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Comparing Dental and Medical Education Standards on Environmental Health (Bio-Medical Waste Management)

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Abstract

Introduction: There has been a progressive and exponential increase in the utilization of healthcare services. Global healthcare spending is projected to increase at an annual rate of 4.1% in 2017-2021, up from just 1.3% in 2012-2016. Medical and dental sciences are expanding in terms of available treatment options, improvised implants and innovation in both fields. Specialized equipment and innovations in available treatment options enable the performance of more complex surgical procedures. Such increasing healthcare service on account of increasing services, enhanced affordability and advancement in technology has to lead a parallel increase in generated bio-medical waste (BMW). The most important component of BMW waste management and handling is its segregation. It thus becomes imperative that doctors are adequately trained and that segregation practices are inculcated in their conduct. Medical and dental colleges are the primary institutions assigned to provide technical education such that a person trained becomes an able doctor. Education in foundation years can have a much more long-lasting effect. This study aims to identify the knowledge levels of young dental and medical graduates and identify possible differences in both streams.

Method: One medical college and two dental colleges were selected based on the convenience and accessibility to the research and a cross-sectional study was performed. Based on the available literature, available guidelines and applicable rules, a structured questionnaire was formed. Pre-defined questionnaire was distributed to all and study objectives were explained.

Result: The study identified that the dental and medical curriculum is deficient in providing training and ensuring logical understanding among young graduates and making them adequately competent to be allowed to handle BMW and consequentially be allowed to run their clinics or work independently at hospitals.

Keywords: Hospital, Healthcare, Medical College, Dental College, Bio-Medical Waste.

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Introduction

There has been a progressive and exponential increase in the utilization of healthcare services. Dixon-Fyle and Kowallik, have projected that many countries will spend more than 20% of Gross Domestic Product (GDP) on healthcare by 2050.[1] Governmental policies such as subsidies can increase demand for healthcare as patients are charged a lower price. The demand for healthcare comes from the desire of the consumer to gain good health. Most people prefer being healthy to being sick. Another factor that makes health care different from most other goods and services is that it is simultaneously an investment. The money consumer spends on being healthy today will also benefit the consumer in the future. If a consumer is sick and requires medical care, the consumer will purchase healthcare services at almost any price.[2] The number of people living in rural (nonmetropolitan) counties has declined by nearly 2,00,000 between 2010 and 2016, which is the first recorded period of rural population decline.[3] Increasing awareness and education has forced the Government to upgrade the rural hospitals and available facilities therein. Global healthcare spending is projected to increase at an annual rate of 4.1% in 2017-2021, up from just 1.3% in 2012-2016.[4]

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Medical and dental sciences are expanding in terms of available treatment options, improvised implants and innovation in both fields. Parallel to this has been an increase in the demand for healthcare services not only for treatment but also for cosmetic reasons like fact reduction, augmentation/reduction of body parts, face upliftment and plastic surgeries. Specialized equipment and innovations in available treatment options enable the performance of more complex surgical procedures.

Such increasing healthcare service on account of increasing services, enhanced affordability and advancement in technology has to lead a parallel increase in generated

BioMedical Waste (BMW). On the other hand cumulative impact of generated waste and problems related to its treatment and disposal warrants scientific intervention in the management of all types of waste. BMW needs scientific management because of its potential to harm the flora, fauna and living organisms, including animals and humans. Experts have worked out possible solutions and the Government of India notified rules for management and segregation on BMW in 1998[5] with future amendments and recently notified new rules in the year 2016[6] with an amendment in the year 2018.[7] In a recent study, significant cross-infection was found due to inadequate awareness among doctors.[8]

The most important component of BMW management and handling (BMWMH) is its segregation. Segregation has to be done at the site of generation and by the generating person to further minimise the risk to handlers. It thus becomes imperative that doctors are adequately trained and that segregation practices are inculcated in their conduct. This requires dedicated and sincere efforts of the faculty providing education to such students. Heads of such institutes must adopt scientific methods to enhance the motivational levels and job satisfaction levels of faculty such that they deliver their best to the budding doctors.[9,10]

