

The Transplantable Organ Shortage in Singapore – Has Implementation of Presumed Consent to Organ Donation Made a Difference?

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Abstract

The success of solid organ transplantation in the treatment of end-stage organ failure has fuelled a growing demand for transplantable organs worldwide that has far outstripped the supply from brain dead heart-beating donors. In Singapore, this has resulted in long waiting lists of patients for transplantable organs, especially kidneys. The Human Organ Transplant Act, introduced in 1987, is an opt-out scheme that presumes consent to removal of certain organs for transplantation upon death. Despite this legislation, the number of deceased organ donors in Singapore, at 7 to 9 per million population per year, remains low compared to many other developed countries. In this paper, we reviewed the clinical challenges and ethical dilemmas encountered in managing and identifying potential donors in the neurological intensive care unit (ICU) of a major general hospital in Singapore. The large variance in donor actualisation rates among local restructured hospitals, at 0% to 56.6% (median 8.8%), suggests that considerable room still exists for improvement. To address this, local hospitals need to review their processes and adopt changes and best practices that will ensure earlier identification of potential donors, avoid undue delays in diagnosing brain death, and provide optimal care of multi-organ donors to reduce donor loss from medical failures.

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Introduction

The first transplant operation was a successful kidney transplantation between identical twins performed on 23 December 1954 at the Peter Bent Brigham Hospital in Boston, USA.¹ Since that time, rapid advances in transplant surgery coupled with advancements in immunosuppressive therapy, have made solid organ transplantation the treatment of choice for end-stage organ failure today.

This has fuelled a growing demand for transplantable solid organs that has far outstripped the supply from deceased organ donors, resulting in a growing organ shortage worldwide.² In 2007 alone, there were 97,000 patients on waiting lists for organ transplantation in the United States.³

In Singapore, the situation is no different. In 2007, there were 563 persons with renal failure waiting for a transplantable kidney.⁴ The number of new end-stage renal failure cases diagnosed each year in Singapore has been climbing steadily, from about 250 per year in 1991 to 564 in 1998 and 675 in 2003.^{5,6} With the average number of

deceased organ donors remaining static at around 20 per year over the last 5 years, the current median waiting time of 8.9 years for a kidney transplant is only going to get much longer.⁴

The Medical (Therapy, Education and Research) Act (MTERA) was passed by Parliament in 1972 to allow persons who wish to pledge their organs for transplant, research or education purposes upon death to opt-in by filling in a registration form.⁷ Despite extensive door-to-door canvassing and publicity through the mass media in the 1970s and 1980s, sign up rates have been poor, with only 45,202 organ pledgers in the Organ Donor Registry in 2007 out of 3.5 million citizens and permanent residents in Singapore.^{4,5} This is despite the Act having been in existence for the past 36 years.

This low take-up rate prompted the introduction of the Human Organ Transplant Act (HOTA) in 1987, essentially an opt-out scheme, which presumes consent to removal of specified organs for purpose of transplantation upon death.⁸ Those who object to doing so have to opt-out by filling in

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an objection form. When first introduced, it applied only to traumatic causes of death among Singapore permanent residents and citizens, aged 21 to 60 years and non-Muslims, and allowed for only removal of the kidneys for transplantation.⁸

This Act was amended in 2004 to include all causes of death and allow the removal of additional organs, namely the heart, liver and corneas for transplantation. A further amendment was made in 2008 to include the Muslims under HOTA such that they too would need to opt-out if they objected to donating their organs upon death.

The number of registered objectors to HOTA in the Organ Donor Registry has remained low, and was 28,875 in 2007.⁴ Therefore, HOTA has effectively increased the pool of potential donors by more than 50-fold, from 45,202 organ pledgers under MTERA, to more than 3 million non-objectors under HOTA.

