

Factors associated with location of death among patients referred to a hospital-based specialist palliative care service

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Factors associated with location of death among patients referred to a hospital-based specialist palliative care service

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Abstract

Background: Palliative care strives to honour patient's last wishes and enable patients to spend the final days of life at their preferred place. Location of death is considered an indicator of quality end-of-life care. The objective of this study was to examine the factors associated with location of death (also preferred place of death as a secondary objective) among patients referred to a hospital-based palliative care service in Malaysia.

Methods: We conducted retrospective analyses of data retrieved from hospital administrative database and death registry. Subjects who received inpatient palliative care services between January 1, 2015 and December 31, 2017 at a tertiary care hospital in Selangor, Malaysia, were included in this study. Multivariable logistic regression analyses were performed to examine association between various demographic, clinical characteristics and location of death and patients' preferred place of death.

Results: A total of 1064 patients satisfied the inclusion criteria and included in the final analysis. Of them 583 (54.8%) were male and 51.5% were <65 years old. More than 67% of patients had Eastern Cooperative Oncology Group (ECOG) performance status of Grade 4 and 64% of them died in the hospital setting. Factors significantly associated with an increased likelihood of home death compared to hospital death included older age (adjusted odds ratio (AOR), 1.55; 95% confidence interval (CI), 1.14–2.09), a referral-to-death interval of ≥ 30 days (AOR, 2.00; 95% CI 1.45–2.74), a referral to community palliative care services (AOR, 2.08; 95% CI 1.46–2.95) and patients' preference for home death (AOR, 21.52; 95% CI 12.88–35.96). Conversely, poor ECOG performance status was associated with reduced likelihood of home death (AOR, 0.72; 95% CI 0.52–0.98). Age, gender, ethnicity, ECOG performance status at referral and referral to community palliative care services were associated with patients' preferred place of death (home vs. hospital).

Conclusion: Our findings suggest that longer referral-to-death interval and involvement of community palliative care services can facilitate home death. Patients aged ≥ 65 years were more likely to opt for home death and to have home death. These findings might be useful in end-of-life care planning and implement interventions to help patients to die at their preferred location.

Background

Palliative care aims to improve the quality of life of patients with life-threatening illness (World Health Organization, n.d.) and it is recognized as a basic human right (Brennan, 2007; International Association For Hospice And Palliative Care & World Palliative Care Alliance, 2008; Radbruch et al., 2013). Besides alleviating the agony experienced by patients and their family member in end-of-life (EOL) care, it is critical to enable patients to die with dignity (Chochinov et al., 2002; UN Committee on Economic, Social and Cultural Rights (CESCR), 2000). It is an important aim of palliative care services to enable patients to spend the final days of life at their preferred place (Clark et al., 2000; House of Commons - Health - Fourth Report, 2004). This is to honour their last wishes and provide them a sense of control over their care during their final days of life especially when they face the unknown process of dying until death. Being able to maintain a sense of autonomy over dying process is considered an important component of EOL care for terminally ill patients (Peters & Sellick, 2006; Rodríguez-Prat et al., 2016). In addition, being able to die in a preferred place is recognized as a key component of achieving good death (Miyashita et al., 2007; Steinhauser et al., 2000). Also, dying at the place of one's choice is considered one of the domains in evaluating quality of dying and death (Patrick et al., 2001).

Numerous studies have shown that most terminally ill patients prefer spending their final days and die at home (Beccaro et al., 2006; Bruera et al., 2002; Tang, 2003) while a recent community-based cross-sectional study conducted by Hospis Malaysia reported that 61% of the respondents prefer to die at home at the EOL (Sekhar et al., 2016). However, most patients eventually die in the hospital despite their preference of home death (Bruera et al., 2002; Cohen et al., 2008; Hansen et al., 2002). A qualitative systematic review of patient preferences observed that 55% of patients preferred to die at home while only 23% finally

could make it (Higginson & Sen-Gupta, 2000). On the other hand, bereaved family members of patients who died at home reported greater satisfaction, lower financial burden and better patients' quality of life at the EOL (Kinoshita et al., 2015; Wright et al., 2010). Studies have also reported that many patients dying in institutions could have unmet needs with regard to symptoms relief, patient-physician communications and emotional support (Sekhar et al., 2016; Teno et al., 2004; Wright et al., 2010; Yao et al., 2007).

