VALIDATION STUDY OF THE MALAY VERSION OF THE 3-MINUTE DIAGNOSTIC INTERVIEW FOR CONFUSION ASSESSMENT METHOD DEFINED DELIRIUM (3D-CAM)

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ORIGINAL LITERARY WORK DECLARATION

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Name of Degree: **Master of Medicine (Anaesthesiology)**

Title of Project Paper / Research Report / Dissertation / Thesis ("this Work"):
Validation Study of The Malay Version of the 3-Minute Diagnostic Interview for Confusion Assessment Method Defined Delirium (3D-CAM).

Field of Study: Validation Study

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ABSTRACT

Background: Postoperative delirium is an increasingly recognized geriatric conundrum that complicates 12-51% of the elderly population after surgery, but it is often overlooked and under-diagnosed. The 3D-CAM tool, which was recently validated as a rapid instrument for identifying delirium, has the potential to empower relevant clinicians to diagnose postoperative delirium earlier for prompter interventions to improve patients' overall outcome. With the greying of populations across many nations, including those in the South-East Asia, this study aims to translate and validate the Malay version of the 3D-CAM for imminent research and clinical use.

Methods: The 3D-CAM was translated and culturally adapted to the Malay version in keeping with existing guidelines on translation. Subsequently, recruited post-operative elderly patients, aged 65 and above, were separately and independently assessed for delirium by two trained anaesthetic registrars using the Malay 3D-CAM tool against the reference diagnosis by a psychiatrist using the Diagnostic and Statistical Manual of Mental Disorders V (DSM-V) to test the validity and reliability of the Malay 3D-CAM.

Results: Of the 110 recruited patients, 100 patients who met the inclusion and exclusion criteria were evaluated. They had a median age of 71 years old. Our expert panel identified 10% of these patients to have postoperative delirium. The sensitivity of the Malay 3D-CAM was 80% for assessor 1 and 90% for assessor 2, while its specificity was 96.7%. The Malay 3D-CAM has a near-perfect inter-rater reliability (κ=0.85, $p<0.001$).

Conclusion: The Malay 3D-CAM demonstrated high sensitivity and specificity in identifying postoperative delirium in the elderly population compared to reference diagnosis of delirium. This translated tool could be integrated into standard of care of Malaysian post-surgical elderly patients to actively identify post-operative delirium for prompt management.

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LIST OF ABBREVIATIONS

DSM	Diagnostic and Statistical Manual of Mental Disorders
DSM-V	Diagnostic and Statistical Manual of Mental Disorders fifth edition
3D-CAM	3-Minute Diagnostic Interview for Confusion Assessment Method (CAM) defined delirium
Malay 3D-CAM	Malay version of the 3-Minute Diagnostic Interview for Confusion Assessment Method (CAM) defined delirium
κ-value	Kappa coefficient value
p-value	Probability value
POD	Postoperative Delirium

CHAPTER 1

INTRODUCTION

Delirium is a major contributor of morbidity and mortality in the hospitalized postoperative elderly patients. Early identification of delirium is essential to start necessary measures to reduce the period of delirium, hence preventing the occurrence of potentially avoidable costly complications.

Traditionally, a diagnosis of delirium is made in accordance to the Diagnostic and Statistical Manual of Mental Disorders (DSM) criteria or the International Classification of Disease (ICD) coding system. In that, more than 20 published screening tool has been used to aid with the diagnosis of delirium, especially for professionals from non-psychiatric based training.

Seeing the need to further simplify existing validated tools for easy and early recognition of delirium, the 3-minute diagnostic assessment of confusion assessment method (3D-CAM) for delirium was recently developed and subsequently validated in patients, both with and without dementia. Given that, 3D-CAM has been validated for use by clinician of non-psychiatric background within 3 minutes of test administration.

As projected, Malaysia will achieve a geriatric population of 15% by 2030, with a concomitant increase in burden on the healthcare service. The need to develop useful, validated translated version of tools to detect delirium in the South-East Asia region is ever pressing for future clinical application and research purposes in this region. Hence, this study was embarked to translate and validate the Malay version of 3D-CAM (Malay—3D CAM).

CHAPTER 2

LITERATURE REVIEW

Delirium, as defined in the Diagnostic and Statistical Manual of Mental Disorders fifth edition (DSM-5), is a neuropsychiatric disorder with an acute disturbance in attention and cognition, which are not explained by another pre-existing neurocognitive disorder (American Psychiatric, American Psychiatric, & Force, 2013). This acute onset in the mental status change can manifests clinically as distinctly hypoactive or hyperactive form and sometimes mixed psychomotor behaviours (Inouye, Westendorp, & Saczynski, 2014).

Postoperatively, the 2 distinctive form of delirium are emergence delirium (ED) and postoperative delirium (POD) (Strom & Rasmussen, 2014). Emergence delirium (ED) is a non-life threatening cognitive disorientation that happens during the shift from anaesthesia to wakefulness, with complete resolution within minutes to hours. In contrast, post-operative delirium (POD) is an acute organic brain syndrome, which most often debuts first three days postoperatively (Deiner & Silverstein, 2009), but is associated with an increase in short- and long-term morbidity and mortality rates (Moyce, Rodseth, & Biccard, 2014; Strom & Rasmussen, 2014).

Previous studies have revealed the incidence of delirium range from 10-56% of patients during hospitalisation, with higher incidence recorded in hospitalized elderly patients, palliative care, postoperative and intensive care population groups (Inouye et al., 2014). In that, delirium affected 12-51% of postoperative elderly patients (Inouye et al., 2014), with a markedly greater incidence (30-70%) in elderly patients undergoing emergency or major surgery (Strom & Rasmussen, 2014). Meta-analysis of elderly patients with delirium was associated with an increased risk of death and

institutionalization post-discharge (Cole & Primeau, 1993; Inouye et al., 2014; Siddiqi, House, & Holmes, 2006; Witlox et al., 2010), as well as hospital length of stay (Cole & Primeau, 1993; Siddiqi et al., 2006), persistent delirium symptoms and cognitive decline and dementia (Inouye et al., 2014; Siddiqi et al., 2006; Witlox et al., 2010). This is also echoed in the outcome of patients with POD, resulting in a lengthier and costlier hospital stay (Deiner & Silverstein, 2009), higher incidence of postoperative institutionalization (Deiner & Silverstein, 2009; Strom & Rasmussen, 2014), lasting cognitive decrement (Deiner & Silverstein, 2009; Inouye et al., 2014; Strom & Rasmussen, 2014), and increase in short- and long-term mortality rate (Deiner & Silverstein, 2009; Strom & Rasmussen, 2014).

Primary prevention, with an emphasis on non-pharmacological multicomponent approaches targeting risk factors, has been shown to be the most effective method in reducing delirium, including POD, and functional deterioration (Bjorkelund et al., 2010; Deiner & Silverstein, 2009; Inouye et al., 2014; Moyce et al., 2014; Zhang et al., 2013). Both meta-analyses, done separately by Moyce and Zhang, concluded that multicomponent interventions and lighter anaesthesia significantly reduced the incidence of POD (Moyce et al., 2014; Zhang et al., 2013). Zhang et al systematic review of limited quality studies even demonstrated favourable preventive role of antipsychotics comprising of haloperidol, olanzapine and risperidone. Equally vital is the early detection of postoperative delirium so that prompt measures can be taken to reduce its complications, including recognising and treating underlying medical contribution, optimization of environment and analgesics, and pharmacological treatment for recalcitrant POD (Deiner & Silverstein, 2009). These measures are important especially when pharmacological prevention and treatment has not conferred much outcome benefits in past interventional studies (Deiner & Silverstein, 2009; Inouye et al., 2014).

Although there is greater acknowledgment of the cost and repercussions of delirium in clinical setting, it is unfortunately still often overlooked and under-diagnosed, especially delirium with hypoactive behavioural change (Inouye et al., 2014; Marcantonio et al., 2014). Of greater concern is the fact that this hypoactive group of patients with delirium are those who would carry a graver prognosis (Inouye et al., 2014). Overall, it is estimated that only 12-35% of patients with delirium was properly diagnosed (Marcantonio et al., 2014). Currently, the standard diagnostic criteria of delirium are in accordance to the American Psychiatric Association published Diagnostic and Statistical Manual of Mental Disorders 5th edition (DSM 5) and WHO's International Classification of Diseases, 10th Revision (ICD-10). Unfamiliarity of the diagnostic criteria and the lack of time are frequently factors contributing to the under-diagnosis of this condition on a daily basis (Shi, Warren, Saposnik, & Macdermid, 2013).

Consequently, more than 20 published screening tools have been developed to improve practicality aspect of the early identification of delirium (De & Wand, 2015; Inouye et al., 2014; Shi et al., 2013). In that, the Confusion Assessment Method (CAM) is the most extensively used tool in recognizing delirium (De & Wand, 2015; Inouye et al., 2014). It was first conceived in 1990 by SK Inouye et al as a rapid yet formal and accurate cognitive testing equipment to detect delirium by non-psychiatric clinicians. With training, CAM as a screening tool has been validated with high sensitivity (94%), high specificity (89%) and excellent inter-rater reliability in many high-quality researches (Inouye et al., 2014). Recognising its applicability limitation to all clinical setting, CAM has been further translated into 12 languages and adapted for ICU, emergency departments and nursing homes uses (Inouye et al., 2014).

