Selection of post-patient death caregiver and family utilities when estimating spillover effects

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BACKGROUND: Where healthcare interventions have disproportionate impacts on the quality of life of family and carers compared to most treatments, it may be appropriate to include these 'spillover' effects in cost-effectiveness models (Al-Janabi et al. 2016).

Where interventions impact survival, an assumption, implicit or explicit, is made regarding family and carers' utility following a patient's death when including spillover effects. This assumption can have a profound impact on the estimated spillover and is contestable. For example, setting carer utility on patient death to zero on might be seen as double counting survival benefits; whereas setting carer utility on patient death to that of the general population leads to reduced, possibly negative, estimates of spillover effects if a treatment extends patient survival.

Based on the following precepts:
1. When we include spillover effects, we are trying to reflect additional (dis)benefits of treating patients that might be experienced by carers and families, rather considering the treatment as a utility maximizing intervention for both carers and families.
2. Carers and family have, ceteris paribus, a preference for longer patient survival.
3. Carers and family would not be willing to vire utility from patients to carers.

We suggest a useful estimator of spillover effects should fulfill the following criteria:
1. Spillover effects should be proportional to the time patients spend in 'better' health states. Incremental spillover effects should be positive if patients spend more time in better health states, negative if they spend less, zero of there is no change.
2. Ceteris paribus, survival should not influence spillover effects. Spillover effects should not be negative because solely because patients live longer. Increased survival should only influence spillover effects to the extent patients spend time more time in better health states compared to comparators.

In this study we compare the performance of number of estimators against the suggested criteria using simulated data representing different scenarios of patient benefit.

METHODS: The following estimators of spillover effects were assessed:
1. Carer/family utility equals 0 on patient death
2. Carer/family utility equals 1 on patient death
3. Carer/family equals worst state on patient death
4. Carer/family utilities are estimated relative to patient's worst state while patients are alive

Estimates of spillover effects were obtained using each of these estimators in a simple model comparing two treatments (Tx A and Tx B) based on the time spent in the following states: responding, non-responding: dead. The carer/family utility was assumed to be 0.9 for the responding state and 0.8 for the non-responding state. General population utility was nominally assumed to be 1. The scenarios evaluated in terms of time spent in responding and non-responding states for each scenario are shown in the table 1.

Table 1: Model Parameters

Scenario	Time in responding State		Time in non-responding state		Overall survival	
	Tx A	Tx B	Tx A	Tx B	Tx A	Tx B
1: Equal survival, longer response	0.6	0.5	0.4	0.5	1	1
2: Longer survival, equal response	0.5	0.5	0.75	0.5	1.25	1
3: Shorter survival, equal response	0.5	0.5	0.25	0.5	0.75	1
4: Longer survival, longer response	0.6	0.5	0.6	0.5	1.2	1

RESULTS: The estimated carer/family utilities for each combination of scenario and estimator are shown in the table 2.

Table 2: Estimated carer/family utilities

Scenario	Time in responding State	Overall Survival	Estimator 1: Carer utility equals 0 on patient death	Estimator 2: Carer utility equals 1 on patient death	Estimator 3: Carer Utility equals worst state on patient death	Estimator 4: Carer Utility relative to worst state
1: Equal Survival, longer response	Tx A > Tx B	A = B	0.01	0.01	0.01	0.01
2: Longer Survival, equal response	A = B	A > B	-0.05	0.2	0	0
3: Shorter Survival, equal response	A = B	A < B	0.05	-0.2	0	0
4: Longer Survival, longer response	A > B	A > B	-0.03	0.17	0.01	0.01

The assessment of the estimators against the criteria are shown in the table 3.

Table 3: Assessment of criteria

Criteria	1: Carer utility equals 0 on patient death	2: Carer utility equals 1 on patient death	3: Carer Utility equals worst state on patient death	4: Carer Utility relative to worst state
1. spillover effects should be proportional to the time patients spend in 'better' health states.	Fail (Scenarios 2,3,4)	Fail (Scenario 2,3,4)	Pass	Pass
2. Ceteris paribus, survival should not influence spillover effects	Fail (Scenario 2,3,4)	ail (Scenario 2,3,4)	Pass	Pass

DISCUSSION: Setting carer utility on patient death to either zero or the general population utility leads to estimators of spillover effects that do not meet our suggested criteria (Al-Janabi et al. 2023). The carer/family utility equals worst state on patient death and carer/family utilities estimated relative to patient's worst state while patients are alive estimators are equivalent and, in our test cases, meet our criteria. These estimators may be reasonable when there is a well-defined patient relevant 'worst state' and effective treatment is generally associated with patients spending less time in this state. We are currently developing a version of this estimator for cases where patient health represented by a continuous variable.

REFERENCES
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