Reasons for under-reporting of paraquat poisoning in India

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ABSTRACT

Background. Paraquat is an inexpensive herbicide used in agriculture because it is easily available and the cost of labour for manual clearance of weeds is prohibitive. Paraquat is toxic to human beings and is also used for committing suicide. We studied the reasons for under-reporting of paraquat poisoning including those related to the training of doctors.

Methods. In this mixed-methods study, we describe a series of patients with paraquat poisoning. We recorded their demographic data, clinical features, treatment and outcome with an intention to explore the reason for an initial misdiagnosis. We also explored whether deficiencies in curricula contributed to the misdiagnosis.

Results. The patients of paraquat poisoning ($n=28$) were mostly young illiterate men driven by impulsive behaviour rather than chronic depression. Paraquat was consumed by patients from non-agricultural background as well, implying easy access to the poison. Many patients could not name the agent and so initial treatment was directed at organophosphorus poisoning. The diagnostic signs included paraquat tongue, renal failure and jaundice. Most of the casualty medical officers and residents were unfamiliar with the symptoms and signs of paraquat poisoning as was evident by their answers to the questionnaire. Knowledge of medical students about paraquat poisoning was not assessed in the theory examinations and viva.

Conclusion. Factors contributing to the limitation in establishing the diagnosis are illiteracy and ignorance of the patients, lack of specific signs and lack of training of medical officers in treating patients with paraquat poisoning.

Natl Med J India 2021;34:138–42

INTRODUCTION

The challenge of ensuring food security for a large population and prohibitive cost of manual clearance of weeds in India has made chemical clearance of weeds with herbicides, such as paraquat, a necessity in agricultural practice.[1]

Paraquat is classified as category 2 or moderately hazardous by the WHO and as hazardous by other agencies.[2,3] It is permitted for sale only in diluted form to registered farmers in a controlled manner in the USA.[4,5] It is banned in many countries due to its toxicity and use with suicidal intent.[1,3] A ban on paraquat sale has reduced the incidence of suicides in some countries.[6–8] In India, it is permitted for use by the Central Insecticide Board and registration committee and is available as a 24% concentrated solution.[1,9] It is often sold without the need for prescription by agricultural officers. Applicators are untrained and store it in easily accessible conditions.[1]

Deliberate self-harm by ingestion of paraquat presents as non-specific vomiting and hypotension followed by painful ulceration of the tongue (Fig. 1), acute kidney injury (AKI) and self-limiting jaundice. Death is due to respiratory failure.[10–13] Sodium dithionite test is used to confirm poisoning.[14] Although there is no antidote, studies have proposed immunosuppression or charcoal haemoperfusion as treatment.[15–18] Only 10 ml of paraquat can kill a human if ingested and mortality ranges from 50% to over 80%.[3,19,20]

Paraquat poisoning is commonly reported in India's neighbouring countries.[3,14] In spite of its easy availability in India, paraquat poisoning is reported in many studies as rare,[10,11] or not reported at all[21,22] although some studies report it as being common.[12,23] Patterns of hospital transfer of patients with poisoning are known to influence the estimation of incidence.[24]

We observed that patients were referred to the dialysis unit for AKI following poisoning. However, a specific diagnosis of paraquat poisoning was missed. When requested to review the

FIG 1. Paraquat tongue presents as an acute painful central ulceration of the dorsum of the tongue on day 2 or 3 of paraquat poisoning

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diagnosis, we found that the residents were unfamiliar with paraquat poisoning. This prompted the conduct of our study.

In this mixed-methods study, we describe a series of patients with paraquat poisoning. We recorded their demographic data, clinical features, treatment and outcome with an intent to explore the reasons for under-reporting.

METHODS

We studied the case records of all patients with paraquat poisoning admitted to a medical college hospital in northern Karnataka. Paraquat poisoning was diagnosed by detailed history and examination, physical verification of the container of the poison or by the pictures of the container on WhatsApp shared by the patient's relatives or by recognizing the poison on observing old empty containers of pesticides that were displayed.

We recorded demographic data, time from ingestion of paraquat to admission for emergency care, first aid provided, initial diagnosis, patterns of referral, measures taken to arrive at a definite diagnosis, clinical features, treatment received, duration of hospital stay, complications and outcome. Informed consent was taken from the patient whose photograph is published.