Striving to improve its practicality as a rapid instrument to pick up delirium, the 3-minute diagnostic interview for CAM (3D-CAM) has been created. Hence, its design

is aimed to be carried out briefly (as a 3-minute test) by trained personnel of non-psychiatric background (Marcantonio et al., 2014). In the initial development of 3D-CAM, the authors have originally pinpointed 36 most informative items from CAM 120 items that represented the four diagnostic features of delirium; (1) acute change and fluctuating course (2) inattention and (3) disorganized thinking or (4) altered level of consciousness. Subsequently, the finalized 3D-CAM has 22 items, which has been prospectively validated to reference standard diagnosis of delirium with high sensitivity (94%), specificity (94%) and great inter-rater agreement of 95% (Marcantonio et al., 2014). However, this study is mainly validated in patients aged above 75 years old mostly from the general medical ward of a single study site, performed during the day shift and on a single hospital day. Therefore, the authors had called for more studies in validating the performance of 3D-CAM in other areas of these clinical gaps (Marcantonio et al., 2014).

CHAPTER 3

METHODOLOGY

The validation of the Malay 3D-CAM involved a two-staged process.

The First Stage: Translation and Cultural Adaptation

The first phase involved cultural adaptation of 3D-CAM into Malay 3D-CAM according to existing guidelines on translation (Beaton, Bombardier, Guillemin, & Ferraz, 2000).

This was firstly done by 2 independent translators, who were amongst the panel of expert in the clinical field of anaesthesia, each proficient in both the English and Malay languages. After each translator forwardly translated the 3D-CAM into the Malay version, reconciliation was done to produce a draft Malay 3D-CAM. The reconciliated draft Malay 3D-CAM was then evaluated by the panel of expert before ethical approval was garnered to continue and complete this study.

After ethical approval, pre-testing was performed. In that, the draft Malay 3D-CAM was pre-tested for face validity on a pilot sample of 20 bilingual healthcare providers from different disciplines and on 5 bilingual patients above 65 years old in the anaesthetic clinic pre-operatively. Subsequently, a detailed discussion was made amongst the panel of expert to appraise the ease of understanding the instructions, the content and the wordings. Based on the feedbacks from the pre-test subjects, adjustments and refinements were made to the draft Malay 3D-CAM.

Then, the refined Malay 3D-CAM was individually back translated by the same 2 translators. Finally, the experts reconvened to compare the back translation with the original 3D-CAM. A finalized version of Malay 3D-CAM was eventually made.

The Second Stage: Testing for Validity and Reliability

The second phase involved testing the Malay 3D-CAM for validity and inter-rater reliability. This study was approved by the Medical Research and Ethics Committee, University Malaya Medical Centre (UMMC), Kuala Lumpur, Malaysia.

Patients

Patients were recruited according to the set inclusion and exclusion criteria over a three months' duration, from 26th June 2016 till 26th September 2016, at the University Malaya Medical Centre. All written informed consent was attained by the author preoperatively, either from the patients or their surrogates, along with the distribution of patient's information sheet (PIS) to the participants.

For this study, we enrolled 110 patients age of 65 and above who were undergoing surgery in the centre. Exclusion criteria were patients who were unable to communicate in the Malay language, patients who were in the intensive care unit (ICU) peri-operatively, patients whose surgery was cancelled, patients who were deaf or dumb, who had been diagnosed as delirious or has psychosis history before assessment, whose Glasgow Coma Scale (GCS) of ≤ 11/15 and those who remained comatose throughout the investigation.

All recruited patients were evaluated for delirium by 2 independent assessors using the Malay 3D-CAM, besides being impartially reviewed by a psychiatrist, in the ward within 24 hours after the surgery.

Sample Size Calculation

The sample size was calculated to be 110. This was taken by initially multiplying the number of items in the 3D-CAM for translation by a factor of 5 (Terwee et al., 2007). As there were 20 items to be translated, a product of 20 items and a factor of 5 corresponded to 100 subjects for recruitment. As a 10% dropout rate was estimated, the number of patients for enrolment was aimed at 110.

Data Analysis

All data collected was analyzed using IBM software SPSS statistics version 22 package for windows.

1) Interrater Reliability and Parallel Reliability

Post-operatively, the author and a research assistant, who were both trained in administering 3D-CAM, independently administered the Malay 3D-CAM on enrolled patients. The author administered both the Malay 3D-CAM and original English version 3D-CAM while the research assistant impartially assessed the same patients for delirium using the Malay 3D-CAM. Hence, by comparing the Malay 3D-CAM ratings between the author and the trained research assistant, interrater reliability was tested by Cohen's κ-coefficient. Whereas, parallel reliability by Cohen's κ-coefficient was evaluated by comparing ratings on the research assistant's Malay 3D-CAM with the original English 3D-CAM evaluation by the author.

2) Validation of Delirium

For standard reference assessment, an experienced psychiatrist independently evaluated delirium using the DSM V criteria. By comparing the Malay 3D-CAM ratings by administered by the trained researchers to the impartial assessment of delirium by the psychiatrist, validity of the Malay 3D-CAM was made.

3) Subgroup-Analysis: Factors associated with postoperative delirium in the geriatric population

With the intention of investigating the risk factors associated with delirium, we ran statistical analysis for participant's age, gender, race and the nature of surgery. As the participant's age was para-normally distributed, Mann-Whitney U test was conducted against delirium diagnosed in accordance with the standard reference. Conversely, chi-square test was used to assess the significance of gender, race and type of surgery. Furthermore, post hoc analysis was conducted should more than 20% of the contingency cells show expected count of <5 with a resultant statistical significance in likelihood ratio of a patient's trait.

4) Analysis of the M3D-CAM and 3D-CAM

a) Likelihood of positive response in the components of M3D-CAM

The demographic characteristics were further analysed for the likelihood of a positive response in the components of M3D-CAM tool; questions 1-21, Features 1-4 and diagnosis of delirium were studied against participant's age, gender, race and surgical field. For age, Mann-Whitney U test was utilized while chi-square testing was employed for gender, race and surgical field. Post hoc analysis would be done if indicated.

b) Components of M3D-CAM and 3D-CAM in diagnosing delirium

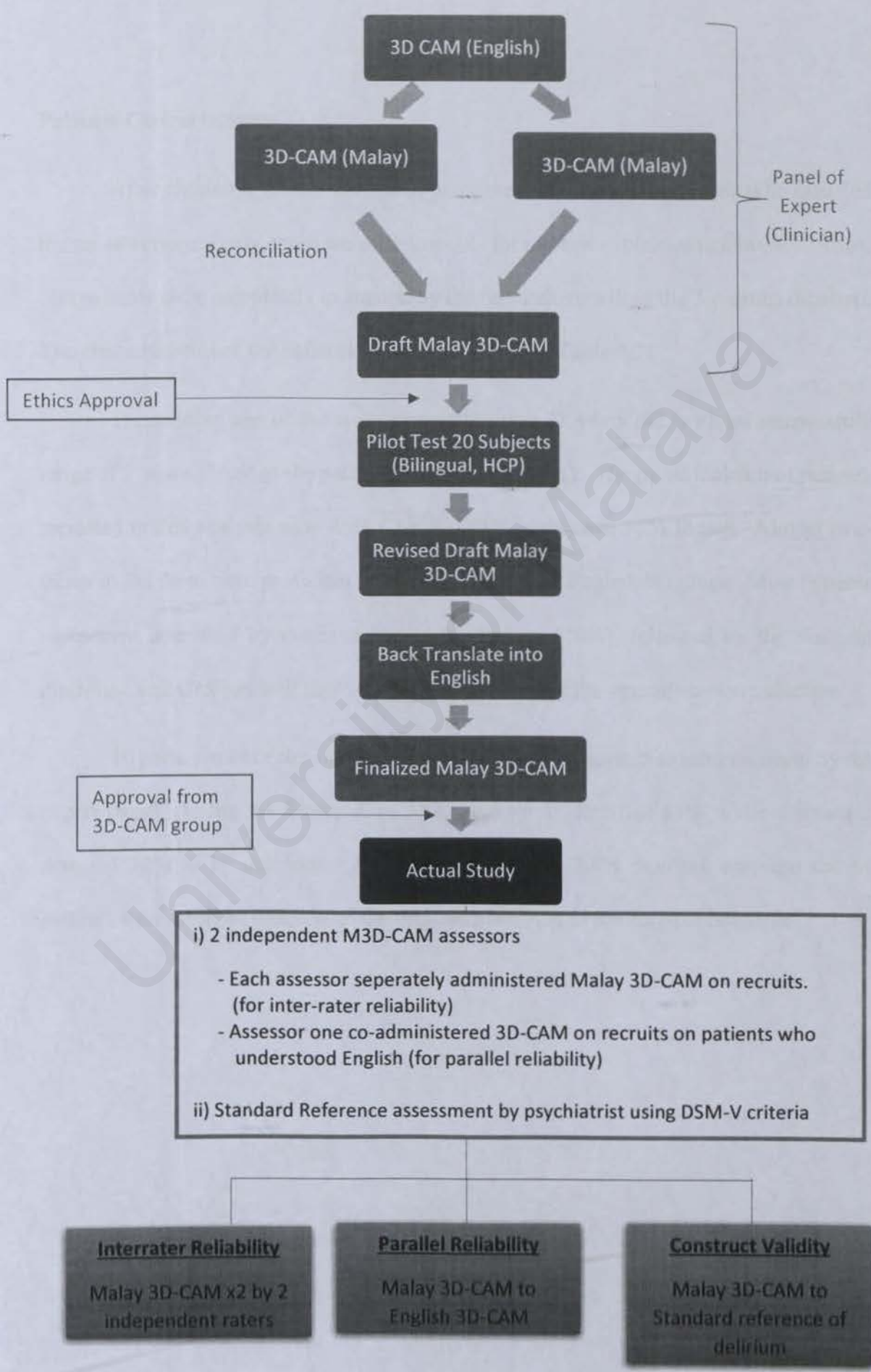
Each of the questions tested in the Malay 3D-CAM and 3D-CAM was statistically assessed against the psychiatric diagnosis of delirium to determine predictors of diagnosing delirium.

