

Notification of healthcare associated infections based on international criteria performed in a reference neonatal progressive care unit in Belo Horizonte, MG

Infecções relacionadas à assistência a saúde baseada em critérios internacionais, realizada em unidade neonatal de cuidados progressivos de referência de Belo Horizonte, MG

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Abstract

Objective: To describe occurrence of Healthcare Related Infections in a neonatal unit of public reference service in Belo Horizonte-MG, based on international criteria. **Methods:** This is a descriptive study, performed by active searching, in the Progressive Care Unit Neonatal Hospital das Clínicas, Federal University of Minas Gerais (HC / UFMG), from 2008 to 2009. Notification of infections was based on National Healthcare Safety Network (NHSN) criteria. The database and analysis were performed in a internal program. **Results:** A total of 325 episodes of infection in newborns were notified and overall incidence density of infections was 22.8/1,000 patient-days, with a rate of 36.7% of newborns. Sepsis was the main infection (62.5%) reported. The incidence density of infections was higher in neonates weighing lower than 750g (42.4/1,000 patient-days). There were 18.15 episodes of central venous catheter related sepsis/1,000 central venous catheter-day and 19.29 umbilical catheter related sepsis /1,000 umbilical catheter-days. Microorganisms were isolated in 122 (37.5%) cases of reported infections, mainly defined as *Staphylococcus* coagulase negative and *Staphylococcus aureus* (51 cases). Mortality and lethality rates were 4.3% and 17,12%, respectively. **Conclusion:** The use of standardized criteria for reporting infections is necessary for the construction of indicators in neonatology, which are scarce in the country and highlight the need for evaluation of national criteria proposed by National Agency of Sanitary Surveillance (ANVISA).

Keywords: Infant. Newborn. Sepsis. Surveillance. Infection control.

Resumo

Objetivo: Descrever a ocorrência de infecções relacionadas à assistência à saúde em uma unidade neonatal de serviço público de referência em Belo Horizonte, MG, baseando-se em critérios internacionais. **Métodos:** Trata-se de estudo descritivo, realizado por busca ativa, na Unidade Neonatal de Cuidados Progressivos do Hospital das Clínicas da Universidade Federal de Minas Gerais (HC/UFMG), de 2008 a 2009. A notificação de infecções baseou-se nos critérios do *National Healthcare Safety Network* (NHSN). O banco de dados e análise foi realizado em programa interno do serviço. **Resultados:** Foram notificados 325 episódios de infecção nos recém-nascidos, com densidade de incidência de 22,8/1.000 pacientes-dia e incidência proporcional geral de infecção de 36,7%. A sepse foi a principal infecção (62,5%) notificada. A densidade de incidência de infecções foi maior em neonatos com peso menor que 750g (42,4/1.000 pacientes-dia). Observou-se 18,15 episódios de Sepse Relacionada a Cateter/1.000 Cateter Venoso Central-dia e 19,29/1.000 episódios de Sepse Relacionada a Cateter Umbilical/1.000 Cateter umbilical-dia. Em 122 (37,5%) casos de infecção notificada houve isolamento de microorganismos, predominando *Staphylococcus coagulase negativo* e *Staphylococcus aureus* (51 casos). A mortalidade e letalidade foram 4,3% e 17,12%, respectivamente. **Conclusão:** A utilização de critérios padronizados para notificação de infecções é necessária para a construção de indicadores em neonatologia, que são escassos no país e ressaltam a necessidade de avaliação dos critérios nacionais propostos pela Agência Nacional de Vigilância Sanitária (ANVISA).

Palavras-chave: Recém-nascido. Sepse. Vigilância. Controle de infecções.

Introduction

Healthcare-Associated Infections (HAI) are recognized risk factors for fatal outcomes in neonates, both in developed and developing countries¹⁻³, and neonatal sepsis is described as being responsible for 13-69% of deaths in this population⁴. In Brazil, 40% of deaths in a cohort of neonates in a multicenter study were secondary to HAI⁵.

