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Brief Communication

Communication Gaps Associated With Donor-Derived Infections

R. Miller[1,*], S. Covington[2], S. Taranto[2], R. Carrico[2], A. Ehsan[3], B. Friedman[4], M. Green[5], M. G. Ison[6], D. Kaul[7], B. Kubak[8], D. J. Lebovitz[9], G. M. Lyon[10], M. A. Nalesnik[11], T. L. Pruett[12], L. Teperman[13], B. Vasudev[14] and E. Blumberg[15]

[1]Divisions of Infectious Diseases and Transplant Surgery, University of Iowa Carver College of Medicine, Iowa City, IA
[2]United Network for Organ Sharing, Richmond, VA
[3]Division of Cardiothoracic Surgery, Brown Alpert Medical School, Rhode Island Hospital, Providence, RI
[4]Clinical Global Services, Minnesota International Medicine, Minneapolis, MN
[5]Division of Pediatric Infectious Diseases, University of Pittsburgh Medical Center, Pittsburgh, PA
[6]Divisions of Infectious Diseases and Organ Transplantation, Northwestern University Feinberg School of Medicine, Chicago, IL
[7]Division of Infectious Diseases, University of Michigan Medical Center, Ann Arbor, MI
[8]Division of Infectious Diseases, University of California, Los Angeles, Los Angeles, CA
[9]Division of Critical Care, Akron Children's Hospital, Akron, OH
[10]Division of Infectious Diseases, Emory University Hospital, Atlanta, GA
[11]Division of Transplantation and Hepatic Pathology, University of Pittsburgh Medical Center, Pittsburgh, PA
[12]Department of Transplant Surgery, University of Minnesota Medical Center, Fairview, Minneapolis, MN
[13]Division of Transplant Surgery, New York University Langone Medical Center, New York, NY
[14]Division of Nephrology, Medical College of Wisconsin, Milwaukee, WI
[15]Division of Infectious Diseases, Perelman School of Medicine of the University of Pennsylvania, Philadelphia, PA
[*]Corresponding author: Rachel Miller, rachel-miller@uiowa.edu

The detection and management of potential donor-derived infections is challenging, in part due to the complexity of communications between diverse labs, organ procurement organizations (OPOs), and recipient transplant centers. We sought to determine if communication delays or errors occur in the reporting and management of donor-derived infections and if these are associated with preventable adverse events in recipients. All reported potential donor-derived transmission events reviewed by the Organ Procurement and Transplantation Network Ad Hoc Disease Transmission Advisory Committee from January 2008 to June 2010 were evaluated for communication gaps between the donor center, OPO and transplant centers. The impact on recipient outcomes was then determined. Fifty-six infection events (IEs; involving 168 recipients) were evaluated. Eighteen IEs (48 recipients) were associated with communication gaps, of which 12 resulted in adverse effects in 69% of recipients (20/29), including six deaths. When IEs and test results were reported without delay, appropriate interventions were taken, subsequently minimizing or averting recipient infection (23 IEs, 72 recipients). Communication gaps in reported IEs are frequent, occur at multiple levels in the communication process, and contribute to adverse outcomes among affected transplant recipients. Conversely, effective communication minimized or averted infection in transplant recipients.

Abbreviations: DTAC, Ad Hoc Disease Transmission Advisory Committee; ESBL, extended spectrum beta-lactamase; GNR, Gram-negative rods; IE, infection event; IWDT, intervention without documented transmission; MRSA, methicillin resistant *Staphylococcus aureus*; OPO, organ procurement organization; OPTN, Organ Procurement and Transplantation Network; R, recipient; UNOS, United Network for Organ Sharing; VRE, vancomycin resistant *Enterococcus*

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Introduction

As the organ donor shortage becomes magnified by increasing numbers of individuals with organ failure on transplant waiting lists, the increased demand results in the routine use of organs from deceased donors with known or increased risk for infection. Organ donor screening for infections is currently based on donor history, physical assessment and laboratory testing (1,2). However, to maximize organ utilization and minimize time delays to optimize allograft function, organs may occasionally be transplanted before behavioral risk factors and/or confirmatory testing of initial laboratory screening tests are fully known based upon a recipient's critical need and life expectancy without immediate transplant. Additionally, there are areas of the United States that do not have

access to timely nucleic acid testing to screen for transmissible viruses. Although transplant transmitted infections are uncommon, they continue to occur due to recognized challenges in detecting these infections and the use of imperfect screening tools (3–5). Even if a donor transmitted infection is suspected in a transplant recipient, clinicians may be unaware of how to obtain and/or report relevant donor/recipient information (6).