Specifically, binary logistic regression was used to analyse questions 1-21 ratings and each of the M3D-CAM delirium features 1-4 against the standard reference diagnosis of delirium. This was done for both assessor 1 and assessor 2 M3D-CAM ratings in the studied population sample.

c) M3D-CAM Diagnostic Criteria of Delirium

From the results of binary logistic regression, the different combinations of tested delirium Features 1 to 4 in the Malay 3D-CAM were made to investigate its sensitivity, specificity, positive predictive value and negative predictive value in diagnosing delirium.

Figure 1: Methodology Flow Chart



CHAPTER 4

RESULTS

Patients Characteristics

After obtaining informed consent preoperatively from 110 patients who satisfied the set selection criteria, there were 10 dropouts for reasons explained in table 4.1. Thus, 100 patients were completely evaluated by the researchers within the 3-months duration. The characteristics of the patients were summarized in Table 4.2.

The median age of the study population was 71 years old, with an interquartile range of 7 years. Most of the patients were female (58%). The racial makeup of patients recruited in this analysis were 46% Chinese, 34% Malay and 18% Indian. Almost two-thirds of the them were proficient in both the Malay and English language. Most patients underwent operation by the orthopaedic department (40%), followed by the Surgical discipline and Urology unit (20% respectively). 65% of the operations were elective.

10 patients out of the 100 analysed (10%) were diagnosed to have delirium by the expert panel. Using the Malay 3D-CAM, assessor 1 identified 11% while assessor 2 detected 12% to be delirious. Assessor 1 diagnosed 7.8% delirium amongst the 64 patients who could be tested with the original 3D-CAM in the English language.

Interrater reliability and parallel reliability of Malay 3D-CAM

Overall, the Malay 3D-CAM tool utilisation has a near perfect interrater reliability of 85% in diagnosing delirium. On evaluating reliability of individual Malay 3D-CAM features to detect delirium, feature 2 scored moderate agreement (κ-coefficient 0.53) whereas other remaining features of 1, 3 and 4 scored substantial agreement (table 4.2).

Generally, the parallel agreement between Malay 3D-CAM compared to its original version was substantial of 70%. Again, on evaluating reliability of individual 3D-CAM features to detect delirium, feature 2 showed moderate parallel agreement. However, features 1 and 3 have substantial parallel agreement of 65% and 71% respectively (table 4.3). Kappa value of feature 4 could not be determined as there were similar amongst the 64 respondents.

Validity of the Malay 3D-CAM

Sensitivity and specificity were measured by comparing the detection of postoperative delirium by each assessor using the Malay 3D-CAM to the standard reference of diagnosis by the psychiatric expert. In that, a sensitivity of 80% was achieved by assessor 1 and 90% sensitivity by assessor 2. On the other hand, specificities of 96.7% was recorded respectively for both assessor 1 and assessor 2 administering the Malay 3D-CAM in identifying delirium post-operatively (table 4.5).

Lastly, table 4.6 depicts the sensitivity of 60% and specificity of 96.6% acquired by exercising the original English 3D-CAM tool in diagnosing post-operative patient. This analysis was done in a subset of 64 participants who understood English besides the Malay language.

Table 4.1 Reasons for dropouts of enrolled patients

3 patients	Cancellation of operation
3 patients	Discharged before completion of review by all 3 researchers
2 patients	Refused to be interviewed post-operatively
2 patients	Postoperatively unplanned ICU admission

Figure 4.1: Histogram of age of patient

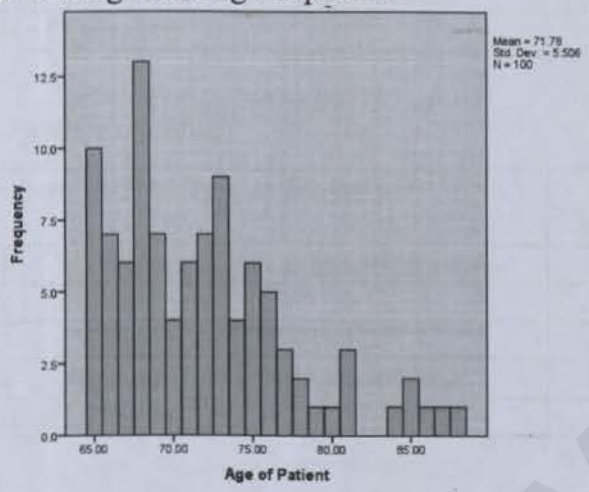


Table 4.2 Descriptive characteristics of the study population

Characteristics		Frequency (Total N = 100)
Age	Median (Interquartile Range) Range	71 (7) 65-88
Gender	Male (N) Female (N)	42 58
Race	Malay (N) Chinese (N) Indian (N) Others (N)	34 46 18 2
Language	Understood Malay & English (N)	64
Sensory Impairment	Severe sensory visual impairment (N)	1
Surgical Discipline	Orthopaedics (N) Surgery (N) Urology (N) Gynaecology (N) Others	45 20 20 8 7
Urgency of Operation	Elective (N) Semi-Emergency (N)	65 35

Table 4.3 Interrater reliability

Component of Malay 3D-CAM		N = 100	
		Kappa coefficient	*p-value*
Feature 1	Acute onset and fluctuating course	0.687	<0.001
Feature 2	Inattention	0.529	<0.001
Feature 3	Disorganized thinking	0.725	<0.001
Feature 4	Altered level of consciousness	0.662	<0.001
Diagnosis of Delirium		0.853	<0.001

Table 4.4 Parallel reliability

Component of 3D-CAM or Malay 3D-CAM		N = 64	
		Kappa coefficient	*p-value*
Feature 1	Acute onset and fluctuating course	0.646	<0.001
Feature 2	Inattention	0.446	<0.001
Feature 3	Disorganized thinking	0.714	<0.001
Feature 4	Altered level of consciousness	-	-
Diagnosis of Delirium		0.702	<0.001

Table 4.5 Landis and Koch (1977) for interpreting kappa values

Kappa statistic equivalent to chance	
0	Agreement equivalent to chance
0.10-0.20	Slight agreement
0.21-0.40	Fair agreement
0.41-0.60	Moderate agreement
0.61-0.80	Substantial agreement
0.81-0.99	Near perfect agreement
1.00	Perfect agreement

Table 4.6 Sensitivity and Specificity of Malay 3D-CAM

	N = 100	
	Assessor 1	Assessor 2
Sensitivity	80%	90%
Specificity	96.7%	96.7%
Positive Predictive Value	72.7%	75%
Negative Predictive Value	97.8%	98.9%

Table 4.7 Sensitivity and Specificity of 3D-CAM

	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value
3D-CAM (N=64)	60%	96.7%	60%	96.6%

Subgroup-Analysis: Factors associated with post-operative delirium in the elderly

Only age has demonstrated statistical significance in association with the diagnosis of delirium by standard reference, where increasing age was associated with delirium (p=0.003) (table 4.7). Consequently, other demographic attributes did not display statistical significance with delirium (table 4.8-4.10)

Analysis of the M3D-CAM and 3D-CAM

a) Likelihood of positive response in components of M3D-CAM

With assessor 1, increasing age was likely to be rated positive in all the M3D-CAM tested delirium features (features 1-4) and the M3D-CAM diagnosis of delirium. This statistically significant findings are displayed in table 4.11 ($p < 0.05$). Gender, race and surgical field has no statistical inclination to a positive response to delirium features of 1-4 and its diagnosis using M3D-CAM (table 4.14).

On the other hand, table 4.12 focused on the likelihood of positive response in M3D-CAM components rated by assessor 2. It revealed that advancing age was likely be have a positive response only in M3D-CAM features 1, 3 and 4, as well as being diagnosed delirium according to the M3D-CAM ($p < 0.05$). As with previous assessor, assessor 2 results discovered that he remaining parameters bared no significant tendency to diagnosis of delirium or its features (table 4.15 and table 4.15a)

Likewise, age was the only participants' characteristics to be statistically important in the likelihood of a positive response in 3D-CAM feature 1, 3 and diagnosis of delirium according to the tool (tables 4.13, 4.16, 4.16a and 4.16b).

Tables 4.8 Mann-Whitney U Test showing association between **age** and delirium

Delirium Present		N	Mean Rank	Sum of Ranks
Age of Patient	No	90	47.62	4285.50
	Yes	**10**	**76.45**	764.50
	Total	100		

	Age of Patient
Mann-Whitney U	190.500
Wilcoxon W	4285.500
Z	-2.990
Asymp. Sig. (2-tailed)	**.003**

Table 4.9 Chi-square test for association between **gender** and delirium

	Value	Df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.657[a]	1	.418		
Continuity Correction[b]	.223	1	.636		
Likelihood Ratio	.679	1	.410		
Fisher's Exact Test				0.513	0.324
Linear-by-Linear Association	.650	1	.420		
N of Valid Cases	100				

a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 4.20.