Death at home has been widely accepted as an indicator of good quality of EOL care (Beccaro et al., 2006; Clark, 2002; Higginson & Sen-Gupta, 2000). Hence, location of death is considered a quality marker to measure palliative care services (Agar et al., 2008; Macleod, 2011). Several studies have identified factors associated with location of death (Alonso-Babarro et al., 2011; Chvetzoff et al., 2005; Lee et al., 2014) and these factors can be categorized into individual, disease-related and environmental (Gomes & Higginson, 2006). Numerous factors such as age, gender, ethnicity and patient's functional status were reported to be associated with home death (Costantini et al., 2000; Gallo et al., 2001; Gomes & Higginson, 2006; Poulouse et al., 2013). In addition, home death occurred more frequently in patients who preferred home death and had early referral to palliative care (Costa et al., 2016; Lee et al., 2014). Besides, evidence suggests that home-based palliative care services increase the likelihood of dying at home, reduce hospitalizations and improve the satisfaction of patients and their families with EOL care (Alonso-Babarro et al., 2011; Brumley et al., 2007). Thus, understanding the factors related to place of death is crucial for healthcare providers to come up with better EOL care planning for patients and family members using targeted approach.

Palliative care services in Malaysia were introduced in the early 1990s as hospice home care run by non-governmental organizations (NGOs) primarily to care for terminally ill

cancer patients (Ministry of Health Malaysia, 2019). At present, palliative care services are available in public hospitals in Malaysia and the provision of specialist palliative care services are mainly concentrated in seven public hospitals located at urban areas which receive referrals from both public and private sectors (Sekhar et al., 2016). There are only four out of 154 Malaysian public hospitals that have inpatient palliative care units. In contrast, community-based palliative care services are delivered by NGOs providing hospice care at patients' homes and inpatient hospice facilities. Almost all voluntary welfare organizations are based in large urban areas and, thus, the distribution of community palliative care services is mainly limited to urban areas (Ministry of Health Malaysia, 2019). Patients who receive hospital-based palliative care services are referred by their primary physicians from other disciplines. After alleviating acute symptoms, these patients are moved back to their home with the provision of home visits by community palliative care service providers.

To date, there are no published studies on factors related to location of death of patients receiving specialist palliative care services in Malaysia. Therefore, the main objective of this study is to examine factors that are associated with location of death of patients enrolled in hospital-based specialist palliative care service. The secondary objective of this study was to examine factors associated with patients' preferred place of death.

Methods

Study design and setting

This study conducted retrospective analyses of data of patients referred to palliative care unit affiliated with Selayang hospital, Selangor, Malaysia. This is one of the seven

public hospitals in Malaysia where resident palliative care physicians provide hospital-based palliative care services (Ministry of Health Malaysia, 2019). It is equipped with inpatient palliative care beds and located in urban area. The palliative care physicians also provide outpatient consultations for regular follow-up patients. This palliative care unit receives referral from public and private sectors to introduce palliative care, symptom management and terminal care. The referral arrangement to community-based palliative care services is an essential part of the consultation even though home care services are not provided.

Study population and data collection

Data of all patients who received inpatient palliative care services between January 1, 2015 and December 31, 2017 were retrieved from hospital administrative database. The list of patients was then matched using national identity number with the death registration data from National Registration Department (NRD) of Malaysia to identify the actual place of death for each patient. Patients with matched records were included in the analysis (N = 1073). EOL outcomes such as age at death, date of death and location of death were extracted from death registry. Data regarding sociodemographic characteristics of patients, referral information and patients' preferred place of death were extracted from hospital administrative database. The ethical approval was obtained from the Medical Research Ethics Committee, Ministry of Health, Malaysia (NMRR-19-27-45601).

Variables

Location of death was the dependent variable for the primary objective of this study and categorized as home (patient's home) vs. hospital (reference category). Potential predictors for location of death considered in this study were: age at death, gender, ethnicity,

number of diagnosis on referral, Eastern Cooperative Oncology Group (ECOG) performance status at the time of first referral, referral-to-death interval, information on referral to community palliative care services and patients' preference for place of death. The number of diagnosis on referral was categorized into two groups (single and multiple diagnoses) and ECOG performance status was categorized into two groups: grade 0-3 vs. grade 4. The higher grade of ECOG performance status indicates deteriorating functional status and capability of self-care (*ECOG Performance Status - ECOG-ACRIN*, n.d.). Referral-to-death interval was defined as the period between patient's first contact with palliative care services and date of death and classified into two groups (<30 days and ≥ 30 days). Patients' preferred place of death consisted of five categories: (i) hospital, (ii) home, (iii) nursing home, (iv) undecided and (v) no discussion documented. All of these variables were considered as independent variables in the multivariable model. Patients' preferred place of death was considered as a dependent variable for the second study objective and separate multivariable model was fitted to identify its predictors as well.