Organ Procurement and Transplantation Network (OPTN) policy requires organ procurement organizations (OPOs) to perform evaluations to determine whether there are conditions that may influence donor acceptance (laboratory testing, physical exam, medical/behavioral history, review of donor's medical records) and provide this information to transplant centers considering organ offers (1). In addition, policy requires OPOs and transplant centers to report any unexpected potential donor-derived infection in a transplant recipient to the OPTN within 24 h of initial suspicion of transmission. Reporting may involve one or more recipients suspected to have, confirmed positive for, or deceased due to disease (infectious or malignant) for which there is substantial concern of donor origin. Conversely, reporting may also be triggered by new donor information relevant to acute patient care learned after recovery and/or transplant of donor organs, with autopsy report or final culture results as an example. Once a report is made, the OPTN Ad Hoc Disease Transmission Advisory Committee (DTAC) confidentially reviews all reports to determine if donor-derived disease transmission occurred. The Committee then reviews aggregate data on all reported cases to guide OPTN policy development and educate the broader transplant community regarding potential donor-derived events.

Effectively communicating relevant recipient and donor information in real time to those involved in individual transplant transmission events is challenging due to the complexity of the communication networks among geographically diverse laboratories, OPOs, and recipient transplant centers. Even with a web-based reporting mechanism available through the OPTN Improving Patient Safety portal, communication gaps may occur and in some cases, have a significant impact on recipient morbidity and mortality (7,8).

The purpose of this study was to determine if delays and errors in communications occur in the reporting and management of donor-derived infections and if communication gaps are associated with preventable adverse events in transplant recipients. Based on our review of the DTAC experience, we assessed the frequency and impact of communication gaps.

Methods

We reviewed all potential donor-derived infection transmission events reported to the OPTN DTAC from January 2008 to June 2010. We included only infection events (IEs) classified as proven, probable or intervention without documented transmission (IWDT) per standard DTAC case classification (9). Donor-derived transmission classifications were defined as follows: (1) proven: proven disease in the donor and at least one recipient; (2) probable: disease in one or more recipients with suggestive data that the donor was the source of the disease; (3) IWDT: no transmission occurred due to the administration of antimicrobials to one or more of the recipients. Case classification and recipient outcomes were based on follow-up at 45 days per OPTN policy.

Although OPTN policy requires information surrounding possible transmission events to be communicated within 24 h (1), we defined a delay in communication as >3 days. This time frame was chosen as the longest reasonable time frame for reporting, acknowledging the difficult logistics that are inherent in the reporting process, the relative newness of the reporting system and our degree of certainty to accurately pinpoint when the communication occurred. As each organ donor resulted in organ transplantation in one to five recipients and recognizing that not all recipients from a common donor were of equal risk for the development of infection, a separate analysis for adverse recipient events was performed among reported transmission events that were classified as proven or probable. Adverse recipient events were defined as the development of an unexpected clinical infection, a more severe infection that resulted than otherwise would have been expected had the communication delay or error not occurred, or death. The association between adverse events and delay or error in reporting was examined by comparing those recipients with delays or errors to those in whom reporting occurred within the 72 h time frame. Data were analyzed using GraphPad Prism version 5 (GraphPad Software, San Diego, CA) and SAS (version 9.3; SAS Institute, Cary, NC). Estimates of relative risk were used to compare association between categorical variables as appropriate. Additionally, the specific circumstance of the communication gap was determined in order to assess whether there was a specific situation where communication breakdown was most likely to occur.