Table 4.10 Chi-square test for association between **race** and delirium

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.411[a]	3	0.038
Likelihood Ratio	**7.993**	**3**	**0.046**
Linear-by-Linear Association	.270	1	0.603
N of Valid Cases	100		

a. 5 cells (62.5%) have expected count less than 5. The minimum expected count is .20.

Table 4.10a Post-hoc analysis of association between race and delirium

			Delirium Present	
			No	Yes
Race of Patient	Malay	Adjusted residual	-1.1	1.1
		Adjusted p-value	0.2713	0.2713
	Chinese	Adjusted residual	2.4	-2.4
		Adjusted p-value	0.0163	0.0163
	Indian	Adjusted residual	-1.0	1.0
		Adjusted p-value	0.3173	0.3173
	Others	Adjusted residual	-1.9	1.9
		Adjusted p-value	0.0574	0.0574

Adjusted p-value is 0.006

Table 4.11 Chi-square test for association between **surgical discipline** delirium

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6.636[a]	7	.468
Likelihood Ratio	8.927	7	.258
Linear-by-Linear Association	4.594	1	.032
N of Valid Cases	100		

Mann-Whitney U Test on association between patient's age and Features 1-4 and diagnosis of delirium on M3D-CAM by both assessor 1 and assessor 2

Table 4.12 **Assessor 1**: Mann-Whitney U Test depicting association between **age** and each features of M3D-CAM

		Feature 1		Feature 2		Feature 3		Feature 4		Delirium	
		N	Mean Rank	N	Mean Rank	N	Mean Rank	N	Mean Rank	N	Mean Rank
Age of Patient	No	87	47.51	35	40.50	77	44.41	98	49.66	89	46.80
	Yes	13	70.54	65	55.88	23	70.89	2	91.50	11	80.41

	Feature 1 Age of Patient	Feature 2 Age of Patient	Feature 3 Age of Patient	Feature 4 Age of Patient	Delirium Age of Patient
Mann-Whitney U	305.000	787.500	416.500	16.000	160.500
Asymp. Sig. (2-tailed)	**0.007**	**0.011**	**0.000**	**0.043**	**0.000**

Table 4.13 **Assessor 2**: Mann-Whitney U Test depicting association between **age** and each features of M3D-CAM

		Feature 1		Feature 2		Feature 3		Feature 4		Delirium	
		N	Mean Rank	N	Mean Rank	N	Mean Rank	N	Mean Rank	N	Mean Rank
Age of Patient	No	83	46.14	46	45.51	82	45.63	99	50.07	88	47.25
	Yes	17	71.79	54	54.75	18	72.67	1	93.00	12	74.33

	Feature 1 Patient's age	Feature 2 Patient's age	Feature 3 Patient's age	Feature 4 Patient's age	Delirium Patient's age
Mann-Whitney U	343.500	1012.500	339.000	7	242.500
Asymp. Sig. (2-tailed)	**0.001**	0.111	**0.000**	**0.160**	**0.002**

Table 4.14 3D-CAM Mann-Whitney U Test depicting association between **age** and each features of 3D-CAM

		Feature 1		Feature 2		Feature 3		Feature 4		Delirium	
		N	Mean Rank	N	Mean Rank	N	Mean Rank	N	Mean Rank	N	Mean Rank
Age of Patient	No	59	30.47	30	28.08	56	30.41	64	32.50	59	30.59
	Yes	9	48.72	34	36.40	8	47.13	0	0	5	55.00

	Feature 1 Patient's age	Feature 2 Patient's age	Feature 3 Patient's age	Feature 4 Patient's age	Delirium Patient's age
Mann-Whitney U	110.500	377.500	107.000	-	35.000
Asymp. Sig. (2-tailed)	**0.007**	0.073	**0.017**	-	**0.003**

Table 4.15 Chi-Square test investigating association between each delirium features of M3D-CAM and demographic characteristics of gender, race and surgery.

Assessor 1 MED-CAM

M3D-CAM 1st Feature	Gender	Race	Surg Discipline
Pearson Chi-Square (df) Asymp. Sig (2-sided)	0.774 (1) 0.379		
Likelihood Ratio Asymp. Sig (2-sided)		1.034 (3) 0.793	11.440 (7) 0.121
M3D-CAM 2nd Feature			
Pearson Chi-Square (df) Asymp. Sig (2-sided)	0.305 (1) 0.581		
Likelihood Ratio Asymp. Sig (2-sided)		1.823 (3) 0.61	13.812 (7) 0.055
M3D-CAM 3rd Feature			
Pearson Chi-Square (df) Asymp. Sig (2-sided)	0.639 (1) 0.424		
Likelihood Ratio Asymp. Sig (2-sided)		2.560 (3) 0.464	12.765 (7) 0.078
M3D-CAM 4th Feature			
Fisher's Exact Test Exact Sig (2-sided)	- 0.508		
Likelihood Ratio Asymp. Sig (2-sided)		0.949 (3) 0.813	3.244 (7) 0.862
M3D-CAM Question 21			
Fisher's Exact Test Exact Sig (2-sided)			
Likelihood Ratio Asymp. Sig (2-sided)	0.139 (2) 0.933	8.470 (6) 0.206	16.197 (14) 0.302
M3D-CAM Delirium Diagnosis			
Fisher's Exact Test Exact Sig (2-sided)	- 0.757		
Likelihood Ratio Asymp. Sig (2-sided)		5.462 (3) 0.141	8.386 (7) 0.3

Table 4.16 Chi-Square test investigating association between each delirium features of M3D-CAM and demographic characteristics of gender, race and surgery

Assessor 2 MED-CAM

M3D-CAM 1st Feature	Gender	Race	Surg Discipline
Pearson Chi-Square (df) Asymp. Sig (2-sided)	1.332 (1) 0.248		
Likelihood Ratio Asymp. Sig (2-sided)		6.508 (3) 0.089	**16.048 (7)** **0.025***
M3D-CAM 2nd Feature			
Pearson Chi-Square (df) Asymp. Sig (2-sided)	1.187 (1) 0.276		
Likelihood Ratio Asymp. Sig (2-sided)		1.151 (3) 0.679	5.993 (7) 0.541
M3D-CAM 3rd Feature			
Pearson Chi-Square (df) Asymp. Sig (2-sided)	0.677 (1) 0.411		
Likelihood Ratio Asymp. Sig (2-sided)		5.162 (3) 0.16	14.355 (7) 0.045
M3D-CAM 4th Feature			
Fisher's Exact Test Exact Sig (2-sided)	- 1		
Likelihood Ratio Asymp. Sig (2-sided)		2.177(3) 0.536	1.609 (7) 0.978
M3D-CAM Question 21			
Fisher's Exact Test Exact Sig (2-sided)	- 1		
Likelihood Ratio Asymp. Sig (2-sided)		0.776 (3) 0.855	5.900 (7) 0.552
M3D-CAM Delirium Diagnosis			
Pearson Chi-Square (df) Asymp. Sig (2-sided)	0.420 (1) 0.517		
Likelihood Ratio Asymp. Sig (2-sided)		7.266 (3) 0.064	11.743 (7) 0.109

Table 4.16a: *Post hoc analysis for M3D-CAM feature 1 rated by assessor 2 association with surgical discipline

	Adjusted p-value
Plastic	0.5485
Urology	0.7641
ENT	0.4237
Surgery	0.0214
Ophthalmology	0.2781
Orthopaedics	0.0214
Gynaecology	0.6891
Neurosurgery	0.6170

Adjusted p-value taken as <0.003

Table 4.17 Chi-Square test investigating association between each delirium features of M3D-CAM and demographic characteristics of gender, race and surgery

3D CAM

3D-CAM 1st Feature	Gender	Race	Surg Discipline
Fisher's Exact Test Exact Sig (2-sided)	- 0.721		
Likelihood Ratio Asymp. Sig (2-sided)		1.440 (3) 0.696	9.207 (6) 0.162
3D-CAM 2nd Feature			
Pearson Chi-Square (df) Asymp. Sig (2-sided)	0.323 (1) 0.57		
Likelihood Ratio Asymp. Sig (2-sided)		4.123 (3) 0.249	8.003 (6) 0.238
3D-CAM 3rd Feature			
Fisher's Exact Test Exact Sig (2-sided)	- 1		
Likelihood Ratio Asymp. Sig (2-sided)		**12.181 (3)** **0.007****	5.710 (6) 0.456
3D-CAM 4th Feature			
Fisher's Exact Test Exact Sig (2-sided)	- -		
Likelihood Ratio Asymp. Sig (2-sided)		- -	- -
3D-CAM Question 21			
Fisher's Exact Test Exact Sig (2-sided)			
Likelihood Ratio Asymp. Sig (2-sided)	0.067 (2) 0.967	9.666 (6) 0.139	4.170 (12) 0.98
3D-CAM Delirium Diagnosis			
Fisher's Exact Test Exact Sig (2-sided)	- 1		
Likelihood Ratio Asymp. Sig (2-sided)		**7.950 (3)** **0.047*****	5.044 (6) 0.538

Table 4.17a: **Post hoc analysis for M3D-CAM delirium feature 3 rated by assessor 2 association with race

	Adjusted p-value
Malay	0.7641
Chinese	0.0069
Indian	0.0278
Others	0.1095

Adjusted p-value is taken as < 0.006

Table 4.17b ***Post hoc analysis for M3D-CAM diagnosis of delirium by assessor 2 association with race

	Adjusted p-value
Malay	0.6891
Chinese	0.0357
Indian	0.2713
Others	0.0214

Adjusted p-value is taken as < 0.006

b) Components of M3D-CAM in diagnosing delirium

Of the 4 features of delirium tested in the M3D-CAM, only feature 3 (disorganized thinking) indicated a statistical significance in predicting the diagnosis of delirium by psychiatrist as standard reference. This outcome was reflected in both assessor 1 (p=0.004) and assessor 2 (p=0.048) in tables 4.17d and 4.18d respectively. This was further echoed in 2 questions (questions 1 and 15) as significant predictors of standard diagnosis of delirium (p=0.016 and p=0.019 respectively). Table 4.18a and 4.18b presented this in assessor 2, but not duplicated in assessor 1 statistical analysis.

