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Competency-based Learning: The effectiveness of targeted resident education and clinical auditing feedback on completed death certificate accuracy rates

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Abstract: *Background:* Death certification is an integral part of physician practice, yet common errors are being encountered from this vital source of health information. Most medical training programs lack formal curricula for this important skill. Accurate information from DC will help in improve our mortality data which can be use public health purposes
Objectives: This study evaluated the effect of a multifaceted educational intervention on accuracy of completing death certification in a tertiary-based paediatric residency program
Method: A pre-post intervention and control cohort study over 12-month period to assess the effect of our multifaceted intervention accuracy rate of completed DC was conducted. The intervention consisted of a 3-part program (distribution of educational material, presentation by a skilled instructor, skills workshop, and clinical mortality/auditing feedback sessions). Primary outcome was the difference in scores pre- and post-intervention and also the rate of accuracy on the MAHI death certificate scoring system.
Results: The mean score before the intervention was 6.8±2.7 and 7.1±2.3 in both the intervention and control cohorts respectively. The mean score after the intervention was 16.3±2.5 and 7.3±2.8 in both the intervention and control cohorts respectively indicating an increase in scores. The mean difference in pre- and post-tutorial scores was significant (t=20.39, p=0.0001).
Conclusions: We found that using a multifaceted educational intervention to train junior physicians on how to correctly complete a DC was effective in a residency-based pediatric program

Keywords: Death certificate, medical education, multifaceted training, heath information, Nigeria.

Introduction

The death certificate (DC) is an important legal and public health document issued by a hospital that declares the date, location, and cause of a person's death. Data from death certificates constitute an essential component of national vital statistics. Death certificates are used by public health researchers for identification of the leading causes of death, disease outbreaks and for surveillance of disease patterns[1,2]. They are also used to determine public health funding and clinical research priorities.[1-3]More so in our setting where practice of performing autopsies is rare, DC have become an even more important source of data on the mortality. Studies have shown that DC error rates are high, particularly in academic setting where junior physicians are the sole certifying officers[3-6]. Despite this responsibility, junior physicians in many medical school and residency programs are given little if any formal training on how to complete DC[1,4-10]. We found no published curricula at the undergraduate medical and residency trainings that teach accurate DC completion, although the Federal Ministry of Health lists DC as a source of vital statistics for the nation. Furthermore, the Medical and Dental council of Nigeria (MDCN) evaluation form for the interns failed to capture death certification skill as one of the core competencies to be assessed. Several studies[1, 3-9] on accurate DC reports educational interventions that were found to be benefit, however, the results were quite variable and success was often non significant and short lasting[6-9]. To achieve a lasting change in residents' accuracy in completing DC, the resident must go through the generic stages of behaviour change as described by Prochaska: pre-contemplative; contemplative; preparation;

action; and maintenance or relapse[11]. It is unusual for a single intervention to be sufficient to move an individual through all these stages and thus facilitate a lasting behavior change. Studies that combine interventions have, however, been more successful.[11-13] Such studies may combine a predisposing intervention (designed to achieve the *preparation* stage of change) with an enabling intervention (designed to achieve the *action* stage of change) and are in forcing intervention (designed to achieve the *maintenance* stage and prevent the *relapse* stage of change)[14]. The aim of this study was to determine whether a targeted junior physician (intern and residents) education program would improve the quality of DC completed by Pediatrics physicians. Research in medical education suggests that optimal learning involves the use of different methods of teaching and that a multifaceted approach leads to higher retention of knowledge and skills.[11-13] We therefore, hypothesized that a 3-part program (distribution of educational material, presentation by a skilled instructor(s), skills/training workshop, and clinical mortality/auditing feedback sessions) would be effective in increasing the quality of DC completed by interns/resident physicians. Accurate information from DC will help in improve our mortality data which can be use public health and legal purposes