Statistical analysis

Continuous variables were reported in median and interquartile range while categorical variables were reported in frequencies and percentages. Descriptive analyses were used to describe the patients' characteristics and clinical information. Bivariable analyses were conducted using chi-square test. Two separate multivariable logistic regression models were fitted to examine predictors of location of death as well as patients' preferences for place of death. Patients' preferred place of death was also dichotomized into home and hospital groups in order to conduct binary logistic regression analysis. Thus, only decedents who chose to die at home or hospital were included in the analysis. Variables for the final

model were selected based on literature search and clinical significance. All variables were checked for multicollinearity and no predictor pairs were found to be colinear. Odds ratio (OR) along with their 95% confidence intervals (CI) were reported for each variable included in the logistic regression analysis. We used the area under the receiver-operating characteristics (ROC) curve and Hosmer-Lemeshow goodness-of-fit test to examine the model fit. Additional analysis was conducted by selecting only decedents whose preferences for place of death were documented and these results were compared with that derived from the main analysis. A p value of < 0.05 was considered statistically significant. Statistical analyses were conducted using Stata version 16 (StataCorp.2019).

Results

A total of 1115 patients were admitted to palliative care unit of Selayang Hospital during January 1, 2015 – December 31, 2017 (Fig. 1). Of them, 42 patients were excluded as their information did not match with death registration dataset. We excluded patients whose death occurred in locations other than hospital and home (i.e., nursing homes and other places). Similarly, a patient who preferred other place as a place of death was also excluded. Thus, the final analysis was based on 1064 patients. For secondary outcome of interest (preferred place of death), only decedents who expressed their preferences to die at home or hospital were included in the analysis.