A questionnaire-based survey of casualty medical officers and of general medicine residents was conducted to assess the awareness of the clinical features of paraquat poison. The questions were validated by discussion among the authors before the survey. An interview of teachers of general medicine was conducted with the objective of exploring the trends in the assessment of MBBS and MD general medicine students in their knowledge regarding paraquat poison. Informed consent was obtained from the participants of the survey and interview. Recommended textbooks of general medicine by Rajiv Gandhi University of Health Sciences (RGUHS, a health science university established by the Government of Karnataka) were reviewed for content about paraquat poisoning.[25–28] Published question banks of general medicine and forensic medicine of the university were reviewed to ascertain whether paraquat poisoning was included in the assessment of students of MBBS and MD general medicine.[29] Clearance from the institutional ethics committee was obtained before conducting the study. Statistical analysis was carried out by expressing the results as means and proportions.

RESULTS

About 1–2 patients were admitted every day for various poisonings. Among them, the number of patients diagnosed as having paraquat poisoning was 28 over a period of 12 months. The average age of the patients was 21 years. Most of the patients were males. Most of the patients in the emergency department had attributed poisoning to 'stomach ache' (20) or accidental consumption (6). However, during later counselling, other contributory factors for deliberate self-harm were found to be present (Table I). Most patients had more than one contributory factor. This behaviour may be related to criminalization of attempted suicide in India and the societal taboo attached to suicide. The number of non-agriculturists outnumbered the agriculturists. The non-agriculturists included drivers (3), homemakers (3), fruit vendor (1) and those who were unemployed including students (9). Illiteracy was common.

The time taken to seek healthcare at a medical college hospital was an average of 22 hours (range 2 hours to 7 days). Only four patients came directly to the emergency room, the rest were referred from primary and community health centres, where the initial suspicion was of organophosphorus poisoning in 19 patients.

Many patients received treatment at the primary care facility for consumption of an organophosphorus poison (Table II). Most patients did not name the poison (*n*=25) nor bring its container to the primary care facility (*n*=21). None of the patients underwent the dithionite test. At the medical college hospital, the corrosive ulcer over the oral mucosa predominantly affecting the central part of the tongue with redness, pain and sloughing was the clinical feature leading to the diagnosis in 24 patients, which developed 2–4 days after the consumption of paraquat. However, at the time of admission to the emergency room, only 2 patients had paraquat tongue. The triad of paraquat tongue, AKI with or without oliguria and jaundice on days 4–7, which subsided without any specific intervention, was the clinical picture in many patients (Table III).

During hospitalization, 25 patients needed intensive care. Twenty-two patients needed inotropic support. Eight patients underwent haemodialysis. Five patients received haemodialysis

TABLE I. Baseline characteristics of patients with paraquat poisoning (*n*=28)

Item	*n*
Mean (range) age (in years)	17 (15–65)
Age range of most patients (in years)	15–24
Males	23
Illiterate	15
Non-agricultural/agricultural background	16/12
Single/married	22/6
Reasons for self-harm	
Alcohol abuse	22
Disease	3
Economic crises or occupation-related insecurity	1
Marital conflict	2

TABLE II. Treatment received by patients before referral (*n*=28)

Treatment	*n*
Atropinization	19
Pralidoxime	12
Stomach wash	24
Oxygen therapy	20
Nasogastric tube insertion	18
Self-retaining urinary catheter insertion	18
Fuller's earth	2

TABLE III. Clinical features of the patients (*n*=28) noted at the medical college hospital

Clinical feature	*n*	Duration after consumption of paraquat when symptoms occurred (in hours)
Vomiting	24	2
Nausea	25	2
Abdominal pain	25	4
Shock	13	28
Paraquat tongue	24	48–96
Odynophagia	1	78
Oliguria	15	24
Jaundice	11	56
Respiratory distress	5	96

without reuse of dialyser. Twenty-two patients needed mechanical ventilation. Eight patients developed gastrointestinal bleeding and were referred for surgery. Twelve patients received parenteral nutrition.

There was a high mortality (23/28) and prolonged hospital stay (average 13 days; range 1–29 days) among the patients. All the patients who survived had received activated charcoal, methylprednisolone, cyclophosphamide, N-acetylcysteine and haemodialysis.