However, HOTA, which has been in existence for the past 21 years, has not yielded the expected increase in donors and transplantable organs. In fact, the number of deceased organ donors for years 2005, 2006 and 2007 has remained low at 21, 30 and 26, respectively (Table 1).⁴ This is roughly equivalent to 7 to 9 deceased donors per million population (pmp) per year, a rate considerably lower than those in the United States where 16 to 28 deceased donors pmp per year are recruited under a consent-based opt-in system and Spain where 33.5 deceased donors pmp per year are recruited with consent from the next of kin even though opt-out legislation exists.^{9,10}

Why has HOTA failed to increase the number of deceased donors in Singapore? One key reason may be our continued reliance on identifying potential donors from among the brain dead heart-beating patients only and leaving out the cardiac death (non-heart-beating) ones, which though much larger in numbers yield poorer quality organs. This has focused undue attention on the smaller pool of brain dead patients and created high expectations on intensive care unit (ICU) physicians, who in addition to managing the medical and end-of-life issues of these patients, are expected to identify potential donors for the national deceased donor

programme.

Singapore is one of about 25 countries in the world, including Switzerland, Norway, Italy, Austria and France that have implemented an opt-out system to organ donation upon death. Unlike the more commonly applied opt-in system, there is presently a dearth of medical literature dealing with the problems faced in identifying potential donors under an opt-out system. In this paper, we aim to review the clinical challenges and ethical dilemmas encountered in managing and identifying potential donors in the neurological ICU of a major general hospital in Singapore. We will explore and discuss solutions that may help ensure ethical end-of-life care in the ICU for our patients afflicted with fatal neurologic injuries while at the same time ensuring that suitable potential donors are identified and referred to the transplant coordinators.

Donor Identification and Speaking to the Next of kin about Organ Donation

The majority of brain dead heart-beating organ donors are patients in apparent good health previously who become afflicted with severe neurologic injuries arising from massive strokes, severe head trauma or severe hypoxic brain injuries following cardiopulmonary arrest. Serendipitously, these patients have been rescued from a near out-of-hospital death, brought to the emergency department where acute resuscitation is carried out and cardiopulmonary support initiated and continued in the ICU. At this point, they are usually not brain dead but in a deep coma with brainstem reflexes still intact.

While the prognosis may be poor, the exact outcomes cannot be predicted with any degree of certainty at presentation. For such patients, 3 outcomes remain possible with continued aggressive treatment in the ICU: (1) gradual improvement and survival with recovery of cognition but with permanent disabilities that require assistance in the activities of daily living, (2) survival in a non-cognitive vegetative state and totally dependent in the activities of daily living and (3) progressive deterioration to eventual brain death.

Table 1. Summary of Organs Recovered from Actualised Donors from 2001-7 (with permission)⁴

	2001	2002	2003	2004	2005	2006	2007
Number of actualised donors	25	15	9	17	21	30	26
Number of organs recovered							
• Kidney	50	30	18	34	41	58	48
• Liver	7	6	1	8	4	9	12
• Heart	2	2	0	4	3	6	4
• Lung	4	4	0	4	2	2	2

As a result of this uncertainty during the early stages of the illness, it is not possible to know which patients will progress to brain death and become potential donors. At this stage, the aggressiveness of care is driven by consideration of the pre-morbid state of health, potential for recovery and the wishes and best interests of the patient made in consultation with the next of kin. Organ donation, appropriately and ethically, is not considered or discussed at this time.

Some families may, at this stage, request or opt for comfort care and withdrawal of cardiopulmonary support, based on the earlier expressed or implied wishes of the patient. These decisions are respected if they are consistent with the assessed prognosis, making continued aggressive care futile. These patients will usually (but not invariably) deteriorate towards eventual cardiac death and do not become organ donors even though they qualify as non-heart-beating donors under the statutes of HOTA.

In allowing the withdrawal of cardiopulmonary support when such patients are not yet brain dead, the ICU physician is guided by the ethical principles of self-determination (via the surrogate decision maker) and acting in the best interests of the patient, recognising that it is neither appropriate nor ethical to aggressively support all patients with potentially lethal neurologic injuries to brain death and organ donation.