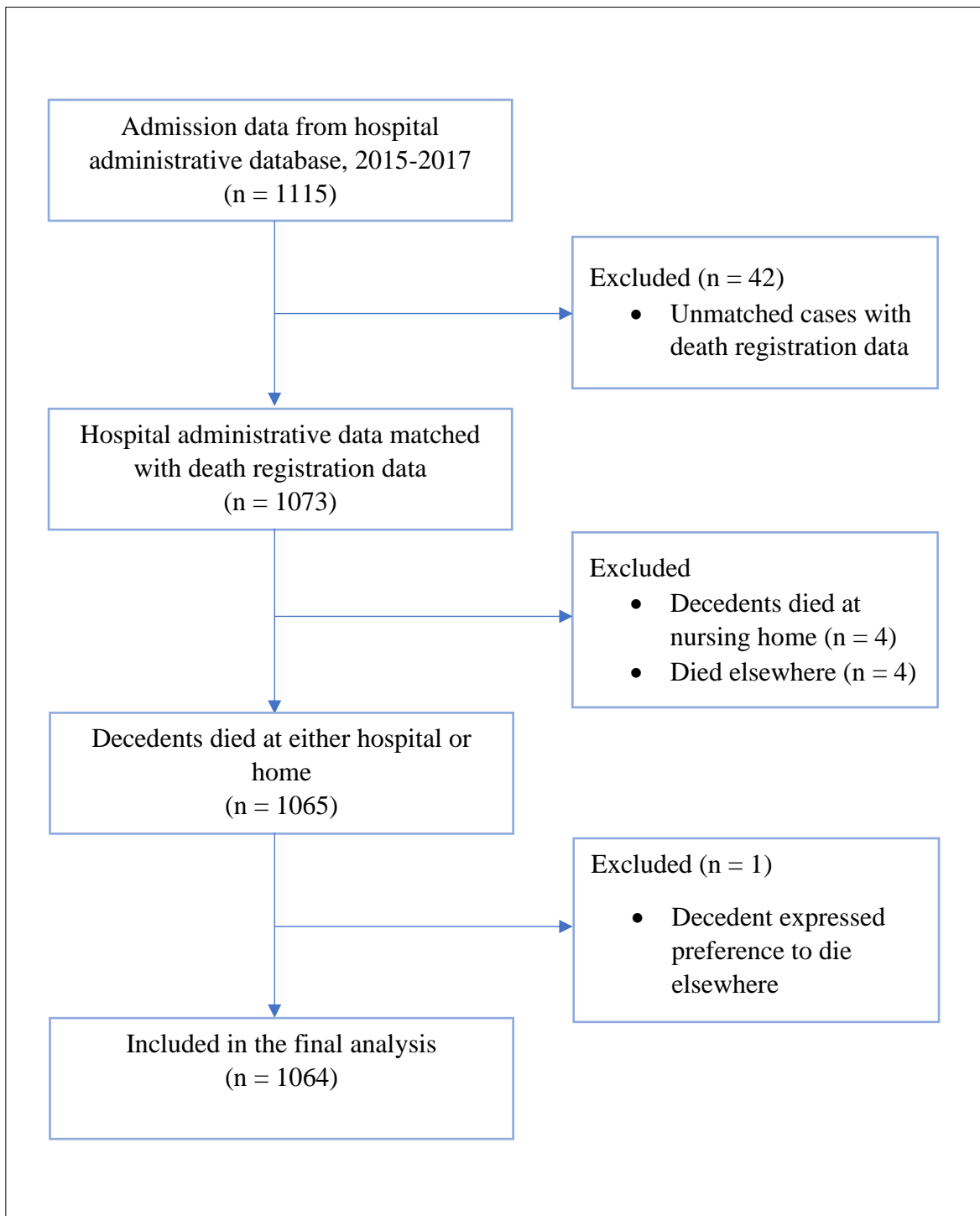


Figure 1 Sample recruitment and data collection flow chart

Patients characteristics

The demographic and clinical characteristics of the patients are summarized in Table 1. The median age at death was 64.4 years (IQR 55.1-74.0) while most of the patients were male (54.8%), ethnically Chinese (52.4%) and had malignant neoplasm (89%). The median referral-to-death interval was 36 days (IQR 11-111.5). About two-thirds of patients (67.1%) had ECOG performance status of Grade 4 (completely bedridden) and similar proportion of them (68.0%) were referred to community palliative care service upon discharge. Most of the patients (64.0%) died in a hospital and 36.0% died at home. Almost a third of the patients (31.1%) preferred to die at a hospital, 25.6% preferred for a home death and 35.6% did not have documentation on preferred place of death.

Table 1 Demographic and clinical characteristics of patients

| Characteristics (N = 1064) | n (%) or median (IQR) |
|---------------------------------------|------------------------------|
| Age, years | 64.4 (55.1-74.0) |
| Age group | |
| <65 yr | 548 (51.5) |
| ≥ 65 yr | 516 (48.5) |
| Gender | |
| Male | 583 (54.8) |
| Female | 481 (45.2) |
| Ethnicity | |
| Malay | 382 (35.9) |
| Chinese | 558 (52.4) |
| Indian | 94 (8.8) |
| Other | 30 (2.8) |
| Referral-to-death interval, days | 36 (11-111.5) |
| Referral-to-death interval | |
| <30 d | 474 (44.5) |
| ≥30 d | 590 (55.5) |
| Diagnosis on referral | |
| Malignant neoplasm | 947 (89.0) |
| Chronic cardiovascular disease | 39 (3.7) |
| Chronic renal disease | 117 (11.0) |
| Chronic liver disease | 154 (14.5) |
| Chronic respiratory disease | 19 (1.8) |
| Neurodegenerative disease | 7 (0.7) |
| Infectious disease | 255 (24.0) |
| Autoimmune disease | 5 (0.5) |

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| Pediatric diagnosis | 0 (0) |
| Other diagnosis | 7 (0.7) |
| Unknown diagnosis | 0 (0) |
| Number of diagnosis | |
| Single | 717 (67.4) |
| Multiple | 347 (32.6) |
| ECOG performance status at referral | |
| Grade 0 | 0 (0) |
| Grade 1 | 11 (1.0) |
| Grade 2 | 83 (7.8) |
| Grade 3 | 256 (24.1) |
| Grade 4 | 714 (67.1) |
| Referral to community palliative care services | |
| No | 340 (32.0) |
| Yes | 724 (68.0) |
| Patient preferred place of death | |
| Hospital | 330 (31.0) |
| Home | 272 (25.6) |
| Nursing home | 3 (0.3) |
| Undecided | 86 (8.1) |
| No discussion documented | 373 (35.1) |
| Location of death | |
| Hospital | 681 (64.0) |
| Home | 383 (36.0) |

IQR = Interquartile range

Factors associated with location of death

Multivariable logistic regression results showed that older age was associated with death at home (Table 2). The odds of dying at home were 1.55 times higher among those aged ≥ 65 years than those aged < 65 years old (OR 1.55, 95% CI 1.14–2.09, $p = 0.005$). A referral-to-death interval of ≥ 30 days (OR 2.00, 95% CI 1.45–2.74, $p < 0.001$) and patients who received referral to community palliative care services (OR 2.08, 95% CI 1.46–2.95, $p < 0.001$) were associated with higher likelihood of dying at home. Patients with worse functional status (ECOG Grade 4) had 28% lower odds of dying at home than patients with better functional status (OR 0.72, 95% CI 0.52–0.98, $p = 0.040$). Patients who expressed their wish to die at home had 21.52 times higher odds of dying there than those who preferred to die in a hospital (OR 21.52, 95% CI 12.88–35.96). Hosmer-Lemeshow goodness-of-fit test (p

=0.144) and ROC curve (area under ROC 0.81, 95% CI 0.79-0.84) showed good fit of the logistic regression model (Fig.2). Additional analysis based on only decedents whose preferences for place of death were documented (n=691), showed similar results in terms of magnitude, direction and statistical significance (Supplementary Table 1). Only ECOG performance status did not achieve statistical significance.