Although feature 1 was not statistically significant as a predictor of a formal diagnosis of delirium, its components of question 21, which was statically important in assessor 1 (p=0.032 in table 4.17c), and question 9 in assessor 2 (p=0.018 in table 4.18a) were.

c) M3D-CAM Diagnostic Criteria of Delirium

From the results of binary logistic regression as explained above, feature 3 directly predicted the diagnosis of delirium while feature 1 indirectly predicted the proper diagnosis of delirium from questions 9 and 21. Hence, different combinations of M3D-CAM features, focusing on features 1 and 3, were made to investigate their sensitivity, specificity, positive predictive value and negative predictive value in diagnosing delirium.

For assessor 1, table 4.19a firstly displayed the sensitivity, specificity, positive and negative predictor value for its current diagnostic criteria of delirium using the presence of feature 1 and 2 with either 3 or 4. In the combination focusing on features 1 and 3, the presence of features 1 and 3 with either 2 or 4 depicted same values as current diagnostic criteria (80%, 96.7%, 72% and 97.7% respectively). Other combinations of features as diagnostic criteria of delirium accomplished lower values.

Similarly, for assessor 2, table 4.19b unearthed results of parallel nature. Focusing on features 1 and 3 in a proposed new diagnostic criterion, the presence of features 1 and 3 with either 2 or 4 did not yield better outcomes than the current diagnostic criteria of delirium. Their sensitivity, specificity, positive and negative predictive values were the same of 90%, 96.6%, 75% and 98.8% respectively. The remaining various combinations of M3D-CAM delirium features fared worse in those measured performances.

Table 4.18a Binary logistic regression of M3D-CAM interview questions 1-10 by Assessor 1

	B	S.E.	Wald	df	Sig.
M3DCAM Question 1	.391	.244	2.569	1	0.109
M3DCAM Question 2	-.080	.770	.011	1	0.917
M3DCAM Question 3	170.691	18506.975	.000	1	0.993
M3DCAM Question 4	-.060	1.509	.002	1	0.968
M3DCAM Question 5	.230	.426	.291	1	0.589
M3DCAM Question 6	-.153	.401	.145	1	0.703
M3DCAM Question 7	.119	.134	.783	1	0.376
M3DCAM Question 8	28.713	6682.181	.000	1	0.997
M3DCAM Question 9	-11.786	1907.775	.000	1	0.995
M3DCAM Question 10	-40.548	6962.461	.000	1	0.995
Constant	-150.839	15898.310	.000	1	0.992

Table 4.18b Binary logistic regression of M3D-CAM observational questions 11-20 by Assessor 1

	B	S.E.	Wald	df	Sig.
M3DCAM Question 11a	55.157	38947.382	.000	1	0.999
M3DCAM Question 13	21.140	22486.283	.000	1	0.999
M3DCAM Question 14	-18.170	40192.991	.000	1	1.000
M3DCAM Question 15	1.934	1.263	2.344	1	0.126
M3DCAM Question 16	21.140	22486.293	.000	1	0.999
M3DCAM Question 17	-59.415	61127.694	.000	1	0.999
M3DCAM Question 18	-17.009	22486.283	.000	1	0.999
M3DCAM Question 19	21.266	61127.736	.000	1	1.000
M3DCAM Question 20	-18.170	40192.991	.000	1	1.000
Constant	-10.906	65132.330	.000	1	1.000

Table 4.18c Binary logistic regression of M3D-CAM collateral history by Assessor 1

	B	S.E.	Wald	df	Sig.
M3DCAM Question 21	**-.206**	**.096**	**4.596**	**1**	**0.032**
Constant	-.683	.724	.888	1	0.346

Table 4.18d Binary logistic regression of M3D-CAM Features 1-4 rated by Assessor 1

	B	S.E.	Wald	df	Sig.	Exp(B)
M3DCAM Feature 1	.759	.965	.619	1	0.431	2.137
M3DCAM Feature 2	-1.253	1.299	.931	1	0.335	.286
M3DCAM Feature 3	**4.078**	**1.400**	**8.487**	**1**	**0.004**	**59.045**
M3DCAM Feature 4	21.503	28420.721	.000	1	0.999	2181405335.982
Constant	-3.885	1.084	12.847	1	0.000	.021

Table 4.19a Binary logistic regression of M3D-CAM interview questions 1-10 by Assessor 2

	B	S.E.	Wald	df	Sig.
M3DCAM Question 1	**.668**	**.277**	**5.818**	**1**	**0.016**
M3DCAM Question 2	-.174	.838	.043	1	0.836
M3DCAM Question 3	21.820	8303.966	.000	1	0.998
M3DCAM Question 4	-.044	.832	.003	1	0.958
M3DCAM Question 5	.363	.588	.382	1	0.536
M3DCAM Question 6	-.001	.358	.000	1	0.997
M3DCAM Question 7	.232	.194	1.418	1	0.234
M3DCAM Question 8	1.166	3.022	.149	1	0.700
M3DCAM Question 9	**4.107**	**1.735**	**5.601**	**1**	**0.018**
M3DCAM Question 10	-1.060	3.469	.093	1	0.760
Constant	-32.318	8303.963	.000	1	0.997

Table 4.19b Binary logistic regression of M3D-CAM observational questions 11-20 by Assessor 2

	B	S.E.	Wald	df	Sig.
M3DCAM Question 11a	-2.381	44910.499	.000	1	1.000
M3DCAM Question 12	-2.381	44910.499	.000	1	1.000
M3DCAM Question 13	58.008	27604.362	.000	1	0.998
M3DCAM Question 14	-15.483	14832.019	.000	1	0.999
M3DCAM Question 15	**3.726**	**1.585**	**5.526**	**1**	**0.019**
M3DCAM Question 16	-34.425	34109.812	.000	1	0.999
M3DCAM Question 17	-17.477	40192.948	.000	1	1.000
M3DCAM Question 19	14.835	29007.862	.000	1	1.000
M3DCAM Question 20	-74.414	36270.401	.000	1	0.998
Constant	66.267	86878.630	.000	1	0.999

Table 4.19c Binary logistic regression of M3D-CAM collateral history by Assessor 2

	B	S.E.	Wald	df	Sig.
M3DCAM Question 21	2.383	2246.864	.000	1	0.999
Constant	-23.586	20221.778	.000	1	0.999

Table 4.19d Binary logistic regression of Features 1-4 rated by Assessor 2

Assessor 2	B	S.E.	Wald	df	Sig.	Exp(B)
M3DCAM Feature 1	3.200	1.295	6.105	1	.013	24.530
M3DCAM Feature 2	-1.116	1.886	.350	1	.554	.328
M3DCAM Feature 3	**3.509**	**1.778**	**3.893**	**1**	**.048**	**33.402**
M3DCAM Feature 4	20.479	40192.969	.000	1	1.000	783301111.741
Constant	-4.869	1.267	14.779	1	.000	.008

Table 4.20a Sensitivity, specificity, positive predictive value and negative predictive value of different diagnostic criteria of M3D-CAM as measured by assessor 1

	M3D-CAM			
	Assessor 1		Assessor 1	
	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value
Original Presence of Features 1+2 + 3 or 4	80%	96.7%	72.7%	97.8%
Presence of Features 1 + 2	40%	94.4%	44%	93.40%
Presence of Features 1+2+3+4	100%	91.8%	100%	92%
Presence of Features 1+3 Only	50%	96.7%	62.5%	96.7%
Presence of Features 1+3+ 2 or 4	80%	96.7%	72%	97.7%

Table 4.20b Sensitivity, specificity, positive predictive value and negative predictive value of different diagnostic criteria of M3D-CAM as measured by assessor 2

	M3D-CAM			
	Assessor 2		Assessor 2	
	Sensitivity	Sensitivity	Positive Predictive Value	Negative Predictive Value
Original Presence of Features 1+2 + 3 or 4	90%	96.6%	75%	98.9%
Presence of Features 1 + 2	90%	94.4%	64.2%	98.8%
Presence of Features 1+2+3+4	10%	100%	100%	90.9%
Presence of Features 1+3 Only	90%	96.7%	75%	97.7%
Presence of Features 1+3+ 2 or 4	90%	96.6%	75%	98.8%

Table 4.20c Sensitivity, specificity, positive predictive value and negative predictive value of different diagnostic criteria of 3D-CAM as measured by assessor 1

	3D-CAM			
	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value
Original Presence of Features 1 + 2 + 3 or 4	60%	96.7%	60%	96.6%
Presence of Features 1 + 2	16.7%	93.1%	16.6%	98.8%
Presence of Features 1+2+3+4	-	-	-	-
Presence of Features 1+3 Only	40%	94.9%	40%	95%
Presence of Features 1+3+ 2 or 4	60%	96.6%	60%	96.6%

Chapter 5

DISCUSSION

In this study, our expert panel identified 10% of the elderly surgical patients to be suffering from postoperative delirium. The Malay 3D-CAM diagnostic tool demonstrated excellent inter-rater reliability and a high sensitivity and specificity in diagnosing postoperative delirium in relation to the standard diagnostic reference. In that, the sensitivity of the Malay 3D-CAM was 80% for assessor 1 and 90% for assessor 2, while its specificity was 96.7%. Cohen's kappa-value of 0.85 indicated a near-perfect inter-rater reliability for the Malay 3D-CAM test.

