









of age, mostly females (62.1%), Chinese (82.9%), and educated up to upper secondary school (54%) (Table 3).

Figure 1 presents the preference weights that best explain the pattern of respondent choices. These are shown on a 0- to 10-point scale with the preference weights for each attribute centered at 5. These preference weights are based on the mixed logit regression results. Attribute levels with larger preference weights are preferred to those with smaller weights. Both patients and caregivers, for instance, preferred the “no pain” level to the “severe pain” level in the “pain” attribute.

Attributes with a greater distance between the most and least preferred level are relatively more important than the other included attributes, given the range of included levels. This figure reveals that both patients and caregivers preferred (the patient) to die at home and to extend their life by 1 year and were averse to severe pain and poor quality care. There was no significant variation in preferences across levels for amount of care received from family or friends in either patient or the caregiver sample.

We can also use the cost attribute as a way of ranking the relative value of moving across levels in the remaining attributes. This can be seen in Table 4, which shows that the WTP of patients to extend their life by 1 year was not statistically different from their WTP to avoid severe pain, to die at home, not be a burden on family and friends, or to receive a high-quality health-care experience. As hypothesized, caregivers had a significantly higher WTP for each EOL improvement (except amount of care) compared to the patients.

A higher proportion of caregivers (artificial feeding: 73.5%, breathing machine: 67.8%, and CPR: 69.2%) than the patients (artificial feeding: 55.9%, breathing machine: 58.8%, and CPR: 58.8%) wanted life-sustaining treatments ( $p < 0.01$  for all treatments). Overall agreement in preference was 59.8% for artificial feeding (kappa: 0.13; 95% confidence interval (CI): 0.01–0.25), 61.3% for breathing machine (kappa: 0.17; 95% CI: 0.03–0.30), and 66.8% for CPR (kappa: 0.27; 95% CI: 0.14–0.40), indicating only slight to fair agreement in patient and caregiver preferences.<sup>52</sup> In 29.4% of the dyads, patients did not want artificial feeding, but caregivers wanted it; in 25.1% of the dyads, patients did not want to be put on a breathing machine, but caregivers wanted it; and in 22.7% of the dyads, patients did not want CPR, but caregivers wanted it.

## Discussion

Our study quantifies the value of life extension as well as other EOL improvements for patients with advanced cancer and their primary informal caregivers. We show that extending life is not the most important consideration of patients. We also show that caregivers have a greater WTP for life extension and other EOL improvements compared to patients and are much more likely to prefer aggressive