Advances in intensive care - availability of invasive devices such as the Central Venous Catheter (CVC), Mechanical Ventilation (MV) and total parenteral nutrition formulas, among others - have provided unquestionable improvements in neonatology, mainly expressed by an increase in survival of preterm and low-weight newborns⁶. Paradoxically, the use of these advances, associated with prematurity, low birth weight, malformations and premature rupture of membranes, are identified as risk factors for HAIs in neonatal units^{3,7-12}. In Brazil, the use of CVC, VM and total parenteral nutrition, and the presence of premature rupture of membranes or concomitant maternal disease were found with a greater frequency in newborns with HAI, when compared to those who did not have this condition^{13,14}.

A better understanding of the epidemiology of HAI in neonatal units, including the etiological agents and antimicrobial susceptibility, risk factors and mortality and lethality rates, has been an essential strategy for preventing and reducing mortality and morbidity in newborns. To this end, since 1998, the Brazilian Ministry of Health⁶ has recommended an active search for Healthcare-Associated Infections in critical care units, including neonatal units, by the Hospital Infection Control Committee of each hospital.

This article describes the occurrence of HAI in a neonatal unit of a public referral service in the city of Belo Horizonte, Southeastern Brazil, according to the internationally recommended criteria for infection notification established by the National Healthcare Safety Network (NHSN) of the Center for Disease Control and Prevention

(CDC) in neonatology, as well as the occurrence of etiological agents and the antimicrobial susceptibility profile.

Methods

This is a descriptive study, conducted by active search of infection records in patients from the *Unidade Neonatal de Cuidados Progressivos* (UNCP – Neonatal Progressive Care Unit) of the *Hospital das Clínicas da Universidade Federal de Minas Gerais* (HC/UFMG). The HC/UFMG is a teaching hospital that serves pregnant women in the city of Belo Horizonte metropolitan area and other regions in the state of Minas Gerais, providing high-risk tertiary obstetric care. The UNCP has 20 beds with an occupancy rate of 97.64% in the study period. Furthermore, it has recently been rebuilt to improve care, aiming for compliance with surveillance rules for the physical plant, equipment and materials¹⁵. Only newborns from the HC/UFMG are admitted to this service.

The study period was from January 1st 2008 to December 31st 2009, after the implementation of the new guidelines from the Centers for Disease Control and Prevention (CDC), used as reference for HAI notification by the Hospital Infection Control Committee (HICC) of the HC/UFMG. The inclusion criteria considered all newborns admitted to the UNCP during the study period; a total of 886 patients were included and there were 14,256 patient-day.

Variables routinely collected follow the recommendations of the legislation¹⁶ that regulates HAI control, including data to allow the calculation of indicators and epidemiological predictors of HAI, microbiological indicators and antibiotic use indicators. It is noteworthy that neonatal indicators are calculated stratified by weight range. In addition to the total number of patients, used as the denominator of some indicators, the patient-day denominator is calculated based on the total number of days each patient remained in the unit and the device-day denominator is calculated

based on the total number of days each device is spent in each patient.

For infection notification, only the standard criteria established by the National Healthcare Safety Network (NHSN) were used¹⁷, which allow intra- and inter-institution comparison. The identification of these infections was made through active daily search, performed by a single trained professional nurse from the HICC, and only notified infections were used in this study. Clinical sepsis, known as bloodstream infection, was notified only when meeting the NHSN¹⁷ criteria.

Cases of infection are only considered in the presence of, at least, one of the following signs or symptoms without further recognized cause: fever, hypothermia, apnea and bradycardia, in addition to no blood tests performed or without isolation of micro-organisms and no apparent infection in a different location and antimicrobial therapy prescribed by a physician. In addition, infection notification considering the location of infection followed the criteria recommended for patients under one year of age¹⁷.

Although notification criteria do not consider this division, early infection was defined when the infection occurred within 48 hours of life and late infection when it occurred after 48 hours of life.

Specimens for culture are routinely sent to the microbiology laboratory. Microorganism isolation is performed with the automated method (VITEK2) and susceptibility testing by agar disk diffusion (Kirby Bauer) is used to confirm the resistance profile. The sensitivity profile of micro-organisms considered definitions of the HICC, based on National Committee for Clinical Laboratory Standards (NCCLS)¹⁸.

The database was built in a statistical program developed by a member of the epidemiology service of the HICC - HC/UFMG. The program allows the generation of reports and other information required, in accordance with the indicators recommended by the legislation¹⁶.