Results

We reviewed 66 IEs involving 196 transplant recipients during a 2.5-year period. Ten IEs were excluded from analysis. In three of these events, specific donor serologies (human T-lymphotrophic virus, *Toxoplasma* and *Trypanosoma cruzii*) were obtained preprocurement based on known donor risk factors and resulted after transplantation. In these cases, infection transmission was anticipated and appropriate action was then taken preemptively in the recipients after transplantation. For the remainder of excluded IEs, no organism was identified (n = 1), serology results were falsely negative and/or discordant (n = 5), or test results were noninterpretable (n = 1).

As displayed in Table 1, of the 56 evaluable IEs (168 recipients), 38 IEs involving 120 transplant recipients were without communication delays/errors (Figure 1). When communication within the 72 h window was effective and prompt intervention (where available) was initiated, recipient infection was minimized or averted. In the 23 of 38 IEs without communication delays/errors, intervention positively influenced case outcome for 72 of 120 transplant recipients. For the remaining 15 IEs without communication delays/errors, the communication process had no influence on the case outcome due to lack of availability of

Table 1: Summary of event and individual recipient outcomes for 56 proven, probable, and IWDT infection events reviewed by DTAC January 2008–June 2010

	IE	%	Recipients	%
Communication delay				
No	38	67.9	120	71.4
Yes	18	32.1	48	28.6
Total	56	100.0	168	100.0

	IE			Recipients	
	N	%		N	%
No communication delay					
Positive intervention	23	60.5		72	60.0
No influence	15	39.5		48	40.0
Total	38	100.0		120	100.0
Communication delay					
At least one recipient with an adverse event	12	66.7	Adverse event	20	41.7
			No adverse event	9	18.8
No adverse event	6	33.3	No adverse event	19	39.6
Total	18	100.0	Total	48	100.0

DTAC, Ad Hoc Disease Transmission Advisory Committee; IE, infection event; IWDT, intervention without documented transmission.

an effective treatment strategy (five IEs), prolonged pathogen incubation time prohibiting timely identification and intervention in recipients (six IEs), or deferral of prophylaxis administration to the recipients by the transplant center without adverse consequences (four IEs). Conversely communication delays/errors were found in 18 IEs involving 48 transplant recipients. Twelve of the 18 IEs with communication delays/errors (67%) were associated with an adverse event in at least one recipient. These 12 events collectively involved 29 transplant recipients; 9/29 recipients (31%) had no adverse events associated with the communication delay/error. However, the remaining 20/29 (69%) recipients experienced an adverse event, including six recipient deaths.

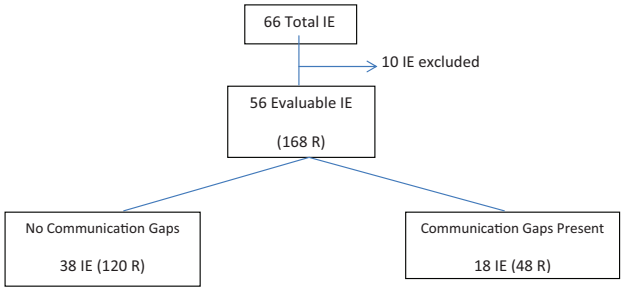

Figure 1: Potential donor-derived infection events (IE) and coinciding numbers of recipients (R) reported to the Organ Procurement and Transplantation Network Ad Hoc Disease Transmission Advisory Committee, with and without associated communication gaps.

Recognizing that not all transplant recipients receiving organs from a common donor were at equal risk for the development of an adverse event, a separate analysis was performed among the recipients involved in potential donor-derived IEs to determine if there was an association between the incidence of proven or probable transmission events and the occurrence of a communication gap. Among the 56 evaluable IEs, there were 168 organ transplant recipients. Of these, 56 recipients experienced a proven or probable infection transmission event, whereas 112 recipients did not. Of the recipients that experienced a proven or probable transmission, 26/56 (46.4%) were subject to a communication gap. In comparison, 22/112 (19.6%) recipients without a proven or probable transmission were subject to a communication gap (Table 2). There was a significant association between having a proven/probable transmission or not, and the presence or absence of a communication gap present ($\chi^2_1 = 13.13$, $p = 0.0003$). The odds of a communication gap are 3.54 times higher (95% CI [1.76, 7.16]) for those with a proven/probable transmission than those without. Equivalently, recipients with a proven or probable infection transmission event were significantly more likely to have a communication gap surrounding the transmission event than those recipients whose exposure to a potential IE was without a communication gap. The relative risk of developing a proven or probable infection transmission event was 2.36 (95% CI [1.48–3.78]) for these recipients.

