and community levels to reduce the burden of diarrhea, there is a paucity of information on activities to promote hand hygiene in HCFs.[17]

Increasing the emphasis on infection control, giving the charge of infection control to senior organizational members, changing the paradigm of surveillance to continuous monitoring and effective data feedback are some of the important measures which need to be initiated in Indian hospitals.

Total mean scores of Monitoring & Evaluation (CC7) and links with public health and other services (CC8) were 38.3 and 72 respectively in the overall network hospitals which was a major concern. There

was a need of improvement because of lack of framework, indicators, reporting, data management and programmes/services at health care facility. As more and more facilities in LMICs work towards addressing these gaps, containment of HAIs would be strengthened.

Although hospital accreditation is not mandatory in India, groups like the autonomous National Accreditation Board of Hospitals and the National Health Mission's National Health Systems Resource Centre have incorporated programmes on IPC, including surveillance of HAIs, as a core part of the review and certification process (11).

In developed countries, surveys done using their own questionnaire have found better performance with respect to availability of guidelines, education and trainings and materials and supplies.[18]

The organization of IPC, human resources, surveillance of HAI, environment and links with public health and other services was significantly better in private facilities compared to public facilities ($P < .05$; Table 2). We conclude that while many CC are present in both private and government healthcare facilities there is wide variability and significant gaps in all hospital IPC programs that need to be addressed. Hospitals should start using standard WHO tools so that findings can be compared across nations.

LIMITATIONS

The study is a small sample size. The hospitals represent tertiary care hospitals which may have more resources and are not representative of the majority of Indian hospitals. Because external assessments were not done due to limited funds and staff, reporting bias may increase the final scores. In our experience inflation of IPC assessment scores is common due to a lack of IPC knowledge, fear of looking poorly, or giving a high score for questions that site plans to improve, but at the time of the assessment is not yet improved.

Presence of trained IPC nurses and completion of surveys in a facilitated workshop setting before or after a biannual network meeting would likely have yielded more complete, timely and accurate results than emailed surveys. The IPCAT tool is a self-reported tool, which makes it amenable to biased reporting. This may be particularly true if the reported observes a very low score in a particular component. Since there was no external validation, this is a limitation of the study. Use of an external assessor would help to validate the self-assessment scores. The actual picture of IPC is likely to be less in other hospitals and makes it even more important to act to improve IPC.

CONCLUSION AND RECOMMENDATIONS

Knowledge of site and aggregate results helps sites to understand they are not alone in the need to improve and motivates members to share successes and thereby support others to fill IPC gaps. When interpreting the data generated through this survey several limitations have to be recognized.

Potentials for improvement were identified particularly with regard to monitoring and evaluation. Insufficient implementation of multimodal strategies was found to be another relevant deficit. Developments and trends may become apparent through repeated application of the IPCAT-H.

PRESENTATION AT A MEETING

Abstract submitted to conference
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Place: Virtual
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