On the other hand, there are many next of kin who, given the sudden and unexpected nature of the inciting illness or event, request for aggressive treatment and cardiopulmonary support to be continued (“do everything possible”) as they struggle to grapple with the new realities. Many such patients will, despite continued aggressive care, continue to deteriorate, progressing to brain herniation, loss of brainstem reflexes and eventually brain death.

During discussions with the family on treatment options and the likely outcomes from each option, the possibility of progression to brain death and the likely consequences if it were to happen are often brought up. In such situations, it is crucial to be honest and upfront with the family about brain death and organ donation – what brain death means, the implications of HOTA, to whom it applies and the process of identifying potential donors – should be explained clearly and sensitively to the next of kin. Having done so, it will make communications with the family much easier later when brain death does occur.

In discussing these issues with the next of kin, the ICU physician often has to strike a fine balance between open disclosure and maintaining his or her credibility as the patient’s advocate versus bringing up sensitive and difficult issues such as HOTA and organ donation prematurely, at a time when the next of kin are not mentally ready for such discussions. Of late, this balance seems to have subtly

shifted towards the need for greater and timelier disclosure. The recent intense publicity by the Ministry of Health, through the mass media and community grassroots, to educate the public about HOTA has helped raise awareness of the opt-out organ donation laws in Singapore. In fact, many families today have some knowledge of organ donation and HOTA but may only be unsure if it applies to their loved ones. They are often waiting for the doctors to bring up the topic and may perceive the failure to do when asked, as a lack of transparency and honesty.

While HOTA has made clearer the wishes of the brain dead patient from a legal standpoint, i.e. absence of a registered objection is taken as presumed consent to organ donation, the task of explaining the whole organ donation process to the next of kin is no less onerous or vital than in a consent-based opt-in system, and should be carried out with the same degree of empathy and sensitivity. In fact, failure to do so will often result in the next of kin becoming angry and openly hostile. In such an environment, it will become extremely difficult for any constructive discussions to take place and the sole objective of the next of kin may just be to get their loved ones out of the “trap of HOTA”.

Clearly, the leadership of the ICU physician in this whole process is vital. However, many ICU physicians are uncomfortable identifying and referring potential organ donors, a role frequently imposed upon them by the hospital or the regulatory authorities. These doctors see themselves primarily as patient advocates with a duty to act in the best interests of their patients, and perceive this role to be in conflict with their responsibilities to society and the need to support the social objectives of HOTA and organ donation. This ethical dilemma may explain, at least in part, some of the apathy towards organ donation and the reluctance of ICU physicians to proactively engage the families of potential donors on this issue.

In addressing this potential conflict of interest, we cannot over-emphasise the importance of the sequential order of the clinicians’ responsibilities. ICU physicians will have acted ethically and in good conscience if they had considered and applied all appropriate treatment measures possible in the management of their patients. For those patients in whom these treatments failed and continued deterioration towards brain death results, dealing with the end-of-life issues, including HOTA and organ donation, are just as necessary and part of holistic care to the patients and their next of kin.

In our experience, we have found it helpful to involve the ICU medical social worker and nursing team in care conferences with the next of kin. The social worker can follow-up with the family after the care conference, to explain and clarify on issues raised by the medical team, which may be misunderstood by the family in the

Table 2. Outcome of Potential Donors Referred in 2007 (with permission)⁴

	HOTA Donors	MTERA Donors
Number of potential donors referred	60	26
Non-actualised donors	36	24
Actualised donors	24	2

emotionally-charged environment of the care conference. If the social worker is able to establish good rapport with the family in the initial stages, he or she can be an important and impartial bridge later between the medical team and the family when navigating the sensitive areas of donor management, organ recovery and end-of-life care.