Methods

Design

We conducted an Institutional Review Board approved, cohort pre-post comparison study over a 12-month period to assess the effect of a targeted interns/residents physician educational program on the quality of DC completed by junior physicians (intern and residents). A 6-month pre-intervention assessment period (January to June 2013) was followed by the intervention educational presentation (July 2013), weekly clinical mortality/ auditing and feedback sessions (July to December 2013) and a 3-month post-intervention evaluation period (October to December 2013). The intervention was targeted primarily at interns and residents at one tertiary-based Pediatrics residency program. In an effort to avoid psychological phenomenon (observational bias) that produces an improvement in human behavior or performance as a result of increased attention from superiors or colleaguesbias (Hawthorne effect)[15] we did not detail our plan to audit the DCs before and after the intervention to the participating interns/residents. Fifty completed DC from the pediatrics department were randomly selected for the last 6 month before the intervention as pre-intervention cohort and 50 completed DC 3 month after/into the starts of the intervention as post-intervention cohort. All DC completed by interns and residents during the pre- and post comparison period were included in the study. We excluded 7 DC which did not have the designation of the certifying physicians. Also DC completed during the same period from internal medicine department were evaluated as control cohort (residents from internal medicine received no additional training on DC).

Educational intervention

Predisposing intervention

The first part of the interventions involved distribution of educational material containing guidelines and recommendations on how to complete DC based on international classification of disesases-10 (ICD-10)[16].

Enabling intervention

The interns/residents attended a two-hour workshop on how to complete DC. The workshop, moderated by two of the authors (GMA and MMG), was held during the usual time of the weekly academic program. The workshop was designed to focus on usefulness of DC, definition of terms and guidelines for completion of DC based on ICD-10[16]. The workshop began with a brainstorming session on 'what went wrong' and 'what went right' during DC completion in which participants were asked to identify reasons why DC that they have completed or reviewed as satisfactory or otherwise. Each item on DC was introduced by one of the instructors. Following this participants were given clinical case-scenario of DC. An example of a scenario is given below:

"9 month-old female with Down's syndrome managed for severe bronchopneumonia with background ventricular septal defect died on day 3 of admission. What was the underlying cause of death?"

Based on the scenario participants were asked to perform the relevant tasks for their case, e.g., completing underline cause of death for their scenario. When all tasks were completed each completed DC was analyzed and graded for accuracy, feedback was given. The session was highly interactive, the faculty described ways of using reflection and feedback ('what went right' and 'what went wrong') with reasons so as to improve accuracy of DC. The session ended with a review of the literature on morning presentation and participants were provided with a memorandum on how to complete DC (predisposing intervention).

Reinforcing intervention

Over the 3 months following the workshop, the course all the authors provided feedback to internists/ residents on the DC certified during routine weekly morbidity and mortality sessions. These short discussions addressed questions or concerns rose by the residents or brought to light by the certifying physician, and were designed to reinforce the elements taught earlier in the workshop.

Data collection

We used a standard DC approved by the WHO, which is in use across the world[16]. Part (I) outlines the events from immediate events to the underlying cause of death in a descending order. Part (II) outlines the associated co -morbidities that add to the disease process. The DC were graded and analyzed based on a modified version of the Mid American Heart Institute (MAHI) Death Certificate Scoring System used in previous studies[1,9]. Each item on scoring instrument was scored on a value of 0 to

2, with 22 being the highest possible score. A score of zero meant inaccurate information, 1 was partially correct and 2 fully correct. Each Completed DC's score was summed and labeled as satisfactory (≥19) or unsatisfactory (≤18). Two of the authors (GMA and AIB) blinded to the DC's cohort reviewed all death certificates, and the mean was considered as the final score for each participant. The interrater reliability (rho) score of 0.93 was obtained suggesting high level of agreement among the assessors. Where there was marked discrepancy of more than 4 points among the assessors, agreement was achieved through reevaluation by both assessors together. After information was extracted on the DC, scores were entered into the computerized spread sheets (Microsoft Excel version 2003, Redmond, Washington). These results represented the final analysis/interpretation of the DCs. For purposes of this study, we defined an accurate DC as one that was both "satisfactory" as defined above and included name of the certifying physicians.