Table 2 Factors associated with location of death (N=1064)

| Characteristics | Bivariable Crude OR ^a (95% CI) | <i>p</i> -value | Multivariable Adjusted OR ^a (95% CI) | <i>p</i> -value |
|--|---|-----------------|---|------------------|
| Age group | | | | |
| <65 yr | 1.00 | | 1.00 | |
| ≥ 65 yr | 1.94 (1.51–2.50) | <0.001 | 1.55 (1.14–2.09) | 0.005 |
| Gender | | | | |
| Male | 1.00 | | 1.00 | |
| Female | 1.08 (0.84–1.39) | 0.533 | 0.93 (0.68–1.27) | 0.648 |
| Ethnicity | | | | |
| Malay | 1.00 | | 1.00 | |
| Chinese | 1.55 (1.17–2.04) | 0.002 | 1.10 (0.79–1.54) | 0.559 |
| Indian | 1.20 (0.74–1.94) | 0.459 | 1.04 (0.59–1.84) | 0.880 |
| Other | 1.78 (0.83–3.78) | 0.136 | 1.19 (0.48–2.94) | 0.705 |
| Referral-to-death interval | | | | |
| <30 d | 1.00 | | 1.00 | |
| ≥30 d | 2.65 (2.03–3.45) | <0.001 | 2.00 (1.45–2.74) | <0.001 |
| Number of diagnosis | | | | |
| Single | 1.00 | | 1.00 | |
| Multiple | 0.95 (0.72 – 1.24) | 0.692 | 0.99 (0.71 – 1.37) | 0.933 |
| ECOG performance status at referral | | | | |
| Grade 0-3 | 1.00 | | 1.00 | |
| Grade 4 | 0.56 (0.43–0.73) | <0.001 | 0.72 (0.52–0.98) | 0.040 |
| Referral to community palliative care services | | | | |
| No | 1.00 | | 1.00 | |
| Yes | 3.08 (2.27–4.17) | <0.001 | 2.08 (1.46–2.95) | <0.001 |
| Patient preferred place of death | | | | |
| Hospital | 1.00 | | 1.00 | |
| Home | 26.08(15.83–42.97) | <0.001 | 21.52 (12.88–35.96) | <0.001 |
| Nursing home | 7.00 (0.61 – 80.24) | 0.118 | 3.96 (0.34 – 46.77) | 0.275 |
| Undecided | 4.81 (2.51–9.21) | <0.001 | 4.10 (2.11–8.00) | <0.001 |
| No discussion documented | 10.63 (6.59–17.16) | <0.001 | 8.54 (5.19–14.07) | <0.001 |

OR = odds ratio; CI = confidence interval

^aHospital death is the reference category; Hosmer-Lemeshow goodness-of-fit statistics p value = 0.144

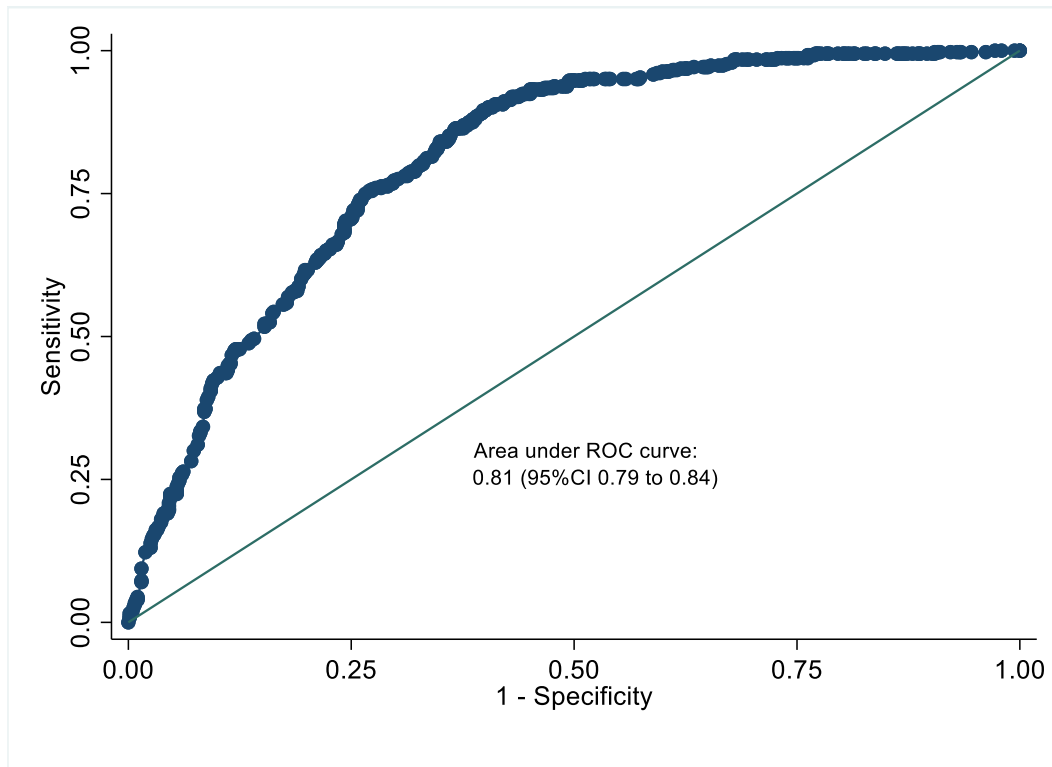


Figure 2: Receiver operating characteristics curve based on the factors associated with location of death