Till date, there are no published Malaysian data on the prevalence or incidence of postoperative delirium (POD). Consequently, our study elucidated a 10% incidence of postoperative delirium amongst the Malaysian elderly population from a mix non-cardiac surgical cohorts of orthopaedics, surgery, urology and gynaecology fields. This was echoed in a 9% delirium incidence reported in a prospective study of 1341 patients aged above 50, who underwent major elective non-cardiac operation (Francis, Martin, & Kapoor, 1990). Other studies reported a higher incidence of POD (Demeure & Fain, 2006), including a recent systematic review on the incidence and outcome of delirium, which concluded that delirium affected 13-51% non-cardiac surgical elderly patients postoperatively (Inouye et al., 2014). Plausible explanations of a relative lower POD incidence in our study included the exclusion of perioperative ICU patients and patients who underwent emergency operations. Both groups of patients have consistently shown to result in higher POD rates (Inouye et al., 2014; Strom & Rasmussen, 2014).

Subgroup analysis of our demographic data revealed that increasing age of the elderly population was significantly associated with development of postoperative delirium. This finding has been mirrored in other studies, where aged above 75 has

displayed higher POD risk (Deiner & Silverstein, 2009; Gherghina et al., 2011). Conversely, we found no statistical significance between POD and other demographic parameters of race, gender and surgical discipline. Our results should be taken with care because with a 10% post-operative delirium incidence, a 100-patients sample size is underpowered to detect statistical significance. Nevertheless, these parameters were also not widely recognized as risk factors for POD. Among other risk factors associated with POD include greater co-morbidity and severe illness, preoperative cognitive impairment and psychopathological symptoms as well as preoperative use of opioids and benzodiazepines (Amador & Goodwin, 2005; Deiner & Silverstein, 2009; Gherghina et al., 2011).

Besides attempting to shed light into post-operative delirium (POD) in our population, the prime purpose of this study and analysis was to translate a validated, brief screening tool for identifying delirium —the 3D-CAM— into the Malay language and prospectively test its validity and reliability on post-operative patients.

The gold standard of diagnosing delirium is in concordance to the DSM criteria, which listed 5 criteria for diagnosing delirium in the DSM 5 (appendix 1). This required clinical training and time, two commodities which were short in clinicians principally caring for the post-operative patients. In contrast to other validated screening tools in identifying delirium, the validated 3D-CAM edged in encasing test items more reflective of the DSM-V criteria and its brevity of administration, taking between 2-5 minutes on average (Marcantonio et al., 2014). The 3D-CAM consisted 20 most informative and statistically weighted items to represent one of the 4 main features to identify delirium (appendage 2). Like its original version, the Malay 3D-CAM (appendage 3) first 10 items were based directly on patient's response while the subsequent 10 were rated based on observation on patients' behaviour. Subsequently, the main Features of 1-4 would be

coded present or absent to cumulatively diagnose delirium should features 1 and 2 with either features 3 or 4 were present.

The sensitivity for Malay 3D-CAM (M3D-CAM) was 80% for assessor 1 and 90% for assessor 2 while the specificity was 96.7% for both raters. The inter-observer reliability was 85.3%. This is comparable to the original study by Marcantonio, where the designed 3D-CAM demonstrated a sensitivity of 93% and specificity of 96%, as well as 95% inter-rater agreement, in diagnosing delirium from 201 medical patients aged at and above 75 years-old (Marcantonio et al., 2014). In contrast, although parallel reliability between 3D-CAM and M3D-CAM was substantial (κ-value 0.71), the use of 3D-CAM to detect delirium in our population obtained a sensitivity of 60% and specificity of 96.7%. Language barrier and cultural understanding might be the impedance to the optimal use of 3D-CAM in our population. 36% of our study elderly population did not understand English to be concurrently administered the 3D-CAM test. Conversely, 3D-CAM use still conferred high specificity and sound negative predictive value.

Upon dissecting the 20 individual items and the 4 main features of the M3D-CAM, only Feature-3 and four items, which corresponded to the presence of Features-1 and -3, were statically predictive of delirium diagnosed by psychiatrist. Hence, the detection of delirium using M3D-CAM would require a combination of features. Various combinations of these features were analysed and the original diagnostic criteria of delirium by the 3D-CAM held the highest yield of sensitivity and specificity. Therefore, presence in Features-1 and -2 with Feature-3 or Feature-4 was necessary to diagnose delirium. Besides age, other demographic characteristics were not associated with a positive answer in the main features of M3D-CAM.

We have several limitations to this study. Firstly, the sample size of this study was small, given the incidence of POD was 10%. This drawback affected the power of the study. Thus, the results on subgroup analysis of demographic data and the statistical examination of the M3D-CAM component breakdown should be inferred with caution. Another limitation is that majority of the sampled population underwent elective surgeries and semi-emergency operations. All of whom were deemed optimized for surgical intervention and fit to be discharged to the general ward, therefore representing the group of fitter surgical patients. Hence, future studies on M3D-CAM would be needed for patients undergoing emergency surgeries, medical patients and patients nursed in high-dependency or intensive care units. In addition, as the primary aim of this study is to test the M3D-CAM tool, delirium was not studied in detailed. Lastly, follow-up study on these patients would be needed for criterion validity of clinical outcomes.

CHAPTER 6
CONCLUSION

Despite being a neuropsychiatric disorder in origin, post-operative delirium (POD) de facto signals physiological or biochemical disturbances with potential devastating sequelae. Regrettably, it is not actively unearthed in the geriatric population after surgery. The Malay 3D-CAM (M3D-CAM) is a reliable, sensitive and specific screening tool for clinicians of non-psychiatric background to promptly detect POD. Coupled with the ease and brevity of its use, it is hoped that the M3D-CAM could be seamlessly incorporated into daily clinical practice for earlier POD detection aiming at timelier management. It is worthy for future studies to examine the clinical outcome of POD in our population and evaluate the effectiveness of M3D-CAM as a standard screening tool to actively diagnose POD for immediate treatment.

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APPENDIX

Appendix 1: DSM-V Diagnostic Criteria for Delirium

Diagnostic Criteria

A. A disturbance in attention (i.e., reduced ability to direct, focus, sustain, and shift attention) and awareness (reduced orientation to the environment).

B. The disturbance develops over a short period of time (usually hours to a few days), represents a change from baseline attention and awareness, and tends to fluctuate in severity during the course of a day.

C. An additional disturbance in cognition (e.g., memory deficit, disorientation, language, visuospatial ability, or perception).

D. The disturbances in Criteria A and C are not better explained by another preexisting, established, or evolving neurocognitive disorder and do not occur in the context of a severely reduced level of arousal, such as coma.

E. There is evidence from the history, physical examination, or laboratory findings that the disturbance is a direct physiological consequence of another medical condition, substance intoxication or withdrawal (i.e., due to a drug of abuse or to a medication), or exposure to a toxin, or is due to multiple etiologies.

Appendix 2: 3D-CAM

3D-CAM Instrument

For Research : Version 3.0

Evaluator:

Date:

Patient:

Time:

COGNITIVE FUNCTION

Now I'd like to ask you some questions to check your memory. Don't worry if you don't know the answers.

[YOU MAY REPEAT EACH QUESTION ONCE]

(WRITE PATIENT'S ANSWERS TO ALL QUESTIONS AND CIRCLE NUMBER AS INDICATED)

ORIENTATION	CORRECT	ERROR	REF	DK/No Response
1. **What is the year?** _____	1	2	7	8
2. **What is the day of the week?** _____	1	2	7	8
3. **What type of place is this?** _____	1	2	7	8

If any of 3 items above are anything other than correct, feature 3 is present

DIGIT SPAN

[SAY DIGITS AT RATE OF ONE PER SECOND]

Now I am going to read some numbers, but I want you to repeat them in backwards order from the way I read them to you. So for example if I said 6-4, you would say 4-6.

DIGITS BACKWARD		Response	Correct	Error	REF	DK/No Response
4.	7 - 5 - 1	___ - ___ - ___	1	2	7	8
5.	8 - 2 - 4 - 3	___ - ___ - ___ - ___	1	2	7	8

6. DAYS OF WEEK BACKWARDS

Can you tell me the days of the week backwards? Say Saturday as your first day.

(May prompt with: "what is the day before Saturday? or if subject stops with Day X, say " what is the day before day X? ...." This prompt may be used 2 times in total. If participant starts reciting days forward repeat overall instructions.