Donor Referral and Actualisation Rates Among Local Hospitals

In 2007, there were a total of 86 potential donors referred to the transplant coordinators of the National Organ Transplant Unit, of which 26 were eventually actualised as organ donors, yielding an overall actualisation rate of 30.2% (Table 2).⁴ This actualisation rate is lower than those reported in the United States, where 32% to 58% of potential donors become actual donors.⁹

The actualisation rates among the 9 referring local hospitals varied widely. Among the 6 government-linked restructured hospitals, accounting for 83 out of 86 referred donors, the actualisation rates varied from 0% to 56.6% (median 8.8%).⁴ There were only 3 potential donors referred from 3 local private hospitals, one of whom was actualised. If only hospitals that referred more than 10 potential donors in 2007 were considered, there were 4 such hospitals and the actualisation rates fared slightly better, ranging from 4.3% to 56.6% (median 27.5%). In fact, 17 out of the 26 actualised donors were referred from our institution alone, which had an actualisation rate of 56.6%.⁴

The reasons for non-actualisation of referred donors are shown in Table 3, with 26 out of 60 non-actualised referrals (43.3%) having had a valid reason, which included donors found to be medically unsuitable and others where the coroner denied consent for organ donation.⁴

However, there were 34 patients (56.7%) that could have been actualised but were not and these included those who had cardiac arrest prior to certification of brain death or who had life support withdrawn, where brain death certification criteria were not met and where consent for organ donation could not be obtained.⁴

This large variance in donor actualisation rates among local hospitals suggests that considerable room still exists for improving the processes for identification and management of potential donors, especially among those with low donor referral volumes and actualisation rates.

Table 3. Reasons for Non-actualisation of Referred Donors (with permission)⁴

	HOTA Donors	MTERA Donors
Brain death criteria not met	7	2
Life support withdrawn or died prior to brain death certification	10	6
Medically unsuitable	15	6
No consent from coroner	4	1
No next of kin available	Not applicable	3
No consent from next of kin	Not applicable	6

Our institution, which has an actualisation rate comparable to rates reported among the best centres in the United States, can certainly share our know how and best practices with the other local hospitals.

Improving the Recruitment and Actualisation of Potential Donors

As highlighted previously, prior to the onset and certification of brain death, many potential donors are lost when the next of kin request for comfort care and withdrawal of cardiopulmonary support. In such cases, consent for organ donation is rarely sought. To include such potential donors, medical and nursing care providers can speak to the next of kin about “opting-in” to organ donation and allowing continuation of cardiopulmonary support till completion of brain death certification. If brain death does not occur within an agreed upon waiting period, cardiopulmonary support can still be withdrawn and cardiac arrest allowed to occur. However, in our local population, many next of kin may decline this option, making the loss of many such patients as potential donors unavoidable.

In others, for whom the plan of care is still aggressive with continuation of life supportive measures, brain death is suspected when the patient’s neurologic condition deteriorates and the brainstem reflexes become absent. When this happens, confirmation of brain death should be carried out as soon as possible. This is because the onset of brain death is often accompanied by profound falls in sympathetic outflow causing marked hypotension and haemodynamic instability.¹¹⁻¹⁴ The pathophysiology of evolving brain death also leads to injuries in many other organs, making maintenance of cardiopulmonary support with stable parameters increasingly difficult, especially with increasing duration of support after brain death has occurred.^{10,13,15,16}

In the management of potential organ donors, “Management Time” has been defined as the time interval from the inciting event causing brain death to the time of organ recovery surgery, which can be further broken down into (1) time from event to brain death certification and (2)

Table 4. The 7 Brainstem Tests for Certification of Brain Death in Singapore²¹

Brainstem test	Description of test	Expected response if brain dead
Pupillary light reflex	Shine strong light into each eye	Both pupils fixed and non-reactive to strong light
Corneal reflex	Touch cornea using a wisp of cotton wool or moistened cotton bud	No muscle contractions noted around the eyes
Oculo-cephalic (Doll's eye) reflex	Turn the head quickly 90 degrees to the left and then to the right	Eyes should remain fixed to the midline and move with the head
Response to pain	Apply pain stimulus centrally e.g. at the supra-orbital ridge or peripherally to the nail beds	No motor response seen anywhere to centrally applied or no facial response seen to peripherally applied pain stimulus
Gag reflex	Pass suction catheter down endotracheal tube to level of carina and/or apply firm pressure to posterior pharynx with wooden spatula	No gag or cough response elicited
Cold caloric test	Inject 50 ml of cold saline into each ear slowly over 1 min with head of bed elevated to 30 degrees (wait 5 min before testing other side)	No tonic deviation of pupil towards the side being syringed should be seen
Apnoea test	Pre-oxygenate for 10 min followed by insufflation of 6 L/min of O ₂ via suction catheter into endotracheal tube while disconnected from ventilator for 6-8 min	No breathing efforts seen at a PaCO ₂ level of >50 mmHg