**Table 3.** Sample demographics.

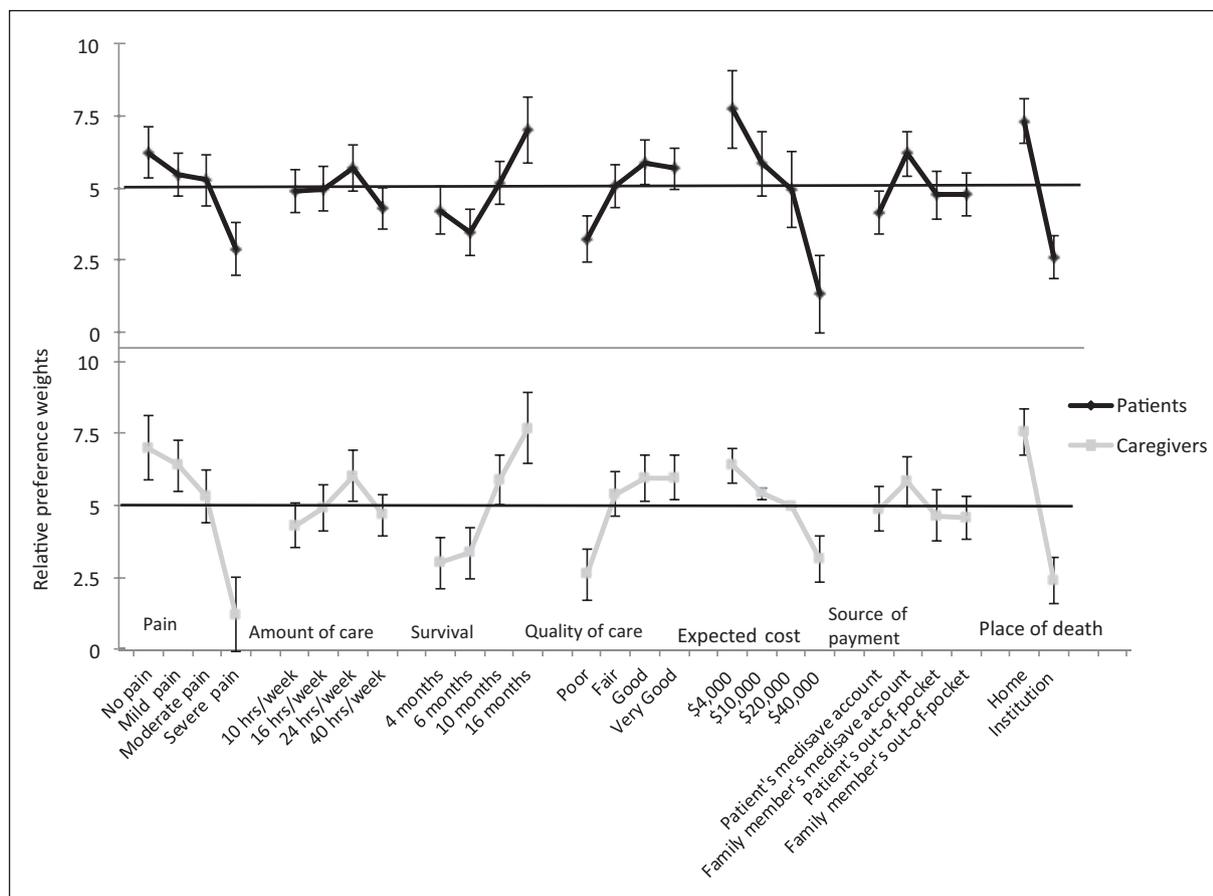
	Patients (N=211)		Caregivers (N=211)	
	n	%	n	%
Mean age (years)	62.7		46.5	
Age (years)				
<40	7	3.3	66	31.3
40–49	25	11.9	49	23.2
50–59	54	25.6	60	28.4
≥60	125	59.2	36	17.1
Gender				
Male	78	37.0	80	37.9
Female	133	63.0	131	62.1
Education				
Less than secondary education	189	86.7	114	54
Secondary education and more	22	12.8	97	45.9
Ethnicity				
Chinese	173	82.0	175	82.9
Malay	23	10.9	22	10.5
Indians and others	15	7.1	14	6.7

life-sustaining treatments for patients compared to the patients themselves.

The results provide guidance for where efforts can be made to improve EOL outcomes. Both patients and caregivers reported a relatively high WTP to avoid severe pain, showing that pain management is of utmost importance. Yet, a meta-analysis reported overall prevalence of pain among cancer patients to be 64%.<sup>52</sup> Previous reports from Singapore reveal pain to be present in 82% of patients referred to hospice care services.<sup>53</sup> In efforts to meet patient preferences, adequate pain management and palliative care services should be a priority.

In Singapore, only about 30% of all cancer patients die at home.<sup>54</sup> This is similar to estimates from other countries (e.g. England: 25%<sup>55–57</sup> and Taiwan: 33%<sup>58</sup>). In contrast, our analyses showed higher point estimates for the WTP to die at home as compared to extending life by 1 year. Greater efforts should be made to facilitate home deaths for those who want it. Further efforts to improve capacity and outreach of home hospice services may be one strategy help to facilitate home deaths on a broad scale.

For patients and caregivers, beyond fair care, there is no statistically significant increase in WTP. While all developed health systems should strive to be responsive to patients' expectations in nonhealth domains such as having shorter waiting and appointment times, these results suggest that an overemphasis on these domains at the expense of other factors would not be a good use of resources. Similarly, reducing burden on caregivers, although important to patients, is not their top priority. However, this may be unique to Singapore where many households have access to low-cost domestic workers,



**Figure 1.** Preferences of patients with advanced cancer and their caregivers.

**Table 4.** Willingness to pay for specific attribute improvements (in S\$).

Attribute	Level transition	Patients (95% CI) (N=211)	Caregivers (95% CI) (N=211)
Survival	4 to 16 months	18,570 (6687 to 30,542)	61,368 (37,030 to 86,210) <sup>a</sup>
Place of death	Institution to home	31,256 (21,249 to 41,391)	67,723 (47,660 to 88,800) <sup>a</sup>
Pain	Severe pain to no pain	22,199 (11,648 to 32,450)	76,047 (47,440 to 104,270) <sup>a</sup>
Amount of care	40 to 10h/week	4051 (-3543 to 11,568)	-5140 (-21,230 to 10,890)
Quality of care	Poor to very good	16,191 (9266 to 23,037)	44,047 (28,750 to 59,480) <sup>a</sup>

CI: confidence interval.