All pathogens involved in the 56 unexpected donor-derived IEs are summarized in Table 3. For recipients with and without communication gaps, IEs involving bacterial

Table 2: Number of transplant recipients (%) with evaluable potential donor-derived infection events reported to Organ Procurement and Transplantation Network Ad Hoc Disease Transmission Advisory Committee, comparing those recipients with and without proven/probable transmissions and whether a communications gap occurred

	Communication gap		
	Yes (%)	No (%)	Total (%)
Proven/probable transmission			
Yes (%)	26 (46.4)	30 (53.6)	56 (100.0)
No (%)	22 (19.6)	90 (80.4)	112 (100.0)
Total (%)	48 (28.6)	120 (71.4)	168 (100.0)

Table 3: Distribution of organisms involved in evaluable infection events (IE) with and without associated communication gaps

Organism type	Infection events *without* communication gaps (n = 38)	Infection events *with* communication gaps (n = 18)
Bacteria	18 total IEs (47%)	11 total IEs (61%)
	Mycobacterium tuberculosis (8)	*Enterococcus* sp.
	Staphylococcus aureus (MRSA)	*Enterococcus* (VRE)
	Streptococcus pneumoniae (2)	*E. coli*
	Abiotrophia sp.	ESBL *E. coli*
	Enterococcus gallinarium	*Acinetobacter/ Enterobacter*
	E. coli	*Klebsiella* sp.
	Enterobacter sp.	*Pseudomonas* sp. (2)
	Pseudomonas sp.	*Serratia* sp.
	Serratia sp.	*Ehrlichia* (2)
	Nocardia	
Viruses	5 total IEs (13%)	3 total IEs (17%)
	West Nile virus (2)	Cytomegalovirus
	Parvovirus	Hepatitis C virus
	H1N1 influenza virus	
	Lymphocytic choriomeningitis virus	
Fungi	12 total IEs (32%)	3 total IEs (17%)
	Candida albicans	*Cryptococcus neoformans* (3)
	Candida glabrata	
	Aspergillus (2)	
	Coccidioides immitis (3)	
	Histoplasma capsulatum (2)	
	Blastomyces dermatitidis	
	Zygomyces	
Parasites	3 total IEs (8%)	1 total IE (6%)
	Strongyloides (2)	*Toxoplasma* sp.
	Balamuthia mandrillaris	

ESBL, extended spectrum betalactamase; MRSA, methicillin resistant *Staphylococcus aureus*; VRE, vancomycin resistant *Enterococcus*.

pathogens were the most common (61% and 47%, respectively), followed by fungal pathogens (17% and 32%, respectively), viruses (17% and 13%, respectively) and parasites (6% and 8%, respectively). Although the wide variety of organisms found among the IEs precluded systematic analysis due to small numbers of patients, the proportion of antibiotic resistant bacterial pathogens (defined as methicillin resistant *Staphylococcus aureus*, vancomycin resistant *Enterococcus*, extended spectrum betalactamase *E. coli* and other hospital-acquired Gram-negative rod infections including *Pseudomonas*, *Serratia*, *Acinetobacter*, *Enterobacter*) was higher in the group with communication gaps (64% vs. 22% of bacterial IEs). Recipients with donor-derived bacterial infections became symptomatic in the range of 6–43 days after transplant. All of the *Cryptococcus* transmissions occurred in the group with communication gaps (n = 3 IEs), with a 1 month or more delay by donor centers in performing donor autopsies and communicating positive findings to the OPO in two of these IEs. Four of the six recipient deaths were attributable to donor-transmitted infections with antibiotic resistant bacterial pathogens or *Cryptococcus*.