Table 5. Steps Implemented to Support the Next of kin and Improve the Workflow of Brain Death Certification

<p>To strengthen the rigour of brain death certification at the bedside</p> <ul style="list-style-type: none"> • Provide a step by step bedside guide to brain death testing in the ICU • Use a checklist prior to brain death certification to ensure consistency in the checking of pre-conditions to brain death testing • Ensure that all certifiers and designated officers have attended the Ministry of Health approved instructional course on organ donation and brain death certification • Deploy a smaller pool of trained certifiers for the certification roster who change over weekly instead of daily for improved follow through of cases referred for certification • Provide an internal expert referral system with in-house senior Neurologists and Neurosurgeons as experts for second opinions (at request of the next of kin) <p>To provide greater next of kin support</p> <ul style="list-style-type: none"> • Provide an ICU medical social worker for social and grief support to the next of kin • Provide religious support through a panel of religious organisations if requested by the next of kin <p>To provide administrative support and oversight of brain death certification process</p> <ul style="list-style-type: none"> • Provide a coordinator for administrative support to the ICU physician managing the brain death certification process in an identified potential donor. • Create a hospital workgroup to oversee and coordinate policies and workflow related to brain death certification • Review and audit of all actualised and non-actualised organ donor referrals

time from brain death certification to actual recovery of organs.¹⁷

It has been reported that shorter Management Times

reduce the risks of losing potential donors to medical failures and help preserve the quality of recovered organs, which in turn determines the mortality and morbidity in transplant recipients.^{10,16-19} Longer Management Times have been reported to result in poorer survival outcomes in heart transplant recipients.¹⁷

Reducing the Time Taken to Certify Brain Death

The diagnosis of brain death is normally made clinically at the bedside through a 4-step process:

- 1) Establish a plausible cause for brain death with irrefutable evidence of extensive brain damage e.g. computed tomographic (CT) scan evidence of a large intracerebral haemorrhage with mass effects and midline shift.
- 2) Exclude reversible causes of coma by reviewing the medication history and checking the haemodynamic parameters and laboratory data to rule out hypotension, hypoxaemia, hypothermia, hypoglycaemia, severe electrolyte disorders and other metabolic derangements.²⁰
- 3) Confirm the presence of intact neuromuscular transmission.
- 4) Establish the absence of response to the 7 brainstem tests, which are detailed in Table 4.

When the primary team doctors have diagnosed brain death, 2 independent medical practitioners, uninvolved in the care of the patient, are required to independently review the clinical course of the patient, repeat the 4 steps and confirm the diagnosis.²¹

We have previously reported, in a survey among clinicians from a tertiary neuroscience referral centre, that the majority

of physicians (84%) on the hospital's brain death certification roster had performed 5 or fewer brain death certifications in the preceding 3 years.²² This infrequency in performing brain death certification resulted in significant variability in the physicians' knowledge of the technical aspects of carrying out the brain death tests and in applying appropriate physiological and biochemical limits as pre-conditions to brain death testing.²²

This unfamiliarity and variability in the conduct of brain death certification, often leads to delays in confirming brain death, either through unnecessary checking and correction of biochemical parameters or from unnecessary ordering of supplementary tests. These delays often result in anger and frustration among families of potential donors who may already be lukewarm or openly hostile to organ donation. Some may even at this juncture withdraw their consent to donation and request for withdrawal of cardiopulmonary support.