Medical and dental colleges are the primary institutions assigned to provide technical education such that a person trained becomes an able doctor. Education in foundation years can have a much more long-lasting effect. BMW rules are the same for both Dental & Medical streams and are equally applicable. Items used are similar, though the proportion of types of items used may vary in proportion. BMW rules require each item to be judiciously segregated without failures, even for a single item. The curriculum [11-13] of both streams includes teaching on BMW.[11-13] Even during their graduation level studies, such future doctors are assigned duties to assist superiors at clinical work. Immediately upon completion of respective courses, these graduates start their one-year compulsory internship training where such young graduates shall be handling clinical work at times independently and also generating and handling BMW. Differences have been found in education provided to diploma and graduate nurses, signifying that education during the basic professional course is important.[14] It thus becomes imperative to assess their knowledge levels upon completion of their graduation and identify possible gaps.

Objectives

This study was conducted to identify the knowledge levels of young dental and medical graduates and identify possible differences in both streams.

Material And Methods

One medical college and two dental colleges were selected based on the convenience and accessibility to the researcher and a cross-sectional study was performed. Identities of these institutions have been masked as the study pertains to the education system rather than specific institutes. This study was performed in the year 2018-2019. Both the Dental colleges together had an annual intake of 150 students for graduation (BDS course) and the medical college had a batch of 50 students (MBBS course) undergoing internship. Following NULL hypothesis was formed $H_0$1: *that is there is no significant difference in knowledge and awareness levels between young graduates of medical and dental colleges.*

Study Instrument

Based on the available literature[5,15], available guidelines and applicable rules a structured questionnaire was formed. The questionnaire was specifically framed to assess the clarity of basic concepts behind the biomedical waste management and handling (BMWMH) rules.[5] The questionnaire was validated by subject experts and a pilot study was conducted. Consent was obtained from the respective colleges. The questionnaire consisted of two parts namely: respondent's demographic profile and awareness of BMWMH rules.

The questionnaire was validated for internal consistency and reliability using Cronbach's α. Our Cronbach's α for the total questionnaire was 0.896, indicating good internal consistency.

Sample Size and Sampling

Principals of all three colleges were requested to gather all final-year students and all interns in batches and to provide their lecture halls. Since all students and interns were invited so there was no need for sample size calculation. The pre-defined questionnaire was distributed to all the attendees and the study objectives were explained. They were requested for their voluntary participation and confidentiality of responses was ensured.

Statistical Analysis

Survey responses were fed into a spreadsheet. Further assessment was done by applying the mean, standard deviation, and t-test using a statistical package (SPSS, Ver.20).

Results

In total 240 participants submitted their responses which included 196 (81.7%) dental doctors and 44 (18.3%) medical doctors. The gender composition of participants included 15% (n = 36) male doctors and 78.3% (n = 188) female doctors (Table 1).

It was enquired when the last class/session on BMW was held for them (Table 2). Of the respondents, only 2.3% (n = 1)

Table 1: Demographic split up of participants

	MBBS (n)	*BDS (n)*	*MBBS (%)*	*BDS (%)*	*Total*
Male	7	29	15.9%	14.8%	15.0%
Female	33	155	75.0%	79.1%	78.3%
No response	4	12	9.1%	6.1%	6.7%
Total	44	196			

Table 2: Last session on BMW training

	MBBS (n)	*BDS (n)*	*MBBS (%)*	*BDS (%)*
< 1year	1	77	2.3%	39.3%
> 1 year	12	65	27.3%	33.2%
Never	30	43	68.2%	21.9%
No response	1	11	2.3%	5.6%
Total	44	196		

Table 3: BMWMH being taught by

	MBBS (n)	*BDS (n)*	*MBBS (%)*	*BDS (%)*
Administrator	0	0	0.0%	0.0%
BMW Coordinator	0	5	0.0%	2.6%
Faculty/Doctor/HOD	14	146	31.8%	74.5%
Infection control Nurse	0	0	0.0%	0.0%
No Response	30	43	68.2%	21.9%
Nurse	0	2	0.0%	1.0%
Total	44	196		