Day	Response	Correct	Error	REF	DK/No Response
Saturday	_____	1	2	7	8
Friday	_____	1	2	7	8
Thursday	_____	1	2	7	8
Wednesday	_____	1	2	7	8
Tuesday	_____	1	2	7	8
Monday	_____	1	2	7	8
Sunday	_____	1	2	7	8

Record response verbatim

Coding Instructions: If the subject leaves 1 day out, total recorded = 6, if 2 days are reversed, total recorded =5

7. MONTHS OF YEAR BACKWARDS

Can you tell me the months of the year backwards? Say December as your first month?

(May prompt with: "what is the month before December? or if the subject stops with Month X, " say what is the month before Month X? ...." This prompt may be used 2 times in total. If participant starts reciting months forward repeat overall instructions)

Month	Response	Correct	Error	REF	DK/No Response
December	_____	1	2	7	8
November	_____	1	2	7	8
October	_____	1	2	7	8
September	_____	1	2	7	8
August	_____	1	2	7	8
July	_____	1	2	7	8
June	_____	1	2	7	8
May	_____	1	2	7	8
April	_____	1	2	7	8
March	_____	1	2	7	8
February	_____	1	2	7	8
January	_____	1	2	7	8

Record response verbatim.

Coding Instructions: If the subject leaves one month out, total recorded = 11, if the months are reversed, total recorded = 10

If any of items 4, 5, 6, or 7 above are anything other than correct, feature 2 is present

PATIENT-REPORTED SYMPTOMS:

If the respondent answers yes to any of the following questions, probe him/her for more details and note responses. E.g. Frequency

If the respondent's answers are nonsensical, code as 8.

Now I am going to ask you some questions about how you have been thinking during the past day.

8. **Have you felt confused at any time during the past day?** *About basic info (i.e. orientation, reason for hospitalization) not details of medical condition/treatment.*

   1 - No 2 – Yes 7 - REF 8 – DK/Uncertain/NR 9 – NA

9. **During the past day did you think that you were not really here [in the hospital]?**

   1 - No 2 – Yes 7 - REF 8 – DK/Uncertain/NR 9 – NA

10. **During the past day, did you see things that were not really there?** (If patient is blind skip and code 9)

    1 - No 2 – Yes 7 - REF 8 -DK/Uncertain/NR 9 – NA

If any of items 8, 9, or 10 above are anything other than 'no', feature 1 is present

End of Patient Interview

Thank you so much for your time.

Proceed to area for completion of interview observation items and final coding.

Used with permission. The SAGES Study: Training Manual and Questionnaires; 2010; Boston, Aging Brain Center.

OBSERVATIONS	FEATURE 4 IS PRESENT?
11A. Was the patient sleepy during the interview? (requires that they actually fall asleep, but is easy to arouse)	1 – No 2 - Yes
11B. Was the patient stuporous or comatose during the interview? (Difficult to impossible to arouse.)	FEATURE 4 IS PRESENT? 1 – No 2 - Yes
12. Did the patient show hypervigilance such as excessively strong responses to ordinary objects/stimuli in the environment, being inappropriately startled, etc.?	FEATURE 4 IS PRESENT? 1 – No 2 - Yes
13. Was the patient's Flow of ideas unclear or illogical, for example saying something non-sensical, unrelated to the interview (tangential) or making contradictory statements	FEATURE 3 IS PRESENT? 1 – No 2 - Yes
14. Conversation rambling, for example did he/she give inappropriately verbose and off target responses?	FEATURE 3 IS PRESENT? 1 – No 2 - Yes
15. Was the patient's speech unusually limited or sparse? (e.g. yes/no answers) or unusually slow or halting?	FEATURE 3 IS PRESENT? 1 – No 2 - Yes
16. Did the patient have trouble keeping track of what was being said during the interview, for example, fail to follow instructions or answer questions one at a time?	FEATURE 2 IS PRESENT? 1 – No 2 - Yes
17. Did the patient fail to attend to the interview due to being inappropriately distracted by environmental stimuli, for example, respond to questions asked of roommate?	FEATURE 2 IS PRESENT? 1 – No 2 - Yes
18. Did the patient's level of consciousness fluctuate during the interview, for example, start to respond appropriately and then drift off?	FEATURE 1 IS PRESENT? 1 – No 2 - Yes
19. Did the patient's level of attention fluctuate during the interview, e.g., did the patient's focus on the interview or performance on the attention tasks (digit span, days & months backwards) vary significantly?	FEATURE 1 IS PRESENT? 1 – No 2 - Yes
20. Did the patient's speech/thinking fluctuate during the interview, for example, patient spoke slowly for a while, then sped up?	FEATURE 1 IS PRESENT? 1 – No 2 - Yes

CAM Summary – FEATURES 1-4

Coding for features 1 -4 (0)NO (1)YES	
_____	1. Acute Onset and Fluctuating Course - Code 'Yes' if any of the items 8, 9, 10, 18,19 and 20 are incorrect/present
_____	2. Inattention - Code 'Yes' if any of the items 4,5,6,7, 16 and 17 are incorrect/present
_____	3. Disorganized Thinking - Code 'Yes' if any of the items 1, 2, 3, 13, 14 and 15 are incorrect/present
_____	4. Altered Level of Consciousness - Code 'Yes' if any of the items 11 and 12 are present

COMPLETE ONLY IF FEATURE 1 IS NOT PRESENT AND FEATURE 2 AND EITHER FEATURE 3 OR 4 IS PRESENT

21. IF IT IS THE FIRST DAY OF HOSPITALIZATION OR NO PREVIOUS 3D-CAM RATINGS ARE AVAILABLE: **Consult the medical record or contact a family member, friend, or health care provider who knows the patient well to find out if the patient is experiencing an acute change. "Is the patient experiencing an acute change in their memory or thinking?"**	FEATURE 1 IS PRESENT? 1 – No 2 – Yes 9 – Skip
22. IF SECOND DAY OF HOSPITALIZATION OR LATER AND PREVIOUS 3D-CAM RATINGS ARE AVAILABLE: Review previous 3D-CAM assessments and determine if there has been an acute change in performance, based on ANY new "positive" items	FEATURE 1 IS PRESENT? 1 – No 2 – Yes 9 – Skip

The diagnosis of delirium by CAM requires the presence of features 1 AND 2 AND either 3 or 4.

____ **5. Delirium present? (0) No (1) Yes**

Appendix 3: Malay 3D-CAM

Instrumen 3D-CAM

Untuk Tujuan Penyelidikan: Versi 3.0

Nama Penilai:

Tarikh:

Nama Pesakit:

Masa:

FUNGSI KOGNITIF

Sekarang, saya ingin tanya anda beberapa soalan untuk menguji daya ingatan anda. Jangan risau jika anda tidak tahu jawapannya.

[ANDA BOLEH MENGULANGI SETIAP SOALAN SEKALI]

[TULIS JAWAPAN PESAKIT KEPADA SEMUA SOALAN DAN BULATKAN NOMBOR YANG BERKENAAN]

ORIENTASI TAHU TIADA JAWAPAN	BETUL	SALAH	ENGGAN MENJAWAB	TIDAK
1. **Tahun apakah tahun ini?** _____	1	2	7	8
2. **Hari apakah hari ini di dalam minggu ini?** _____	1	2	7	8
3. **Di manakah tempat ini?** _____	1	2	7	8

***Jika mana-mana 3 jawapan di atas adalah selain daripada betul, ciri-ciri ke-3 wujud*

RANGKAIAN ANGKA

[SEBUTKAN ANGKA PADA KADAR SATU ANGKA DALAM SATU SAAT]

Sekarang, saya akan bacakan beberapa nombor, tetapi saya mahu anda mengulangi nombor tersebut dalam urutan ke belakang dari apa yang saya sebutkan kepada anda. Sebagai contoh, jika saya bacakan angka 6 – 4, kamu harus ulanginya sebagai 4–6.

ANGKA UNTUK Tahu/ Menjawab	Jawapan URUTAN KE BELAKANG Tiada Jawapan	Betul	Salah	Enggan	Tidak
4. 7 – 5 – 1	____--____--____	1	2	7	8
5. 8 – 2 – 4 – 3	____--____--____--____	1	2	7	8

6. HARI DALAM SEMINGGU MENGIKUT URUTAN KE BELAKANG

Bolehkah anda sebutkan hari-hari dalam seminggu dalam urutan ke belakang? Gunakan hari Sabtu sebagai hari yang pertama.

(Boleh membantu dengan: "Apakah hari sebelum hari Sabtu?" atau jika subjek terhenti dengan Hari X, boleh membantu dengan "Apakah hari sebelum hari X? ...."

Bantuan begini boleh digunakan sebanyak 2 kali. Jika subjek mula menyebut hari-hari dalam urutan ke hadapan, ulang keseluruhan arahan semula.

Hari / Tiada Jawapan	Jawapan	Betul	Salah	Enggan	Tidak Tahu Menjawab
Sabtu	_____	1	2	7	8
Jumaat	_____	1	2	7	8
Khamis	_____	1	2	7	8
Rabu	_____	1	2	7	8
Selasa	_____	1	2	7	8
Isnin	_____	1	2	7	8
Ahad	_____	1	2	7	8
	Salin jawapan kata demi kata				

Arahan kod: Jika subjek meninggalkan 1 hari, jumlah direkodkan = 6, jika 2

hari adalah terbalik, jumlah direkodkan = 5

7. BULAN DALAM SETAHUN SECARA URUTAN KE BELAKANG

Bolehkah anda sebutkan bulan-bulan dalam setahun secara urutan ke belakang? Katakan bulan Disember sebagai bulan pertama anda.