To address this problem and minimise such delays, we have provided in our ICU, a step-by-step bedside guide to performing the brainstem tests, as a reference tool for clinicians called to certify brain death.²² We have also introduced a brain death certification checklist, to be filled in by the primary team doctors in the ICU, prior to certification of brain death. Included in this list are the 4 steps mentioned earlier, together with the upper and lower limits of a few common pre-conditions to brain death testing, such as body temperature and sodium and glucose levels that have been endorsed by the hospital's medical board. Many experts have similarly recommended using such standardisation and checklists to guide certifying physicians and ensure consistency in their certification of brain death.^{23,24}

Providing education and training to certifying physicians on the "nuts and bolts" of brain death certification and having a smaller pool of formally trained and appointed certifiers in each institution are also critical in ensuring rigour, consistency and expediency in the certification process. We have co-organised and conducted, in collaboration with the Singapore Ministry of Health, an instructional course on brain death certification for physicians, nurses and case managers involved in certifying brain death in local hospitals. This course is conducted 2 to 3 times per year and has so far been successful in meeting its intended objectives.

Reducing the Time from Certification of Brain Death to Organ Recovery

After certifying brain death, the potential donor is referred to the transplant coordinator for further workup, which involves first running a search in the Organ Donor Registry to check if the potential donor had previously registered as

an organ pledger or objector to HOTA. If no registered objection to organ donation is found, the donor is then screened for medical contraindications to organ donation while the transplantable organs are evaluated for suitability.

When this evaluation has been completed, the organ recovery surgery is then scheduled, the timing of which will depend on the availability of an operating theatre and anaesthesiologist, and the various transplant surgeons involved.

This whole process, from the time when brain death is certified to the time when the organs are recovered, may take many hours to complete. The donor families, having been told of the death and passing of their loved ones, are often eager to get the organ recovery surgery over and done with. It is important for all parties involved in this multi-faceted process to understand the urgency involved and to make the necessary changes to their work schedules so that organ recovery can be carried out as soon as possible.

Medical Management of the Brain Dead Multi-organ Donor

The medical management of brain dead multi-organ donors (MODs) presents many unique challenges. In these patients, the focus of care has shifted from cerebral protection and lowering intracranial pressures while maintaining cerebral perfusion to preserving the function of transplantable organs and maintaining systemic perfusion pressures.²⁵

In the ICU, the MOD is frequently not high on the list of priorities of the ICU physician and may not receive care as aggressively as the haemodynamic condition would warrant.²⁶ As a result, potential donors may suffer irreversible cardiac arrest before organ recovery can take place. The incidence of such donor loss from medical failures has been reported at 15% to 25%.^{10,19,25} A dedicated critical care team taking over the care of all identified potential donors, and providing aggressive donor management using standardised management protocols, has been reported to decrease the number of donors lost to cardiovascular collapse and increase the number of organs recovered per potential donor.¹⁸

The goals of haemodynamic management in the MOD are to ensure normovolaemia with maintenance of cardiac output and perfusion pressures. Systolic blood pressures of 90 to 120 mmHg have been reported to be adequate and can be confirmed at the bedside through monitoring of the urine output as an index of adequate organ perfusion.^{10,15} Hypotension occurs in more than 80% of MOD and is frequently due to hypovolaemia from previous intracranial pressure lowering therapies, uncorrected blood loss, myocardial dysfunction or diabetes insipidus.^{16,25} Inotropic or vasopressor support is frequently needed when

hypotension persists despite adequate volume resuscitation. This occurs in more than 90% of cases, with about 33% needing more than 1 vasopressor agent, most commonly dopamine with either dobutamine or noradrenaline.²⁷ The use of vasopressors has also been reported to provide beneficial immunomodulatory effects with improved graft survival following renal transplantation.²⁷

One of the keys to maintaining haemodynamic stability in the MOD is early recognition and correction of diabetes insipidus (DI). DI occurs in about 80% of brain dead patients and results from disruption to the hypothalamic-pituitary axis following brain death.¹¹ Delays in diagnosis and treatment will result in patients becoming severely hypovolaemic, hypotensive, tachycardic and hypernatraemic. Hormone replacement with desmopressin or arginine vasopressin, coupled with correction of the free water deficit, is required to reverse and correct the hypernatraemia.