Data Analysis

Death certificates were classified categorically by the absolute score obtained as satisfactory and unsatisfactory. Fisher's exact test was used for comparisons involving the categories/items of the DC score before and after the intervention. Mean DC score for pre and post intervention for the two groups were compared using paired t-test and the effect size was calculated based on the method described by Cohen in 1988.[17] All analyses were one-sided and a p-value of < 0.05 was considered to be statistically significant. Pre and post-intervention assessment results were also tabulated. Statistical analyses were performed using Microsoft Excel and SPSS 16.0 software (Chicago)

Results

A total of 200 DCs were analyzed (50 each before and after the intervention in both the intervention and control groups). In the DCs analyzed, the mean difference in the pre and post-intervention scores in the intervention cohort was statistically significant (t=23.39, p < 0.001) and also the mean difference between post-intervention scores for the intervention and control cohorts was significant (t=22.14, p< 0.001). While the mean difference in the pre and post-intervention in the control cohort was not statistically significant. This indicates an increase in the scores of about 34% after the intervention both vertically and horizontally (table 2) and (fig 1). Table 3 demonstrates that the intervention cohort showed a significant improvement in 7 of the 8 parameters of the DC scored, compared to the control group were no such improvement was observed based on modified MAHI DC scoring ssytem[1].

All the 50 post-intervention DCs in the intervention scored more than 13 (≈60%) points with 21 DC received a satisfactory score of ≥19 compared with no satisfactory score in the post-intervention control cohort. The overall mean score of improvement attributable to the multifaceted educational improvement is shown in figure 1.

Table 1: Modified Mid America Heart Institute Death Certificate Scoring System

Item	Description
1	Etiologically relevant cause of death has been identified
2	Sequential format for Part I of death certificate has been followed
3	Line A in Part I has been correctly identified
4	Line B in Part I has been correctly identified
5	Line C in Part I has been correctly identified
6	Only one condition per line has been identified
7	Co-morbid conditions have been correctly identified in Part II of death certificate
8	Did not utilize mechanistic terminal events
9	Did not utilize symptoms and signs
10	Did not oversimplify inappropriately
11	Did not report abbreviations

Fig 1: Mean difference in the completed death certificate scores before and after in the control and intervention cohorts (p<0.000)

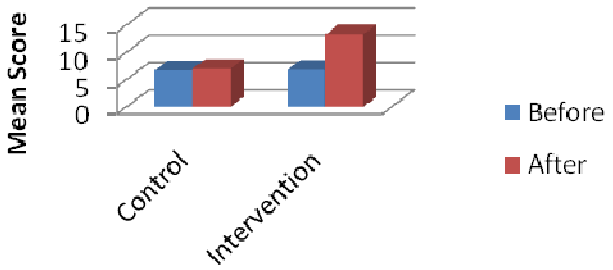

Table 2: The effect of the educational intervention on mean death certificate scores before and after in the control and intervention cohorts

Mean Scores	Intervention Before*	Intervention After*	Effect Size (d)	P value
Intervention Group	6.8±2.7	16.3±2.5	3.51	<0.001
Control Group	7.1±2.3	7.3±2.8	0.08	1.000

*$=mean ±0.SD, d= effect size, P value < 0.05= statistically significant,

Table 3: Descriptions and frequency of Accuracy Rate in the death certificate before and after the education intervention in the control and intervention cohorts

Performance Parameters	Intervention Before (%)	Intervention After (%)	P value
Etiologically relevant cause of death has been identified			
Control	3(6%)	4(8%)	1.000
Intervention	3(6%)	17 (34%)	0.000$
Sequence format for Part I of DC has been followed			
Control	2(4%)	3(6%)	1.000
Intervention	1(2%)	33(66%)	0.000$
Line A in Part I has been correctly identified			
Control	3(6%)	3(6%)	1.000
Intervention	7(14%)	34(68%)	0.000$
Only one condition per line has been identified			
Control	17(34%)	21(42%)	0.410
Intervention	21(42%)	47(94%)	0.000$
Co-morbid conditions has been identified in Part II of DC			
Control	4(8%)	6 (12%)	0.741

Intervention	5(10%)	33(66%)	0.000[$]
Did not utilize mechanistic terminal events			
Control	10(20%)	7(14%)	0.424
Intervention	9(18%)	42(84%)	0.000[$]
Did not utilize symptoms and signs			
Control	19(38%)	20(40%)	0.680
Intervention	21(42%)	48 (96%)	0.000[$]
Did not report abbreviations			
Control	45 (90%)	44(88%)	0.749
Intervention	46 (92%)	50 (100%)	0.410