Table 4a: Response to segregation of twenty specified items in coloured bins

	t-test for Equality of Means		
	t	*df*	*Sig. (2-tailed)*
Correct responses	-.675	238	.500
Incorrect responses	3.489	238	.001

Table 4b: Response to segregation of twenty specified items in coloured bins

		N	*Mean*	*Std. Deviation*	*Std. Error Mean*
Correct responses	MBBS	44	2.89	.754	.114
	BDS	196	2.98	.897	.064
Incorrect responses	MBBS	44	1.16	.479	.072
	BDS	196	0.91	.420	.030

MBBS doctors and 39.3 (n = 77) had session/class on BMW in the last year, for 27.3% (n = 12) BDS doctors and 33.2% (n = 65) MBBS doctors session was held more than a year ago. MBBS doctors, 68.2% (n = 30) and 21.9% (n = 43) BDS doctors never had any session on BWW. Further, it was inquired as to who was taking sessions on BMW for the respondents at their respective colleges. It was found that the majority 31.8% (n=14) MBBS and 74.5% (n = 146) were taught by faculty (Table 3).

Respondents were then required to respond to twenty healthcare waste items and the color coding for their segregation. Data was analyzed by comparing results between the two streams (Table 4a). It was found that while there was no significant difference ($p = 0.5$) in incorrect responses between

Table 5a: Treatment options exercised by CBMWTF

	t	*df*	*Sig. (2-tailed)*
Incineration	-1.971	238	0.049
Autoclaving	-.532	238	0.595
Shredding	-4.267	100.626	.00004
Chemical disinfection	-3.812	77.925	.0003
Burial	2.342	71.339	0.022
Mutilation	.859	238	0.391

Table 5b: Treatment options exercised by CBMWTF

		N	*Mean*	*Std. Deviation*	*Std. Error Mean*
Incineration	MBBS	44	.50	.506	.076
	BDS	196	.66	.476	.034
Autoclaving	MBBS	44	.16	.370	.056
	BDS	196	.19	.396	.028
Shredding	MBBS	44	.09	.291	.044
	BDS	196	.33	.470	.034
Chemical disinfection	MBBS	44	.18	.390	.059
	BDS	196	.44	.498	.036
Burial	MBBS	44	.77	.424	.064
	BDS	196	.60	.491	.035
Mutilation	MBBS	44	.09	.291	.044
	BDS	196	.06	.231	.016

the two colleges, there was a significant difference in incorrect responses ($p = 0.001$) between medical and dental graduates with medical graduates having higher incorrect responses (Table 4b).

Young graduates were asked to specify treatment options which CBMWTF exercises. Responses (Tables 5a and 5b) were analyzed; wide and statistically significant variation was found for responses on shredding (p =0.00004), chemical treatment ($p = 0.0003$) and burial ($p = 0.022$). Such error was found to be more common among medical doctors for Burial and MBBS, while dental graduates erred more for chemical disinfection. For other options, though there was no significant difference, responses were away from being 100% correct. Graduates of the dental stream fared better than medical graduates.

Respondents were then asked multiple choice questions on the treatment of various coloured-coded bags and sharps by CBMWTF. Significant differences were found in responses for both color-coded bags and sharps (Table 6a**)** among the graduates of the two colleges. It was further observed that (Table 6b) a significant proportion of young graduates selected the wrong treatment options exercised by CBMWTF. Graduates of dental streams fared better as compared to medical graduates on the same.

Null Hypothesis $H_0$1 is thus rejected due to a significant difference in responses between the graduates of the two colleges.

Table 6a: Treatment subjected to coloured coded bags by CBMWTF

	t	*df*	*Sig. (2-tailed)*
Yellow			
incinerated	-.884	238	0.377
Autoclaved	2.071	47.074	0.044
Crushed and autoclaved	2.239	48.721	0.030
Disinfected with hypochlorite and then buried	-.362	238	0.718
Blue			
incineration	1.677	238	0.095
Autoclaved	3.426	47.497	0.001
Chemical Disinfection	2.782	49.955	0.008
Deep burial	-1.050	238	0.295
Shredding	-1.837	238	0.067
Mutilation	.306	238	0.760
Sharps			
incineration	-.920	238	0.358
Autoclaved	2.863	45.935	0.006
Chemical Disinfection	4.755	48.878	0.00002
Deep burial	-1.478	238	0.141
Shredding	-3.305	103.409	0.001
Mutilation	-.076	238	0.940