(Boleh membantu dengan: "Apakah bulan sebelum Disember? Atau jika subjek terhenti dengan Bulan X, boleh membantu dengan "Apakah bulan sebelum bulan X?"

Bantuan begini boleh digunakan sebanyak 2 kali. Jika subjek mula menyebut hari-hari dalam urutan ke hadapan, ulang keseluruhan arahan semula.)

Bulan / Tiada Jawapan	Jawapan	Betul	Salah	Enggan	Tidak Tahu Menjawab
Disember	_____	1	2	7	8
November	_____	1	2	7	8
Oktober	_____	1	2	7	8
September	_____	1	2	7	8
Ogos	_____	1	2	7	8
Julai	_____	1	2	7	8
Jun	_____	1	2	7	8
Mei	_____	1	2	7	8
April	_____	1	2	7	8
Mac	_____	1	2	7	8
Februari	_____	1	2	7	8
Januari	_____ *Salin jawapan kata demi kata.*	1	2	7	8

Arahan kod: *Jika subjek meninggalkan satu bulan, jumlah yang direkodkan = 11, jika bulan adalah terbalik, jumlah yang direkodkan = 10.*

Jika mana-mana perkara 4, 5, 6 atau 7 di atas adalah selain daripada betul, ciri-ciri ke-2 wujud.

LAPORAN SIMPTOM OLEH PESAKIT

Jika responden menjawab 'ya' untuk mana-mana soalan di bawah, soal beliau untuk mendapatkan butir-butiran yang lebih teliti dan ambil perhatian tentang jawapannya. Contohnya: kekerapan.

Jika jawapan responden tidak munasabah, kod adalah 8.

Sekarang, saya akan tanya anda beberapa soalan tentang pemikiran anda pada beberapa hari yang lepas.

8. **Pernahkah anda merasa keliru pada bila-bila masa pada hari yang lepas?**
   Tentang maklumat biasa (seperti orientasi, sebab kenapa dalam hospital) tetapi bukan butir-butir tentang kesakitan/ rawatan.

   1 – Tidak **2** – Ya **7** – Tidak Menjawab **8** – Tak tahu/Tak pasti/Tiada jawapan

   9 – Tidak Berkenaan

9. **Pada hari yang lepas, adakah anda merasa seperti tidak betul-betul berada di sini (dalam hospital)?**

   1 – Tidak **2** – Ya **7** – Tidak Menjawab **8** – Tak tahu/Tak pasti/Tiada jawapan

   9 – Tidak Berkenaan

10. **Pada hari yang lepas, adakah anda melihat perkara-perkara yang tidak benar-benar ada? (Jika pesakit adalah buta, langkau dan kodkan 9)**

    1 – Tidak **2** – Ya **7** – Tidak Menjawab **8** – Tak tahu/Tak pasti/Tiada jawapan

    9 – Tidak Berkenaan

Jika mana-mana perkara 8, 9 ataupun 10 di atas adalah selain daripada 'tidak', ciri-ciri 1 wujud

Akhir Temu Bual Pesakit

Terima kasih banyak-banyak kerana sudi meluangkan masa

Sila teruskan ke bahagian seterusnya supaya soalan-soalan tentang pemerhatian semasa sesi temubual pesakit dan pengkodan muktamad dapat dilengkapkan.

Digunakan dengan kebenaran. The SAGES Study: Training Manual and Questionnaires; 2010; Boston, Aging Brain Center.

PERMERHATIAN	
11A. Adakah pesakit mengantuk semasa sesi temuramah? (mereka seharusnya tertidur tetapi senang dibangunkan)	Ciri-ciri ke-4 wujud? 1–Tidak 2—Ya
11B. Adakah pesakit dalam keadaan hampir pengsan ataupun dalam keadaan koma semasa sesi temubual? (Susah dibangunkan ataupun mustahil dibangunkan)	Ciri-ciri ke-4 wujud? 1–Tidak 2—Ya
12. Adakah pesakit menunjukkan hipervigilans (sifat terlampau waspada)? Contohnya reaksi yang kuat dan melampau kepada benda/stimuli yang lumrah dalam persekitaran, dalam keadaan terkejut yang tidak sesuai dengan situasi, dan lain-lain	Ciri-ciri ke-4 wujud? 1–Tidak 2—Ya
13. Adakah proses aliran idea pesakit tidak jelas ataupun tidak logikal? Contohnya menyebutkan sesuatu yang tidak munasabah, tidak berkenaan dengan temuramah ataupun membuat penyataan-penyataan yang bercanggahan.	Ciri-ciri ke-3 wujud? 1–Tidak 2—Ya
14. Perbualan yang merewang, seperti adakah pesakit memberi respons yang panjang lebar dan tersasar isi kandungannya?	Ciri-ciri ke-3 wujud? 1–Tidak 2—Ya
15. Adakah percakapan yang terhad dan terlampau sikit daripada biasa? Contohnya, jawapan ya / tidak ataupun dijawab dengan perlahan dan tersangkut-sangkut, yang luar daripada biasa.	Ciri-ciri ke-3 wujud? 1–Tidak 2—Ya
16. Adakah pesakit menghadapi masalah untuk mengikuti apa-apa yang disebutkan semasa sesi temuramah, seperti gagal untuk mengikuti arahan ataupun menjawab soalan dengan satu demi satu?	Ciri-ciri ke-2 wujud? 1–Tidak 2—Ya
17. Adakah pesakit gagal memberi perhatian semasa sesi temuramah kerana sewenang-wenangnya senang diganggu oleh stimuli persekitaran, seperti menjawab soalan yang ditanya oleh pesakit lain yang bersebilik dengannya?	Ciri-ciri ke-2 wujud? 1–Tidak 2—Ya
18. Adakah tahap kesedaran pesakit berubah-ubah semasa sesi temuramah, seperti memberi respons yang berpatutan pada permulaannya tetapi kemudiannya tersasar?	Ciri-ciri pertama (1) wujud? 1–Tidak 2—Ya
19. Adakah tahap perhatian pesakit berubah-ubah semasa sesi temuramah? Contohnya adakah focus pesakit pada sesi soal-jawab ataupun prestasi pesakit dalam tugas yang memerlukan perhatian (bidang ingatan nombor, urutan senari hari dan bulan secara bertentangan) berubah-ubah?	Ciri-ciri pertama (1) wujud? 1–Tidak 2—Ya
20. Adakah pertuturan / pemikiran pesakit berubah-ubah semasa sesi temuramah? Contohnya, pesakit berkacap dengan perlahan pada permulaannya tetapi kemudiannya bercakap dengan laju?	Ciri-ciri pertama (1) wujud? 1–Tidak 2—Ya

Ringkasan CAM – Ciri-ciri 1-4

Pengekodan untuk Ciri-ciri 1-4 (0) TIDAK (1) YA

_____ 1. **Permulaan akut dan proses yang turun naik**
Kod 'Ya' jika sebarang perkara 8, 9, 10, 18, 19 dan 20 adalah salah / hadir.

_____ 2. **Tidak menumpu perhatian**
Kod 'Ya' jika sebarang perkara 4, 5, 6, 7, 16 dan 17 adalah salah / hadir

_____ 3. **Permikiran yang tidak tersusun**
Kod 'Ya' jika sebarang perkara 1, 2, 3, 13, 14 dan 15 adalah salah / hadir

_____ 4. **Tahap kesedaran yang berubah**
Kod 'Ya' jika sebarang perkara 11 dan 12 wujud

LENGKAPKAN HANYA JIKA **TIDAK TERDAPAT CIRI-CIRI 1** DAN TERDAPAT **CIRI-CIRI 2** DAN TERDAPAT **SALAH SATU CIRI-CIRI 3 ATAU 4**

21. JIKA HARI INI ADALAH HARI PERTAMA PESAKIT MASUK KE HOSPITAL ATAU JIKA TIDAK ADA KEPUTUSAN 3D-CAM YANG LEPAS TERSEDIA ADA: Sila rujuk rekod perubatan atau hubungi ahli keluarga, rakan, atau penyedia jagaan kesihatan yang mengenali pesakit dengan baik untuk mengetahui jika pesakit mengalami satu perubahan yang akut. 'Adakah pesakit mengalami satu perubahan yang akut dalam ingatan atau pemikiran mereka?'	Ciri-ciri pertama (1) wujud? 1–Tiada 2—Ya 9—Lompat
22. JIKA HARI INI ADADLAH HARI KEDUA ATAU HARI SETERUSNYA PESAKIT MASUK KE HOSPITAL DAN KEPUTUSAN 3D-CAM SEBELUMNYA TERSEDIA ADA Kaji keputusan 3D-CAM sebelumnya dan tentukan sama ada terdapat satu perubahan yang akut kepada prestasi pesakit, berdasarkan SEBARANG item baru yang 'positif'.	Ciri-ciri pertama (1) wujud? 1–Tiada 2—Ya 9—Lompat

Diagnosis kecelaruan oleh CAM memerlukan kewujudan ciri-ciri 1 dan 2 dan sama ada 3 atau 4.

_____ **5. Ada kecelaruan? (0) Tidak (1) Ya.**