[$]= statistically significant, DC= Death certificate, Fisher's Exact Test (2-sided) was used in case with the count is less than 5 per cell,

Discussions

Our study suggests that most completed DCs were not competently certified with regard to accuracy of information (MAHI parameters)[1,9] entered. We found that educational intervention which includes distribution of educational material, presentation by a skilled instructors, fictional clinical vignette, and clinical mortality/ auditing feedback sessions resulted in 34% increase in this core clinical practice among junior physicians. The usual increase in physicians' performance from similar educational interventions is between 12-15%[4-7]. The high performance in our study could be attributed to the multifaceted design. This sharp improvement in the accuracy rates could translate into better mortality data and improved quality of data for epidemiologic and legal purposes. Junior physicians are performing this practice frequently during the course of their training period. Therefore, this educational intervention served as a rare opportunity to bridge the gap in physicians' training and practice.

Previous studies have evaluated an educational intervention to improve the quality of DC[4-9]. In those studies, the rate of improvement are either insignificant, short term or have small effect size but their study methods was very different (no controls) from ours and in most cases single intervention was employed. Two studies by Lakkireddyet al[9] from USA and Myers and Farquhar[7] from Canada attempted to improve the likelihood of achieving a significant change through the using multi-prong approach which led to significant improvement of the results similar to our findings.

In our study, we used multifaceted intervention cognizant of the steps involved in skill and behavioral change and the limitation of single interventions. Our analysis used a validated scoring system[9] and our designed is both vertical (pre-post assessment) and horizontal (intervention verse control). It could be argued, therefore, that the increased accuracy rates observed were not merely as a result of time and increase experience in practice or were due to some unforeseen intervention. Reasonably, the fact that the effect size between assessments were extremely large further supporting the contribution of the intervention since the control cohort were not given any formal presentation or interventions as far as DC completion is concerned. We did not set out to compare the individual components of the intervention as it was our belief that they could not be considered as independent. For example success in the clinical auditing feedback is dependent upon the success of the case stimulation and the presentation.

Although further testing in other setting using large sample is needed, our intervention is generic, it is hoped that this may serve as a model for improving the training value of the DC completion and other residency teaching sessions.

Study limitations

Our study has several important limitations; firstly, interns rotate between clinical departments, it was not possible to ensure that the interns who were trained initially also participated in the post-intervention phase of the study as some of them could have rotated out of the department. Secondly, this was a small sampled study limited to a unit in a tertiary-based centre, increasing the size and testing this intervention in other settings will increase the precision of our results, although this might also introduce variability in the nature of the delivered intervention. Thirdly, the study design limits our capability of testing individual participant's performance and the factor(s) that influence performance. Future evaluation of this intervention could examine which factor (s) influence positive change. This in turn may help tailor future educational interventions. Lastly, we do not know how many of the physicians that participated in part or whole sessions of the intervention and physician prior training on competing DC before the intervention. We do not think that these had a major impact on the results, as the pre-intervention and control rates were similar and DC were randomly selected, thus limiting contaminants/confounders.

Conclusions

This multifaceted educational intervention is an effective tool to significantly improve junior physicians' performance in completing DC. Our findings are important given increase public health concern regarding the quality of DC which is one of the principal sources of health information and in many countries is the most reliable form of health data.

Another source of concern is the recent stipulations from the National University Commission, MDCN, and the postgraduate medical colleges on the need to implement competency-based curricula in medical education. Residency programs should consider incorporating targeted education coupled with clinical auditing feedback (morbidity and mortality meetings, and during rounds) into in-service training. The MDCN should also incorporate completion of DC as part of the houseman-ship evaluation form and the continuing medical education package for physicians.

Authors' contributions
GMA and MMG conceived the study, obtained ethical approval, co-instructs all the intervention, distributed the learning materials and drafted the manuscript. MB, AMA, IBA and HEA co-instruct all the intervention including the clinical auditing feedback and participated in the data collection and analysis. All the others read and approved the final manuscript.

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