Factors associated with patients' preferred place of death

A total of 602 patients were included in this analysis (Table 3). Similar associations were observed in adjusted analyses with regard to age at death and referral to community palliative care services as predictors of patient preferences on the place of death. Patients aged 65 years or older (OR 1.94, 95% CI 1.36–2.76, $p < 0.001$) and those who received referral to community palliative care services (OR 2.55, 95% CI 1.69–3.83, $p < 0.001$) were more likely to express preference to die at home than their counterparts. Female patients (OR 1.65, 95% CI 1.15–2.37, $p = 0.007$), Chinese ethnicity (OR 1.98, 95% CI 1.34–2.92, $p = 0.001$) and other ethnic group (OR 3.33, 95% CI 1.14–9.69, $p = 0.028$) were associated with

increased likelihood of choosing home death. Hosmer-Lemeshow goodness-of-fit test showed good fit of the logistic regression model ($p=0.301$). Area under ROC curve for this model was 0.72 (95% CI 0.68-0.76) (Fig. 3).

Table 3 Factors associated with patients' preferred place of death (N=602)

| Characteristics | Bivariable Crude OR ^a (95% CI) | <i>p</i> -value | Multivariable Adjusted OR ^a (95% CI) | <i>p</i> -value |
|---|---|-----------------|---|------------------|
| Age group | | | | |
| <65 yr | 1.00 | | 1.00 | |
| ≥ 65 yr | 2.18 (1.58–3.03) | <0.001 | 1.94 (1.36–2.76) | <0.001 |
| Gender | | | | |
| Male | 1.00 | | 1.00 | |
| Female | 1.49 (1.08–2.07) | 0.015 | 1.65 (1.15–2.37) | 0.007 |
| Ethnicity | | | | |
| Malay | 1.00 | | 1.00 | |
| Chinese | 2.14 (1.49–3.06) | <0.001 | 1.98 (1.34–2.92) | 0.001 |
| Indian | 1.28 (0.69–2.39) | 0.428 | 1.04 (0.54–2.02) | 0.902 |
| Other | 4.24 (1.55–11.63) | 0.005 | 3.33 (1.14–9.69) | 0.028 |
| Referral-to-death interval | | | | |
| <30 d | 1.00 | | 1.00 | |
| ≥30 d | 1.98 (1.43–2.75) | <0.001 | 1.39 (0.97–1.99) | 0.074 |
| Number of diagnosis | | | | |
| Single | 1.00 | | 1.00 | |
| Multiple | 0.87 (0.62 – 1.22) | 0.424 | 0.88 (0.60 – 1.28) | 0.495 |
| ECOG performance status at referral | | | | |
| Grade 0-3 | 1.00 | | 1.00 | |
| Grade 4 | 0.54 (0.37–0.80) | 0.002 | 0.54 (0.35–0.82) | 0.004 |
| Referral to community palliative care services | | | | |
| No | 1.00 | | 1.00 | |
| Yes | 3.23 (2.22–4.70) | <0.001 | 2.55 (1.69–3.83) | <0.001 |

OR = odds ratio; CI = confidence interval

^aPreference to die in a hospital is the reference category; Hosmer-Lemeshow goodness-of-fit test p value = 0.301