The statistical analysis included descriptive analysis with proportional incidence

of infections (number of infections per 100 patients at risk) and incidence density of infections (number of infections per 1,000 patient-day). Infections were stratified by weight range and the analysis was performed for incidence density of infection devices: a) CVC associated sepsis and incidence density of sepsis associated with CVC (number of sepsis per 1,000 CVC-day); b) urinary tract infections (UTI) associated with urinary indwelling catheter (UIC) and incidence density of UTI associated with UIC (Number of UTI per 1,000 UIC-day); c) Pneumonia (PNM) associated with the Mechanical Ventilation (MV) and incidence density of pneumonia associated with mechanical ventilation (PNM per 1,000 MV-day). The frequency and percentage of infections by topography and by isolated microorganisms, and the overall mortality (deaths per patient at risk) and mortality (number of deaths in patients with HAI) rates were subsequently described.

The comparative analysis of infections was performed by considering the risk weight range (with the MidP exact test) and lethality of microorganisms (with chi-square test), considering a statistical significance of $p < 0.05$.

A control chart considering the average incidence density, the alert limit (two standard deviations) and the control limits (three standard deviations) was constructed to evaluate notifications over the period. The mean and limits of the endemic level were calculated considering the monthly rates of HAI per 1,000 patient-day. The model selected to represent the graph of rates was the U type, based on Poisson probability distribution. Statistical stability was considered when there was not any of the following rules, defined by Sellick¹⁹: one point above the control limit, two of three consecutive points above the alert threshold, six consecutive points increasing or decreasing; nine consecutive points lower or higher than average.

The present study was approved by the Institutional Review Board (IRB) of the UFMG (ETIC 312/08).

Results

During the study period, 886 newborns admitted to the UNCP were included for infection surveillance, totaling 14,256 patient-day. A total of 325 episodes of infection in newborns in the UNCP were notified, 110 (33.8%) with early infection and 215 (66.2%) with late infection. A total of 222 (25.1%) newborns had at least one episode of infection, corresponding to a proportional incidence of 36.7% (Table 1).

The overall incidence density was 22.8 per 1,000 patient-day. The incidence density of infection was significantly higher in neonates weighing up to 750g (mid-P exact test showing an 18.91 times greater chance and 95%CI from 4.7 to 124.97). In this weight range, the incidence density was 42.4 per 1,000 patient-day, with a small variation (21 to 24 per 1,000 patient-day) in the other weight ranges (Table 1). The chart of infection control over the study period is shown in FIGURE 1, demonstrating stability of values during this period.

When the incidence density of infection by invasive device was considered, there were 18.15 episodes of sepsis per 1,000 CVC-day, 5.7 episodes of pneumonia per 1,000 day-MV-day and 3.3 urinary tract infections per 1,000 UIC-day.

The main invasive device-associated infection notified was sepsis associated with CVC and higher densities were observed in the weight ranges below 1000g, reaching 29.1 per 1,000 CVC-days in patients weighing less than 750g (Table 1). When only the umbilical catheter was considered, a density of incidence of 19.29 per 1,000 catheter-day was obtained. Bloodstream infection (sepsis) was the primary infection notified, corresponding to 203 (62.5%) of them, followed by infections of the skin (thrush), pneumonia, and conjunctivitis (Figure 2). When only laboratory-confirmed sepsis (SLC) was considered, 67 cases were reported (33.0% of sepsis).

In 122 (37.5%) cases of notified infection, microorganisms were isolated. The main isolated microorganisms associated with

Table 1 - Healthcare Associated Infections (HAI), according to birth weight, Neonatal Progressive Care Unity, HC/UFMG, 2008 to 2010.

Tabela 1 - Infecções Relacionadas à Assistência a Saúde (IRAS) por estratificação de peso de nascimento, Unidade Neonatal de Cuidados Progressivos, HC/UFMG, 2008 a 2010.

	Patients at risk N	Patients with HAI N (%)	ID of HAI (/1,000 patient-day)	ID of CLABSI (/1,000 CVC-day)	Mortality N (%)	Lethality N (%)
Até 750 g	14	12 (85.71)	42.37	29.1	7 (50)	7 (58.33)
between 751 g and 1,000 g	45	31 (68.89)	23.96	25.7	5 (11.11)	5 (16.13)
between 1,001 g and 1,500 g	98	49 (50.00)	22.07	14.4	4 (4.08)	4 (8.16)
between 1,501 g and 2,500 g	354	65 (18.36)	21.01	17.5	9 (2.54)	9 (13.85)
higher than 2,500 g	375	65 (17.33)	21.32	13.6	13 (3.47)	13 (20)
TOTAL	886	222 (25.06)	22.8	18.15	38 (4.29)	38 (17.12)

HAI: Healthcare Associated Infections; ID: Incidence density; CLABSI: Central Line-Associated Bloodstream Infection.