The adequacy of treatment should be monitored with serial checking of the serum sodium levels, which will show a gradual return towards normal coupled with improvements in the hypotension and tachycardia. There should not be any fear of either rapid or over correction of DI as any acute brain swelling that may normally result from rapid lowering of the serum sodium levels, is of no relevance in a brain dead patient. In fact, uncorrected hypernatraemia in the donor has been linked to failed or delayed graft function, especially in liver transplant recipients.²⁸

The role of routine hormone replacement with thyroid and steroid hormones in brain dead donors remains controversial and unproven, with several studies yielding conflicting results.²⁹ However, it may have a role in haemodynamically unstable donors and in those requiring high doses of vasopressors, where it has been reported to reduce vasopressor requirements, improve haemodynamic stability and increase the number of organs recovered per donor.^{29,30}

Conclusion

An opt-out system with presumed consent to organ donation has been in existence in Singapore for the past 21 years. This change from a consent-based opt-in system has not yielded the expected increase in deceased heart-beating organ donors. Instead, the number of deceased donors actualised per year has remained low compared to other developed countries.

Despite the rising affluence and educational level of the general public in Singapore, a general antipathy towards organ donation upon death still exists. This antagonism is rooted in the traditional beliefs of the different ethnic groups towards death and the need to preserve the

“wholeness” of the body for the “after life”. To educate the public and change these beliefs will take considerable time and effort, and should start from the young in our schools and through education via the mass media and even national campaigns. Only then, is it possible for healthcare professionals to work in an environment where honest and open discussions on brain death and organ donation can take place.

Clearly, there are no simple or quick fixes to this problem. More legislation is also not the answer. At present, many ICU physicians attending to patients with potentially lethal neurologic injuries remain reluctant to actively identify and refer potential donors. In our busy hospitals and ICUs, brain dead potential donors continue to be treated with passivity and restraint.

As a start, interested physicians and stakeholders, in institutions where they work, need to take the lead and drive changes in behaviour and practices among their colleagues. As the task of identifying donors in the ICU is a daunting and emotionally draining burden to healthcare workers, it should be viewed as a shared national responsibility and distributed equitably. Hospitals should not hesitate to review their own processes, allocate appropriate resources and proactively share best practices with each other. We have provided a summary of the steps that we have implemented in our institution to provide support for the grieving next of kin and to improve the rigour of our brain death certification process (Table 5).

Finally, any solution that aims to increase the number of actualised donors must incorporate processes that ensure early identification of potential donors, early diagnosis of brain death to reduce management times and optimal care of multi-organ donors to prevent donor loss to medical failures and to preserve the viability of transplantable organs.

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REFERENCES

1. Merrill JP, Murray JE, Harrison JH, Guild WR. Successful homotransplantations of the human kidney between identical twins. *JAMA* 1956;160:277-82.
2. Hauptman PJ, O'Connor KJ. Procurement and allocation of solid organs for transplantation. *N Engl J Med* 1997;336:422-31.
3. Steinbrook R. Organ donation after cardiac death. *N Engl J Med* 2007; 357:209-13.
4. National Organ Transplant Unit. Annual Report 2007. Singapore: Ministry of Health, 2007.
5. Rauff A. Renal transplantation in Singapore—a brief historical perspective. *Ann Acad Med Singapore* 1991;20:556-8.