Table 6b: Treatment subjected to coloured coded bags by CBMWTF

Treatment	*Stream*	*Yes*	*% Yes*
Yellow			
Incinerated	MBBS	21	47.7%
	BDS	108	55.1%
Autoclaved	MBBS	6	13.6%
	BDS	5	2.6%
Crushed and autoclaved	MBBS	8	18.2%
	BDS	9	4.6%
Disinfected with hypochlorite and then buried	MBBS	14	31.8%
	BDS	68	34.7%
Blue			
Incineration	MBBS	18	40.9%
	BDS	55	28.1%
Autoclaved	MBBS	13	29.5%
	BDS	10	5.1%
Chemical Disinfection	MBBS	12	27.3%
	BDS	15	7.7%
Deep burial	MBBS	11	25.0%
	BDS	65	33.2%
Shredding	MBBS	2	4.5%
	BDS	29	14.8%
Mutilation	MBBS	2	4.5%
	BDS	7	3.6%
Sharps			
Incineration	MBBS	14	31.8%
	BDS	77	39.3%
Autoclaved	MBBS	9	20.5%
	BDS	5	2.6%
Chemical Disinfection	MBBS	20	45.5%
	BDS	16	8.2%
Deep burial	MBBS	3	6.8%
	BDS	30	15.3%
Shredding	MBBS	3	6.8%
	BDS	45	23.0%
Mutilation	MBBS	3	6.8%
	BDS	14	7.1%

Discussion

Dental and Medical graduates regularly participate in clinical treatment and participate in patient treatment, especially in the final year of graduation and subsequently independently treat patients during their internship. Many of such doctors after their graduation, get into independent clinical practice where they may not get the opportunity for enhancement in knowledge through colleagues. The generation of BMW during treatment procedures is inevitable. Thus, it becomes imperative that doctors are taught applicable rules and regulations on handling and BMW disposal are appropriately taught to them. Education on BMW is part of the dental and medical education curriculum which requires that graduates are taught adequately on BMW rules and regulations.[16,17] Induction training is a regular feature in accredited hospitals as required by agencies.[18,19] Further current rules[6] require induction training as well as yearly training on BMW. With only 32.5% (n = 78) respondents having training sessions on BMW in the last year and 30.4% (n = 73) having no training on BWW; it is evident that either the dental and medical education is lacking or that dental & medical colleges may not be serious in imparting ensuring adequate training on BMW. This lack of adequate training was found to be common in both streams. It is unlikely that no session was held as the same is a part of their curriculum; it could be interpreted that the sessions held in the past were either forgotten or were not dedicated sessions to be remembered by young graduates. Further, it was found that 66.7% (n = 160) of the graduates were taught by faculty. This implies that there are no dedicated BMW coordinators at dental and medical colleges and all are dependent on their faculty. It may also mean that dedicated/expert professionals are not involved in student education. It is possible that with colleges having multiple departments, respective departmental heads are being entrusted to ensure compliance with BMW at their respective departments. This can lead to dissimilarities in procedures being followed and consequent confusion with

subordinates. Authors had earlier in another study[14] (2018) highlighted the importance of dedicated BMW coordinators and the importance of BMW training among nurses at graduation level studies.

Applicable penal provisions for violating BMWMH leave no scope errors due to confusion/errors. At the hospital level; the doctor's role is appropriate segregation of generated BMW into designated color-coded bins. One way to correctly segregate is by conceptual clarity on color coding and the other way is to remember color coding is by repeated reading and mugging-up or following the visual displays, including posters specifying segregation of mentioned items. On analysis, responses on respective applicable designated color-coded bags/bins for specified twenty items, it was found that while there was an insignificant difference ($p = 0.500$) in incorrect responses between the two colleges, there was a significant difference in incorrect responses ($p < 0.001$) between the young doctors of two streams (Table 4a). This difference can lead to faulty segregation at colleges and their hospital, which is probably getting unchecked and ignored at their respective colleges. Means of correct and incorrect responses along with standard deviation, have been highlighted in Table 4b. Even though the difference may be insignificant, any single episode of non-compliance to BMW may lead to serious consequences to the environment and institution and spread of infection to the innocent. Another study highlighted the spread of infection on account of inadequate infection control practices at clinics and hospitals.[8] A similar study on graduates of dental college found moderate to poor awareness levels.[20]