IRAS: Infecções Relacionadas à Assistência a Saúde; DI: Densidade de Incidência; SACVC: Sepse Associada a Cateter Venoso Central.

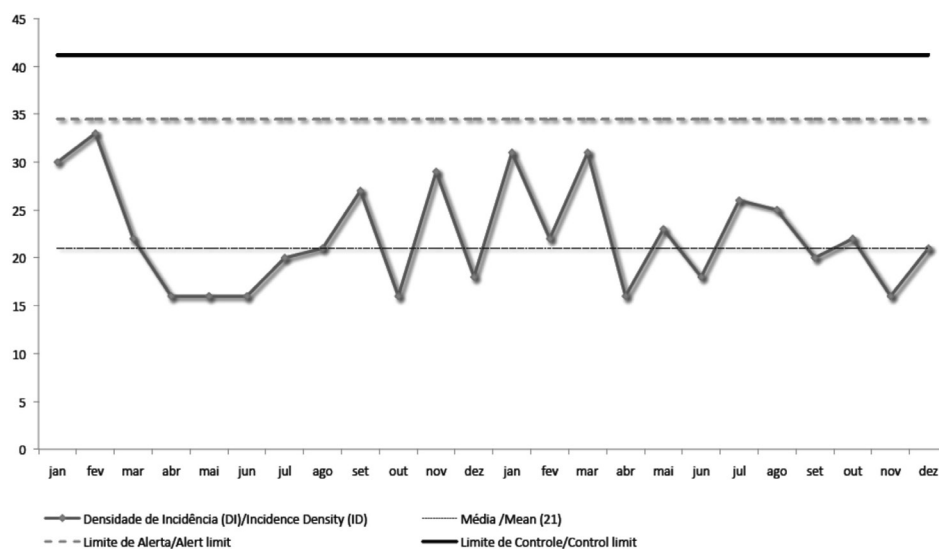


Figure 1 – Incidence density of infections, Neonatal Progressive Care Unity, HC/UFMG, 2008 to 2010.

Figura 1 – Densidade de incidência de infecções, Unidade Neonatal de Cuidados Progressivos, HC/UFMG, 2008 a 2009.

episodes of infection in the UNCP–HC/UFMG were gram-positive, mainly coagulase-negative *Staphylococcus* (35 cases) and *Staphylococcus aureus* (16 cases). Gram-negative bacteria were identified in 25 cases of infection (16 fermenting and nine non-fermenting rods), with a predominance of *Enterobacter cloacae* and *Klebsiella spp.* In addition, fungi were isolated in seven cases, all identified as *Candida spp.* (Table 2).

According to the sensitivity profile, all

strains of coagulase-negative *Staphylococcus* were sensitive to vancomycin and three (18%) of 13 *S. aureus* isolates were resistant to oxacillin. Gram-negative resistance to third generation cephalosporins and carbapenems and strains of *E. coli* and *Klebsiella* species producing extended spectrum beta-lactamases were not identified.

Regarding mortality, 38 deaths were reported in the study period, representing 4.29% of patients at risk, with a mortality