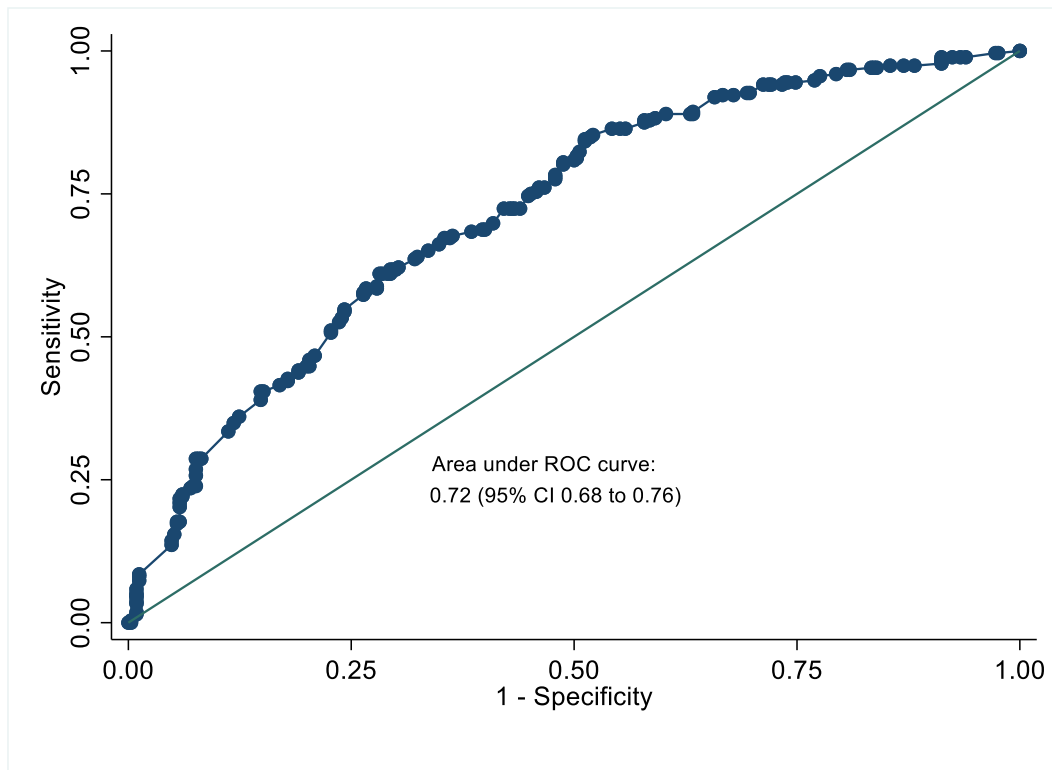


Figure 3: Receiver operating characteristics curve based on the factors associated with patients' preferred place of death

Discussion

To our knowledge, this is the first study to examine factors associated with location of death among patients referred to hospital-based palliative care services in Malaysia. Our findings show that age, interval between palliative care referral and death, ECOG performance status, referral to community palliative care services and patients' preferences had statistically significant association with location of death. On the other hand, age, gender, ethnicity, ECOG performance status and referral to community palliative care services were significantly associated with patient's preferred place of death.

Several studies conducted elsewhere observed that patients' preferences for home death, older age group, early palliative care referral and home-based palliative care were associated with higher likelihood of dying at home (Alonso-Babarro et al., 2011; Costa et al., 2016; Costantini et al., 2000; Gomes & Higginson, 2006; Lee et al., 2014). The current study

also observed similar factors as predictors of home death among hospital-based palliative care patients. Together, these studies support the idea that factors associated with location of death among hospital-based palliative care patients might be similar across geographical boundaries.

Although patient's preference was one of the important factors in predicting location of death, only 56.9% of patients expressed a preference regarding place of death. This is comparable with results reported by Alonso-Babarro et al (2011) and Lee et al (2014). The reason could be healthcare providers did not discuss this issue with patients directly as some of patients might not be aware of their diagnosis and prognosis. In addition, open discussion about death with patients might be culturally sensitive and offensive (Ho et al., 2013; Lee et al., 2014; Tenzek & Depner, 2017). Some patients could be reluctant to discuss about place of death as it may upset their family members (Sekhar et al., 2016). Considering all these factors, it would be challenging for healthcare providers to bring up this topic to obtain information on the intention about preferred place of death which is an important component of EOL care planning. Other possible reasons could be due to poor documentation practices and sudden unexpected death where discussion on EOL care could not be taken place.

The current study observed patients from older age group were more likely to die at home as observed in other published studies (Costantini et al., 2000; Poulouse et al., 2013; Yun et al., 2006). But no significant association between gender and home death was observed in this study which is consistent with other published studies (Fukui et al., 2004; Gyllenhammar et al., 2003; Ko et al., 2017). Also, several studies have shown that ethnicity was associated with place of death (Hong et al., 2011; Poulouse et al., 2013). However, our study showed that patients' ethnicity was not associated with location of death. This study did not examine social factors which too might play important roles in influencing patient's

decision on place of death as observed in published studies (Costa et al., 2016; Gomes & Higginson, 2006).

In this study, the likelihood of dying at home increased when patients were referred to community palliative care services. This could be due to the fact that community palliative care team assists family members to take care patients at home, manage symptoms and provide psychosocial support to patients and their families. Home care visits and its frequency were also found to be correlated with higher likelihood of death at home (Alonso-Babarro et al., 2011; Gomes & Higginson, 2006). But, number of home visits has not been investigated in the current study.