As per the existing guidelines, common BMW treatment facilities (CBMWTF) collect solid BMW generated by healthcare facilities (HCF) for further treatment, processing and disposal. To assess the overall clarity of the complete process, young graduates were asked to specify treatment options that CBMWTF exercises. Significant (Table 5a) and wide (Table 5b) variation was found for responses on shredding ($p = 0.000004$), Chemical disinfection ($p = 0.0003$) and burial process ($p = 0.022$) being followed by CBMWTF. Generated solid BMW to be taken away by CBMWTF is required to be segregated by HCF in color-coded bags as per the pre-defined criterion, which in turn is based on the treatment process to be followed by CBMWTF. This segregation is to prevent wrong treatment in the hands of the unskilled workforce deployed by CBMWTF and to prevent accidental injuries to such workers. This segregation of waste by HCF ensures minimal secondary handling and that generated waste undergoes designated treatment and disposal process at CBMWTFs. Understanding final and approved treatment and disposal options can help doctors perform correct segregation even in uncommon situations (BMW being handled for the first time or uncommonly). Table 6 depicts significant variation in responses of graduates of two streams on responses to treatment processes that CBMWTF is subjecting to color-coded bags. This highlights confusion among young graduates and a potential source of error among doctors and further depicts that training sessions are deficient in providing meticulous understating to young graduates. It may mean that teaching on BMW is to a minimal extent, with guidance only on color coding rather than making them understand the underlying logic. Lower awareness was also found in other earlier studies.[20,21] Further, with the same rules applying to all HCFs and being included in the curriculum of respective streams, this significant variation in understanding of young doctors of both streams may mean a lack of uniformity in the curriculum, which is leading to confusion among faculty and subsequent knowledge being imparted to graduates.

One may argue that there is confusion on BMW rules and regulations, which makes it difficult for graduates to imbibe rules with complete clarity and understanding. However, on the other hand, the expert may argue that dedicated efforts are required for thorough understanding. Earlier studies[22,23] had endorsed improvement in knowledge levels after dedicated training sessions including teaching based on scientific skills. Remarkable improvement in responses was found in the pre-test and post-test studies, but in even such studies, responses were not 100% correct, which essentially signifies the need for repeated sessions.[6,14] rather than just being one or two classes. Authors believe that sincere efforts can reduce confusion. On the other hand, considering the strict penal provisions under the act with imprisonment as a minimum punishment, there is no scope for even a single error and young graduate ought to be made ready to independently manage and run their clinics and perform meticulous segregation at the hospitals.

Conclusion

Such deficiency could be due to an improperly structured curriculum, variation in knowledge levels of faculty, non-inclusion of expert professionals and lesser weightage given to the same in theory and practical exams. While the BMW rules are the same, the significant difference observed between the two streams signifies the lack of uniformity in education and training, with dental colleges providing better training than medical colleges. To conclude this study, it can be said the dental and medical curriculum is deficient in providing training and ensuring logical understanding among young graduates and making them adequately competent to be allowed to handle BMW and consequentially be allowed to run their clinics or work independently at hospitals.

Recommendations

Strict implementation of biomedical waste management rules is the need of the hour. The dental and medical curriculum needs to be redefined and refined to ensure the adequacy of training before the completion of graduation. Healthcare facilities must consider appointing specifically trained healthcare personnel and involve such professionals to train future doctors. Training sessions must not be occasional and casual ones; rather training on BMW should be a continued process with regular competency assessments and knowledge levels.

Study limitation

The study was limited to three colleges only. The sample size might not be the exact representative of the national scenario to generalize the findings of the study. Possible variation due to public and private sector colleges cannot be ruled out.

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