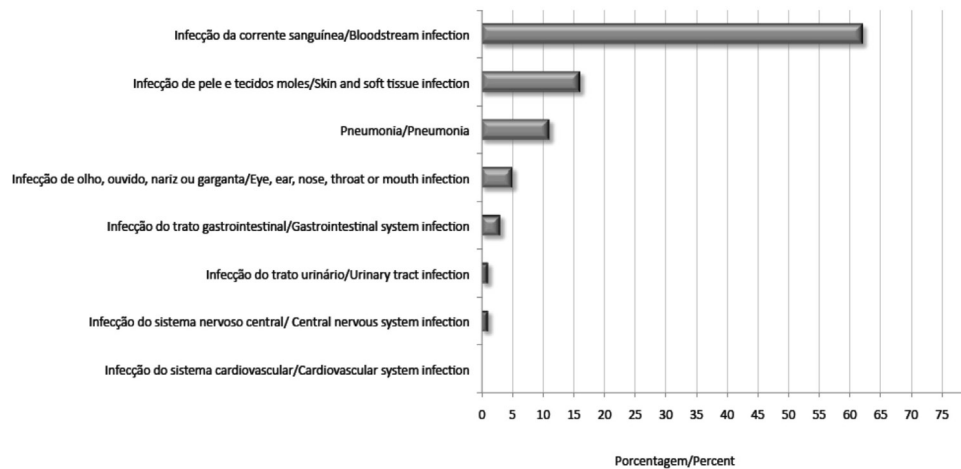


Figure 2 – Site of infections notified at Neonatal Progressive Care Unity, HC/UFMG, 2008 to 2010.
Figura 2 – Topografia das infecções notificadas na Unidade Neonatal de Cuidados Progressivos, HC/UFMG 2008 a 2009.

rate of 17.12% of patients with infection. An inverse relationship between mortality and weight range was observed, reaching 50% among newborns weighing up to 750g (Figure 2). The lethality of infections associated with devices was 6.5% for sepsis associated with CVC, and there were no deaths in patients with umbilical catheter-associated sepsis, pneumonia associated with MV or UTI associated with UIC. When mortality by microorganism was considered, a rate of 13.6% in newborns with infection by gram-negative bacteria and 3.7% in newborns with infection by gram-positive bacteria was observed. However, no statistical difference in the proportion of deaths was observed between groups (Fisher $p = 0.13$).

Discussion

The incidence density of infection in the UNCP – HC/UFMG (22.8 infections/1000 patient-days) was found to be higher than those of developed countries such as the United States (5.2-8.9-infections/1,000 patient-day)^{20,21}, Italy (7.8 infections /1,000 patient-day)²² and Germany (6.5 infections /1,000 patient-day)²³.

In a systematic review performed by Allerganzi²⁴, which included studies reporting HAI in several countries and found a wide variation in rates, four Brazilian studies

with a neonatal population were analyzed. In these studies, a high incidence (40.8%) and incidence density (30 episodes per 1,000 patient-day) were observed, similar to the data found in the present study.

Few publications differentiate the incidence of early and late infections. This, as a result, emphasizes the limitations of such comparisons because international data primarily included infections reported only after 48 hours of life. The incidence proportion of early infections (33.8%), considered to be of maternal origin, was much higher than the one shown by a German study (3.3%)²⁵, although similar to other national studies (28.1% and 36.3%)^{5,13}, a fact which may be related to deficiencies in prenatal care in Brazil.

The group of newborns with a birth weight lower than 750g showed the highest incidence density of HAI, with significant differences in other weight ranges, comparable to what was observed in the international literature^{3,5,7}. This is due to variables associated with these newborns, such as long periods of hospitalization, duration of exposure to invasive devices and immaturity of immune response²⁶.

In all weight ranges, the incidence density of bloodstream infection associated with CVC was above the 90th percentile, according to NHSN reports²⁷. Although the surveillance

Table 2 – Microorganisms isolated in cultures of newborns, Neonatal Progressive Care Unity, HC/UFMG, 2008 to 2010.

Tabela 2 – Principais microorganismos isolados em culturas de recém-nascidos, Unidade Neonatal de Cuidados Progressivos, HC/UFMG, 2008 a 2009.

MICROORGANISM	N	%
GPC – Aerobic		
<i>Negative-coagulase Staphylococcus (Total)</i>	35	10.8
<i>Staphylococcus haemolyticus</i>	15	4.62
<i>Staphylococcus epidermidis</i>	14	4.31
<i>Staphylococcus warneri</i>	5	1.54
<i>Staphylococcus hominis</i>	1	0.31
<i>Staphylococcus aureus</i>	16	4.92
<i>Enterococcus faecalis</i>	2	0.62
<i>Micrococcus</i> sp.	1	0.31
GNB – Enterobacteriaceae		
<i>Enterobacter cloacae</i>	4	1.23
<i>Klebsiella pneumonia</i>	4	1.23
<i>Klebsiella oxytoca</i>	3	0.92
<i>Escherichia coli</i>	2	0.62
<i>Pantoea</i> sp.	1	0.31
<i>Serratia liquefaciens</i>	1	0.31
<i>Serratia marcescens</i>	1	0.31
GNB – Non-fermenting		
<i>Burkholderia cepacia</i>	3	0.92
<i>Pseudomonas aeruginosa</i>	3	0.92
<i>Acinetobacter lwoffii</i>	2	0.62
<i>Ralstonia mannitolilytica</i>	1	0.31
GPB – Aerobic		
<i>Bacillus</i> sp.	1	0.31
Fungi		
<i>Candida parapsilosis</i>	5	1.54
<i>Candida albicans</i>	2	0.62