Curricular factors

The number of casualty medical officers and residents of general medicine who participated in the study was 21 from two districts. The age of the participants ranged from 25 to 62 years. The highest number of participants (16) were 25–34 years old. The qualification of the participants was MBBS, and they had 1 to 38 years of experience. Thirteen participants reported as not having seen even 1 patient of paraquat poisoning. Fifteen participants recognized nausea, vomiting and abdominal pain as the clinical features of paraquat poisoning, but missed the oral lesions. Four participants identified multi-organ failure as a complication of paraquat poisoning. Only two residents identified AKI and acute respiratory distress syndrome as complications of paraquat poisoning. None of the residents were aware of the dithionite test. Thirteen participants considered atropine and pralidoxime as antidotes for paraquat poisoning.

Eight teachers of general medicine with experience of being examiners for MBBS and MD general medicine were interviewed. Their experience at being undergraduate examiners ranged from 3 to 30 years. Their experience of being postgraduate examiners ranged from 1 to 24 years. The most senior teacher reflected upon paraquat use for deliberate self-harm and noted that the poisoning has been seen only since a decade, calling for changes in the curricula. He also recalled his conversation with a pesticide dealer when he learnt that paraquat sale is largely unregulated in spite of its toxicity (Table IV).

Sections about paraquat in textbooks of general medicine, prescribed by RGUHS for MBBS, were checked for content. While *Davidson's Principles and practice of medicine* and *Harrison's Principles of internal medicine* had two paragraphs and a few lines in a table, respectively, the *API Textbook of medicine* and *Kumar and Clark's Clinical medicine* had no mention about paraquat poisoning.

We also checked the question papers from 2009 to July 2018 for any assessment of knowledge of paraquat poisoning. However, none of the 92 MD general medicine, 37 MBBS general medicine and 24 MBBS forensic medicine question papers had a question related to paraquat poisoning.

DISCUSSION

The demographic profile of patients who had consumed paraquat poison was contrary to expectations. The patients were young persons with multiple behavioural factors contributing to deliberate self-harm. Alcohol abuse followed by conflicts between patients and their parents was the most common cause as told by patients or their caregivers. None of the patients had consulted any psychiatrist in the past. Young age and impulsive behaviour had been observed among patients with deliberate self-harm in Sri Lanka too. Eddleston *et al*. reported a similar average age of patients and impulsive behaviour causing self-harm.[30] In contrast, Lin *et al*. attributed suicides to depression in over 50% of patients with a mean age of 41 years.[31] Seok *et al*. also reported the average age as being 46 years and causative factors for suicidal attempts as being pessimism, depression, family trouble and economic problems.[32]

In our study, the mean time taken to arrive at the medical college hospital was 22 hours. In contrast, the time taken in Sri Lanka was <120 minutes. This could be due to multiple factors including better awareness of Sri Lankan primary care doctors, ease of access to the primary care centre, shorter travel distance, etc.[24]

Moderate poisoning by paraquat presents with non-specific symptoms such as nausea, abdominal pain and vomiting. Its presumed rarity with non-specific initial symptoms interferes with early diagnosis and referral. Prior to referral, many patients received treatment directed at organophosphorus poisoning such as stomach wash, atropine, pralidoxime and oxygen due to the same reasons. Kakhandki *et al*. observed that atropine and pralidoxime are used as universal antidotes by some physicians for all pesticides.[33] Similarly, amitraz poisoning has also been

TABLE IV. Reflections of teachers of general medicine about students' knowledge of paraquat poisoning (*n*=8)

The most common questions related to toxicology that are asked in undergraduate or postgraduate examinations during viva voce.	• What is an antidote? (3) • Name common substances used in poisoning. (8) • What are the clinical features of organophosphorus poisoning? (8) • What are the clinical features of kerosene (2), paracetamol (2), rat killer poison (1), antidepressant (1), diazepam (4), antipsychotic (1) toxicity? • What is the treatment of organophosphorus poisoning? (7) • How is atropinization monitored? (4) • What are the nicotinic and muscarinic effects of organophosphorus poisoning? (7)
Attempts to assess the knowledge of paraquat poisoning in the practical or viva voce examinations	No (8)
Do you recall seeing a question paper with any question related to paraquat poisoning?	No (8)
Will it change the management of paraquat poisoning if knowledge about it is assessed in examinations?	• Yes (5) • Killer diseases must be taught (1) • Only if it is taught in the classes previously (2) • There is a need to change the curriculum of toxicology in general medicine giving weightage to other common forms of poisoning also (1) • No. If such a question is asked hardly any student will answer (1) • It may be asked as a short note to create awareness (1)

mistaken for organophosphorus poisoning.[34] Verma *et al*. reported misdiagnosis of agrochemical poison consumption in 17% of their patients in Bangladesh; this increased the cost of treatment.[35]