6. Vathsala A. Twenty-five facts about kidney disease in Singapore: in remembrance of World Kidney Day. *Ann Acad Med Singapore* 2007;36:157-60.
7. The Medical (Therapy, Education and Research) Act. Legislative Acts and Guidelines, Ministry of Health, Singapore. Available at: <http://www.moh.gov.sg/mohcorp/legislations.aspx?id=1674>. Accessed 7 July 2008.
8. The Human Organ Transplant Act. Legislative Acts and Guidelines, Ministry of Health, Singapore. Available at: <http://www.moh.gov.sg/mohcorp/legislations.aspx?id=1672>. Accessed 7 July 2008.
9. Sheehy E, Conrad SL, Brigham LE, Luskin R, Weber P, Eakin M, et al. Estimating the number of potential organ donors in the United States. *N Engl J Med* 2003;349:667-74.
10. Lopez-Navidad A, Caballero F. For a rational approach to the critical points of the cadaveric donation process. *Transplant Proc* 2001;33:795-805.
11. Dosemeci L, Yilmaz M, Cengiz B, Dora B, Ramazanoglu A. Brain death and donor management in the intensive care unit: experiences over the last 3 years. *Transplant Proc* 2004;36:20-1.
12. Scheinkestel CD, Tuxen DV, Cooper DJ, Butt W. Medical management of the (potential) organ donor. *Anaesth Intensive Care* 1995;23:51-9.
13. Wood KE, Becker BN, McCartney JG, D'Alessandro AM, Coursin DB. Care of the potential organ donor. *N Engl J Med* 2004;351:2730-9.
14. Ramos HC, Lopez R. Critical care management of the brain-dead organ donor. *Curr Opin Organ Transplant* 2002;7:70-5.
15. Power BM, Van Heerden PV. The physiological changes associated with brain death – current concepts and implications for treatment of the brain dead donor. *Anaesth Intensive Care* 1995;23:26-36.
16. Nygaard CE, Townsend RN, Diamond DL. Organ donor management and organ outcome: a 6-year review from a level I trauma centre. *J Trauma* 1990;30:728-32.
17. Cantin B, Kwok BW, Chan MC, Valentine HA, Oyer PE, Robbins RC, et al. The impact of brain death on survival after heart transplantation: time is of the essence. *Transplantation* 2003;76:1275-9.
18. Salim A, Martin M, Brown C, Rhee P, Demetriades D, Belzberg H. The effects of a protocol of aggressive donor management: implications for the national organ donor shortage. *J Trauma* 2006;61:429-35.
19. Grossman MD, Reilly PM, McMahon DJ, Hanson CW, Anderson HL, Behringer EC, et al. Loss of potential solid organ donors due to medical failure. *Crit Care Med* 1996;24:A76.
20. Powner DJ. The diagnosis of brain death in the adult patient. *J Intensive Care Med* 1987;2:181.
21. The Interpretation Act (2002 revision), Part 1,2A. Criteria for determining death. Available at: <http://statutes.agc.gov.sg/>. Accessed 17 July 2008.
22. Chin KJ, Kwek TK, Lew TWK. A survey of brain death certification – an impetus for standardisation and improvement. *Ann Acad Med Singapore* 2007;36:987-94.
23. Wijdicks EFM. The clinical criteria of brain death throughout the world: why has it come to this? *Can J Anesth* 2006;53:540-3.
24. Doig CJ, Young K, Teitelbaum J, Shemie SD. Brief survey: determining brain death in Canadian intensive care units. *Can J Anesth* 2006;53:609-12.
25. Wood KE, Coursin DB. Intensivists and organ donor management. *Curr Opin Anaesthesiol* 2007;20:97-9.
26. Joshi NR, Margulies DR. Aggressive organ donor management: more from less? *Curr Opin Organ Transplant* 2006;11:141-45.
27. Schnuelle P, Berger S, de Boer J, Persijn G, van der Woude FJ. Effects of catecholeamine application to brain-dead donors on graft survival in solid organ transplantation. *Transplantation* 2001;72:455-63.
28. Totsuka E, Fung JJ, Ishii T, Urakami A, Moras NP, Nakamada K, et al. Influence of donor condition on postoperative graft survival and function in human liver transplantation. *Transplant Proc* 2000;32:322-6.
29. Salim A, Martin M, Brown C, Inaba K, Roth B, Hadjizacharia P, et al. Using thyroid hormone in brain-dead donors to maximise the number of organs available for transplantation. *Clin Transplant* 2007;21:405-9.
30. Salim A, Vassiliu P, Velmahos GC, Sava J, Murray JA, Belzberg H, et al. The role of thyroid hormone administration in potential organ donors. *Arch Surg* 2001;136:1377-80.