system implemented in Australia²⁸ shows consolidated data from not only Neonatal Units, but also various Intensive Care Units, the incidence density of sepsis associated with laboratory-confirmed CVC reported (6.4 per 100 patient-day) appeared below that observed in the present study, similar to the density observed in developing countries^{5,14,29}. According to the State of São Paulo Epidemiological Bulletin³⁰, the values found for these infections are also above the 90th percentile in weight categories below

1,000g and between the 75th and 90th percentiles for higher weight ranges. It should be emphasized that the study by Balkhy et al¹¹, in which only reported laboratory-confirmed sepsis associated with umbilical catheter and CVC was notified, the density of infection observed was below that of the present study, probably due to criteria restriction and, consequently, a lower number of notifications.

The incidence density of VAP (5.7 pneumonia cases per 1,000 MV-day) was higher

than the 75th percentile of all weight ranges assessed by NHSN²⁶ data and the Pediatric Prevention Network²⁰. However, this was lower than data found in European countries^{22,25}, Latin America, and even Brazil⁵. However, the reported data were comparable to those of other national studies conducted by Couto et al³¹ and Brito et al¹⁴. It is noteworthy that these studies also used the notification criteria proposed by CDC.

The topographic distribution of HAI showed a predominance of bloodstream infection, as defined in other studies^{8,21,31}, although only one third included the identification of microorganisms. Understanding the microbiology of HAI is essential to make decisions about the empirical antibiotic therapy. Gram-negative organisms are reported as more prevalent in neonatal sepsis in developing countries^{31,32}. Enterobacteriaceae are the main etiologic agents identified in the literature^{31,33}. However, after the introduction of sophisticated apparatus in neonatal units and high invasiveness in newborn infants, coagulase-negative *Staphylococcus* has been appointed as the principal agent of nosocomial sepsis¹⁴, as observed in the present study. This emphasizes the difficulty of diagnosis, considering the need for two blood cultures showing growth of the same microorganism associated with any clinical signs, which is non-specific in newborns¹⁷.

The overall mortality observed (4.29%) was below those described in the literature²⁶, although varying according to weight range. Increased mortality in patients with laboratory-confirmed infection by gram-negative bacteria has been observed in the literature, totaling more than 40%, which is higher than what was reported in this study (13.6%)¹⁷. The lethality of gram-positive infection was lower (3.7%), which can be attributed to the low pathogenicity of the most prevalent microorganism, coagulase-negative *Staphylococcus*¹⁴. However, *S. aureus* infections can reach more than 50% of mortality, three times that of other agents^{34,35}.

Some limitations can be attributed to the present study, considering that data are from a single center and that surveillance with the new criteria was performed for only two years of collection. Furthermore, notification of laboratory confirmed infections included bacterial and fungal etiology. Viral infections, such as the respiratory syncytial virus (RSV), are important for newborns, especially premature ones and those with low birth weight, and they may have been underreported³⁶, considering the criteria employed.

The use of the NHSN criteria established in the UNCP allowed the comparison of infection rates with data originated from other services, including international institutions. The indicators reported were similar to the values found in studies from Brazil and other developing countries and higher than those found in developed countries, showing the difference between the Brazilian reality and that of other countries.

In this context, it becomes necessary to use national criteria, as proposed by the ANVISA, aiming to achieve greater uniformity of information and better suitability for the Brazilian context. .

Conclusion

This study revealed HAI indicators in the Neonatal Progressive Care Unit of the HC/UFGM that can be used as the basis for prevention and control at the local level. The use of standardized criteria for reporting infections is necessary for the construction of indicators in newborns. However, these are scarce in the country, so it is important to highlight the need for national assessment criteria.

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