Early recognition and referral may have a bearing on survival.[18,23] Oxygen therapy is known to cause free radical injury and increased mortality in these patients.[15,16] Gastric lavage is also contraindicated in paraquat poisoning.[15] Atropinization can cause toxicity and had masked the paraquat tongue in our patients. Lack of antidote, need for expensive healthcare, resulting burden on the family's economy and high mortality reflected the enormity of this disease in our patients. Gawarammana and Buckley have discussed two competing approaches in the management of paraquat poisoning.[15] The first is palliative care, which at least reduces the economic burden on the family. The second is that no treatment is worse than the suffering caused by the poisoning and promotes aggressive, experimental treatment. Efforts of the second kind advance medicine and move towards finding solutions. For either of the approaches to be successful, recognition of the disease condition is most important.

Inconclusive diagnosis may have been due to illiteracy and non-agricultural workers who could not name the poison they consumed. Those who were agriculturists used the words '*keetanashaka*' (insecticide) and '*kalenashaka*' (weedicide) interchangeably.

Mew *et al*. discussed that the disaggregation of Indian national data of self-poisoning into 'insecticides' and 'other poisons' lacked a more general 'pesticides' category, which also includes rodenticides, fungicides and herbicides, resulting in an underestimation of the number of suicides due to pesticides.[36] Our study emphasizes the importance of disaggregation of the data into insecticides, rodenticides, fungicides and herbicides, rather than clubbing all under the heading 'pesticides'.

The possibility of banning paraquat was discussed with a weed control scientist at an agricultural university. The scientist drew our attention to the consequences of disturbing food security due to inadequate pest control. He expressed that the herbicide was not marketed as a tool for deliberate self-harm. Sale of paraquat as a ready-to-use diluted solution in doses as required for directly spraying in the fields instead of the present form of 24% concentrate was a possible solution to its consumption as a poison. He said that the cost of production of the large cans and their transport could be reflected as increased expenses in agricultural practice (personal communication, Dr Ramesh Babu, weed control scientist, Agricultural University, Dharwad, 19 February 2019).

Under-reporting of the condition, misdirected classification and treatment for organophosphorus poisoning by the residents and casualty medical officers could be attributed to their training related to a few curricular revisions without considering special needs assessment for the area. Our evaluation system does not assess the knowledge of paraquat poisoning either in written examinations[29] or viva voce. The recommended textbooks provide little information about this fatal condition.[27,28]

The curricular revisions for MBBS in India introduced in 2018 after a gap of 21 years are competency-based, which include competency in the management of paraquat poisoning also (Forensic medicine, Topic: Toxicology. Competency number: FM 9.5),[37] which is a welcome change. India is a vast country; however, the revision of curricula at various universities must not be detached from prevalent local diseases. Hence, regional levels of special needs assessment for curricular reforms must be commissioned.[38]

Conclusion

Deliberate self-harm by paraquat poisoning is common but unrecognized as an important health condition. Factors contributing to the limitation in establishing the diagnosis are illiteracy and ignorance of patients, lack of specific signs, non-availability of point-of-care testing facility for pesticides and training of medical officers and residents. Restricting the sale to licensed applicators on prescription by agricultural scientists and a ban on sale in concentrated form can prevent deliberate self-harm by this agent. Periodic medical curricular revisions after general and special needs assessment with a focus on assessment techniques directed at addressing regionally emergent diseases are necessary.

ACKNOWLEDGEMENTS

We thank Dr Niranjan Kumar, Vice-chancellor, Dr S.K. Joshi, Pro vice-chancellor, Dr B.S. Patil and Dr Kiran Aithal (former and present Head of Department), for their encouragement and support. We thank Dr Kalsad S.T., Director of Belgaum Institute of Medical Sciences, Belagavi, and Dr Viveki R.G., Head of Community Medicine, for their encouragement.