Several studies observed that worse functional status as a strong predictor of home death (Chvetzoff et al., 2005; Gomes & Higginson, 2006). In contrast, we observed significant association between poor performance status and hospital death. This finding could be due to lack of family support and weakened family network in urban area. Patients might fear of being a burden to their families as observed in a study (Johnson et al., 2007). As a result, they might prefer to die in the hospital to avoid emotional and psychological distress to the family.

Our study demonstrated that longer time interval between palliative care and death is associated with home death as observed in other studies (Costa et al., 2016; Poulouse et al., 2013). The reason could be early referral better equip patients and their family members to have better communication with healthcare providers in achieving EOL care goals. We speculate that early palliative care referral provides adequate time to the family members of the patient to accept the prognosis or imminent death and symptoms control. Temel et al. (2010) also observed that early referral to palliative care was associated with less aggressive interventions at EOL.

This study has several limitations. First, this study used retrospective data on palliative care patients extracted from hospital administrative database. Because of retrospective nature of data, we were unable to include other sociodemographic information such as educational level, marital status and information related to social support including family support, living arrangements, availability of caregiver and caregiver's preferences for place of death in our analytical model. Second, this study was based on a single facility and only included inpatients, thus, the findings may not be generalized to the larger population. Finally, due to sociodemographic, cultural and healthcare system differences by countries, our findings should be interpreted within local context. Further studies are warranted to explore caregivers' concern or preferences, congruence between patient and caregivers on preferred place of death and healthcare system related factors to help guide discussions among healthcare providers, patients and their family members regarding the best place for death. Prospective cohort studies are required to shed more lights in this regard.

Conclusion

The location of death is determined by multiple factors including sociodemographic characteristics, social support, factors related to illness and healthcare system. Our study highlights the impact of longer referral-to-death interval and role of community palliative care services in predicting a home death. The identification of these modifiable factors has important implications on clinical practice. This helps to create awareness on the importance of early referral to palliative care and community-based palliative care services to enable more home death. Understanding the determinants of place of death can provide insights to the policymakers and healthcare providers to ascertain the best way to intervene in order for terminally ill patients to achieve home death. This information will enable healthcare providers in identifying strategies to meet the needs of patients and improve quality of EOL

care.

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Appendices:

Supplementary Table 1 Factors associated with location of death among those who expressed preferences (N = 691)

| Variables | Bivariable Crude OR ^a (95% CI) | <i>p</i> -value | Multivariable Adjusted OR ^a (95% CI) | <i>p</i> -value |
|-------------------|---|-----------------|---|-----------------|
| Age group (years) | | | | |
| <65 | 1.00 | | 1.00 | |
| ≥ 65 | 2.49 (1.79–3.47) | <0.001 | 1.84 (1.21–2.80) | 0.004 |
| Gender | | | | |
| Male | 1.00 | | 1.00 | |
| Female | 1.11 (0.80–1.52) | 0.542 | 0.75 (0.50–1.15) | 0.187 |
| Ethnicity | | | | |
| Malay | 1.00 | | 1.00 | |

| | | | | |
|--|--------------------|--------------------|---------------------|------------------|
| Chinese | 1.88 (1.30–2.72) | 0.001 ^b | 1.24 (0.77–1.98) | 0.379 |
| Indian | 1.73 (0.94–3.17) | 0.078 ^b | 1.75 (0.80–3.83) | 0.164 |
| Other | 3.29 (1.35–7.98) | 0.009 ^b | 2.08 (0.67–6.51) | 0.207 |
| Referral-to-death interval (days) | | | | |
| <30 | 1.00 | | 1.00 | |
| ≥30 | 2.26 (1.63–3.14) | <0.001 | 1.69 (1.12–2.57) | 0.013 |
| Number of diagnosis | | | | |
| Single | 1.00 | | 1.00 | |
| Multiple | 0.85 (0.61–1.20) | 0.368 | 0.80 (0.51–1.26) | 0.336 |
| ECOG performance status at referral | | | | |
| Grade 0-3 | 1.00 | | 1.00 | |
| Grade 4 | 0.68 (0.47–0.98) | 0.036 | 0.90 (0.57–1.44) | 0.672 |
| Referral to community palliative care services | | | | |
| No | 1.00 | | 1.00 | |
| Yes | 3.67 (2.42–5.54) | <0.001 | 2.13 (1.28–3.56) | 0.004 |
| Patient preferred place of death | | | | |
| Hospital | 1.00 | | 1.00 | |
| Home | 26.08(15.83–42.97) | <0.001 | 22.18 (13.17–37.33) | <0.001 |
| Nursing home | 7.00 (15.83–42.97) | 0.118 | 5.05 (0.42–61.06) | 0.203 |
| Undecided | 4.81 (2.51–9.21) | <0.001 | 4.36 (2.22–8.53) | <0.001 |

OR = odds ratio; CI = confidence interval

^aHospital is the reference category