Upon closer review of the type of communication delays/errors that occurred in all 18 IEs with communication errors/delays, we identified that gaps occurred at several points in the communication process and some IEs involved more than one communication gap. Specifically, in five IEs, the transplant center delayed contacting the OPO or the OPTN with a suspected donor-derived infection (range 22–56 days). In four IEs, the laboratory failed to relay donor results (including autopsy results) to the OPO and/or transplant center. Other communication gaps included an OPO delay in contacting the OPTN or transplant centers (three IEs), clerical errors in the reporting donor viral serologies (three IEs), and incomplete communication of test results by the OPO to transplant centers (three IEs). Case details of three of the aforementioned IEs have been previously published (7,10,11).

Discussion

Communication between donor hospitals, OPOs and transplant centers is a complex process, requiring the ongoing exchange of information in a time-critical manner. Our review of potential donor-derived infection transmission events reported to the OPTN DTAC demonstrates that delays and errors in communication are frequent and occur at multiple levels in the communication process. The majority of communication gaps occurred within 2 months of transplantation and involved bacterial pathogens. This is likely the result of OPTN policy requiring routine preprocurement donor bacterial cultures and the ease of linking subsequent recipient infections to these donor cultures, rather than any characteristics inherent to bacterial pathogens. These communication gaps contributed to adverse outcomes among affected transplant recipients,

in some cases even leading to potentially preventable recipient deaths. Conversely, effective communication was associated with minimized or averted infection in transplant recipients through the implementation of preventive or preemptive treatment strategies.

Based on observations such as these, improving communication at all levels in the transplant process has been an area of focus in the transplant community, informed by lessons learned by DTAC's ongoing review of reports of potential donor-derived disease transmissions. In 2011, the OPTN implemented policy changes regarding communication, largely focusing on the procedures for OPOs and transplant centers to report and share donor-related information with relevant groups (1). This included policy requiring the identification of specific individuals responsible for communication on a 24 h daily basis at all centers and OPOs. Further refinements of the process are currently being explored by the OPTN as resources available for this process vary tremendously at all levels and all institutions. Obtaining results from diverse locations and communicating them in a timely manner is especially challenging given the variable access to efficient communication systems. A failure mode and effects analysis is currently under way as a joint effort with representation from the OPO, Transplant Administrators and Transplant Coordinators Committees. The committee is tasked with identifying areas of communication breakdown in this process in order to improve posttransplant communication of new donor information. Other organizations, including the Council of State and Territorial Epidemiologists, Centers for Disease Control and World Health Organization, are also involved in improving these communication deficiencies in the context of transplant-transmitted disease on a broader scope (12,13). Educational efforts continue by all groups, targeting transplant and nontransplant healthcare providers, to increase awareness of potential donor-derived events, utilize the existing reporting process, and understand the channels of communication to obtain timely, clinically relevant information for patient management. Our findings also support future actions to require expedited donor autopsies with reporting of findings to OPOs, as well as safeguards to prevent clerical errors in the reporting of donor serologies.

This study has several limitations, primarily related to the existing OPTN reporting process. The data collection is retrospective, and information available for reported IEs in real time may be incomplete. Follow-up information on these events is limited and testing recommendations provided by DTAC necessary to prove/disprove donor transmission are not always followed. As such, there is the possibility of bias in data interpretation surrounding these events. Recognition of IEs relies on the passive reporting system through the OPTN. Although reporting of suspected donor-derived transmission events is required by OPTN policy (1), we believe that underreporting may occur, due both to the failure of clinicians to recognize the occurrence of this possibility or incomplete understanding of the reporting requirements. The passive reporting system also precludes determining the true incidence of these transmission events due to lack of denominator data. These limitations may result in an over- or underestimate of the number and severity of communication gaps occurring within the organ procurement and transplant process.

Despite these limitations, our study clearly highlights the potential for communication gaps to lead to unexpected and potentially preventable adverse events. Equally importantly, it highlights the potential benefits to timely communication as a means to prevent or ameliorate the impact of donor-derived transmissible disease, thereby promoting the expansion of the donor pool by utilizing more donors with potentially treatable infections. Further research to more fully understand the causal factors for communication delays and errors is critically needed to improve patient safety. Developing a comprehensive understanding of how this communication process occurs and the factors leading to inefficient transmission of critical information will lead to developing steps to improve the transplantation process.

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Disclosure

The authors of this manuscript have no conflicts of interest to disclose as described by the *American Journal of Transplantation*.

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