Conflicts of interest. None declared

REFERENCES

1 Kumar D. Conditions of paraquat use in India. Berne Declaration, IUF/UITA, PAN AP, PAN India; 2015.
2 WHO recommended classification of pesticides by Hazard and Guidelines to Classification 2009. Google Books; 2018. Available at *www.who.int/icps/publications/pesticides_hazard_2009.pdf* (accessed on 19 Feb 2019).
3 Watts M. Paraquat monograph. Pesticide Action Network Asia and the Pacific (PAN AP); 2011.
4 United States Environmental Protection Agency, Exposure Factors Handbook. U.S. Environmental Protection Agency; 2011. Available at *www.epa.gov/ingredients-used-pesticide-products/paraquat-dichloride* (accessed on 19 Feb 2019).
5 CDC, USA. Facts about Paraquat; 2019. Available at *https://emergency.cdc.gov/agent/paraquat/basics/facts.asp* (accessed on 19 Feb 2019).
6 Ko DR, Chung SP, You JS, Cho S, Park Y, Chun B, *et al*. Effects of paraquat ban on herbicide poisoning-related mortality. *Yonsei Med J* 2017;**58:**859–66.
7 Vijayakumar L, Satheesh-Babu R. Does 'no pesticide' reduce suicides? *Int J Soc Psychiatry* 2009;**55:**401–6.
8 Wilks MF, Tomenson JA, Fernando R, Ariyananda PL, Berry DJ, Buckley NA, *et al*. Formulation changes and time trends in outcome following paraquat ingestion in Sri Lanka. *Clin Toxicol (Phila*) 2011;**49:**21–8.
9 Central Insecticide Board and Registration Committee, Directorate of Plant Protection, Quarantine and Storage. Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India. Insecticides/Pesticides Registered under Section 9(3) of the Insecticides Act, 1968 for use in India as on 31.12.2018. Available at *http://Ppqs.gov.in/divisions/cib-rc/registered-products* (accessed on 19 Feb 2019).
10 Agarwal R, Srinivas R, Aggarwal AN, Gupta D. Experience with paraquat poisoning in a respiratory intensive care unit in North India. *Singapore Med J* 2006;**47:** 1033–7.
11 Kumar H, Singh VB, Meena BL, Gaur S, Singla R. Paraquat poisoning: A case report. *J Clin Diagn Res* 2016;**10:**OD10–1.
12 Cherukuri H, Pramoda K, Rohini D, Thunga G, Vijaynarayana K, Sreedharan N, *et al*. Demographics, clinical characteristics and management of herbicide poisoning in tertiary care hospital. *Toxicol Int* 2014;**21:**209–13.
13 Pavan M. Acute kidney injury following paraquat poisoning in India. *Iran J Kidney Dis* 2013;**7:**64–6.
14 Goel A, Aggarwal P. Pesticide poisoning. *Natl Med J India* 2007;**20:**182–91.
15 Gawarammana IB, Buckley NA. Medical management of paraquat ingestion. *Br J Clin Pharmacol* 2011;**72:**745–57.
16 Eddleston M, Wilks MF, Buckley NA. Prospects for treatment of paraquat-induced lung fibrosis with immunosuppressive drugs and the need for better prediction of outcome: A systematic review. *QJM* 2003;**96:**809–24.
17 Agarwal R, Srinivas R, Aggarwal AN, Gupta D. Immunosuppressive therapy in