<sup>a</sup>Estimates are statistically significantly different from those of patients at the 95% level.

who often serve as the primary caregivers for ailing older adults.<sup>59</sup>

Notably, we find that caregivers have a higher WTP to extend the patient's life, thus suggesting that they may be more willing to initiate expensive treatments in efforts to extend their life. About a quarter of patient-caregiver dyads also disagreed on their preference for life-sustaining treatments, with caregivers having a greater preference for these treatments for patients than the patients themselves. This suggests that when patients have the capacity to make decisions, clinicians should ensure that they are involved in decision making and that their preferences are elicited and respected. Efforts should also be made to elicit and

document patient preferences through advanced directives or care planning, so that even when they have lost capacity, treatment can be provided as per their wishes.

We also find that patient's WTP for treatments that extend life by 1 year was lower than the commonly accepted thresholds for cost-effectiveness used in many countries.<sup>60,61</sup> Even when patient's WTP to extend life by 1 year is weighted by their health-related quality of life, as measured by EQ-5D (mean score=0.742), the WTP was S\$25,027, which is also lower than the commonly accepted cost-effectiveness thresholds. This suggests that generous reimbursement by government for EOL treatments may not be appropriate, at least in Singapore. If Singapore

adopts coverage thresholds for treatments that extend life by an average of 1 year or less based on patient WTP estimates, coverage would be far more restrictive than what is recommended by NICE in the United Kingdom, which restricts coverage to treatments with cost-effectiveness ratios below £30,000 (~\$63,367) per quality adjusted life year gained<sup>62</sup> or that recommended by the World Health Organization, which considers interventions with cost-effectiveness ratios below three times gross domestic product per capita (~\$195,297) to be cost-effective.<sup>63,64</sup>

This analysis has several limitations. One common feature of all stated preference surveys is that they are hypothetical. However, several studies have examined the external validity of DCEs. Telser and Zweifel<sup>65</sup> compared WTP values derived from actual choices with ones derived from a DCE and found a close correspondence between the two results. Mark and Swait<sup>66</sup> examined the relationship between revealed and stated preference data for physicians' prescribing decisions and found that parameters from both were similar. These studies provide support for using a DCE in the context of medical decision making. Future studies should attempt to back up the results from this DCE with real choice data, although it would be challenging to observe patient preferences independently from their caregivers and physicians who may also influence their choices. Due to sample size and design considerations, we were also unable to explore interaction effects between attributes, such as pain severity and life expectancy, and consequently, are only reporting average WTPs. Another concern is that patient and caregiver preferences may not be consistent over time. Future studies should prospectively assess changes in patient's and caregiver's WTP for various aspects of EOL care to assess stability of EOL preferences. Some differences between patient's and caregiver's WTP may be attributed to their educational differences. Finally, due to the difficulty of recruiting patients and caregivers for this study, and that only patients who were accompanied by their primary informal caregiver to the clinic were included in the study, our patient sample should not be considered representative of those with late stage cancer in Singapore. Regardless, the general pattern of preferences between patients and caregivers is likely to hold across samples and setting. Quantifying the generalizability of these results in other countries should be an area of future research.

## Conclusion

Our results suggest that a greater focus on pain management and supporting home deaths would be in line with the preferences of advanced cancer patients and, from that perspective, would be a more appropriate use of scarce health resources. Greater efforts should also be made to elicit and respect patient preferences in cases where caregivers are making treatment decisions presumably on behalf of the patient.

## Declaration of conflicting interests

The authors declare that there is no conflict of interest.

## Funding

This research was supported by Lien Centre for Palliative Care (Duke-NUS-LCPC(I)/2011/0001).

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