lung injury due to paraquat poisoning: A meta-analysis. *Singapore Med J* 2007; **48:**1000–5.
18 Rao R, Bhat R, Pathadka S, Chenji SK, Dsouza S. Golden hours in severe paraquat poisoning—the role of early haemoperfusion therapy. *J Clin Diagn Res* 2017; **11:**OC06–8.
19 Sandhu JS, Dhiman A, Mahajan R, Sandhu P. Outcome of paraquat poisoning: A five year study. *Indian J Nephrol* 2003;**13:**64–8.
20 Narendra SS, Vinaykumar S. Paraquat poisoning: A case series in South India. *Int J Sci Res* 2015;**4:**561–64.
21 Koulapur VV, Pujar SS, Honnungar RS, Jirli PS, Patil S. Epidemiological profile of pesticide poisoning cases in Bijapur, Karnataka in southwest India: A retrospective study. *Internet J Med Toxicol Forensic Med* 2015;**5:**180–4.
22 Nayak GH, Biradar SS, Shivakumar J, Shenoy JP, Madhusudhan S, Ravindrakumar CN. Pattern of deaths attributable to poisoning in North Karnataka. *Int J Health Sci Res* 2015;**5:**78–82.
23 Jagadeesan M, Nithyananthan P, Banupriya M, Mahendrakumar K, Prasanna KS, Kannan R. A study on clinical profile of paraquat poisoning in a tertiary care hospital. *Int J Adv Med* 2017;**4:**1088–91.
24 Eddleston M, Sudarshan K, Senthilkumaran M, Reginald K, Karalliedde L, Senarathna L, *et al.* Patterns of hospital transfer for self-poisoned patients in rural Sri Lanka: Implications for estimating the incidence of self-poisoning in the developing world. *Bull World Health Organ* 2006;**84:**276–82.
25 Thomas SH. Poisoning: Emergency and critical care medicine. In: Ralston SH, Penman ID, Strachan MW, Hobson RP (eds). *Davidson's Principles and practice of medicine*. 23rd ed. London:Elsevier; 2018.
26 Mycyk MB. Poisoning and drug overdose. In: Kasper DL, Fauci AS, Hauser SL, Longo DL, Jameson JL, Loscalzo J (eds). *Harrison's Principles of internal medicine*. *Vol. 2*. 19th ed. New York:MacGraw Hill Education; 2016:2733.
27 Singh NP. Poisoning and toxicology. In: Munjal YP, Sharma SK, Agarwal AK, Gupta P, Kamath SA, Nadkar MY, *et al*. (eds). *API Textbook of medicine*. 10th ed. Mumbai:Association of Physicians of India; 2015:2628–93.
28 Vale JA, Bradberry SM. Poisoning. In: Kumar P, Clarck M, Feather A (eds). *Kumar and Clarke's Clinical medicine*. 9th ed. London:Elsevier; 2017:79.
29 RGUHS University Library. Available at *http://rguhs.ac.in/digitallibrary/RGUHS%20Digital%20Library.htm* (accessed on 4 Feb 2019).
30 Eddleston M, Karunaratne A, Weerakoon M, Kumarasinghe S, Rajapakshe M, Sheriff MH, *et al.* Choice of poison for intentional self-poisoning in rural Sri Lanka. *Clin Toxicol (Phila)* 2006;**44:**283–6.
31 Lin C, Yen TH, Juang YY, Lin JL, Lee SH. Psychiatric comorbidity and its impact on mortality in patients who attempted suicide by paraquat poisoning during 2000–2010. *PLoS One* 2014;**9:**e112160.
32 Seok SJ, Gil HW, Jeong DS, Yang JO, Lee EY, Hong SY. Paraquat intoxication in subjects who attempt suicide: Why they chose paraquat. *Korean J Intern Med* 2009;**24:**247–51.
33 Kakhandki S, Yahya M, Praveen M. Acute methaemoglobinaemia initially treated as organophosphate poisoning leading to atropine toxicity. *Indian J Anaesth* 2012;**56:**397–400.
34 Dhooria S, Behera D, Agarwal R. Amitraz: A mimicker of organophosphate poisoning. *BMJ Case Rep* 2015;2015. pii: Bcr2015210296.
35 Verma V, Paul S, Ghose A, Eddleston M, Konradsen F. Treatment of self-poisoning at a tertiary-level hospital in Bangladesh: Cost to patients and government. *Trop Med Int Health* 2017;**22:**1551–60.
36 Mew EJ, Padmanathan P, Konradsen F, Eddleston M, Chang SS, Phillips MR, *et al.* The global burden of fatal self-poisoning with pesticides 2006–15: Systematic review. *J Affect Disord* 2017;**219:**93–104.
37 Medical Council of India. Competency based undergraduate curriculum for the Indian Medical Graduate 2018. New Delhi:Medical Council of India; 2018. Available at *www.old.mciindia.org/UG-Curriculum/UG-Curriculum-vol-1.pdf* (accessed on 12 Feb 2019).
38 Modi JN, Gupta P, Singh T. Competency-based medical education, entrustment and assessment. *Indian Pediatr* 2015;**52:**413–20.