**SUPPORTING INFORMATION**

**Figure S1. Study population**

Adult patients who received a solid organ transplant (SOT) at Duke University Hospital (DUH)

in the period Jan 1, 2015 - Dec 31, 2019

n=2074

**Single organ SOT**

**n=1955**

**Late SSI**

n=32



**Late Invasive Primary SSI**

n=26

**Multi organ SOT**

**n=118**

1-year follow-up at DUH available

**n=2073**

**study population**

**Figure S2. Rate of late invasive primary surgical site infections (IP-SSI) among adult solid organ transplant recipients at Duke University Hospital in the period Jan 1, 2015 – Dec 31, 2019.**

**Figure S3. Time from transplant to development of late invasive primary surgical site infection (IP-SSI) among adult patients who received a solid organ transplant at Duke University Hospital in the period Jan 1, 2015 - Dec 31, 2019. Analysis limited to monomicrobial late IP-SSI and stratified by pathogen category.**

![A graph with blue squares

Description automatically generated]()

**Figure S4. Microbiology of late IP-SSI compared to microbiology of early IP-SSI for adult solid organ transplant recipients transplanted at Duke University Hospital in the period Jan 1, 2015 – Dec 31, 2019.**

**Figure S5. Survival curve in the first year after transplant** **for adult solid organ transplant recipients transplanted at Duke University Hospital in the period Jan 1, 2015 – Dec 31, 2019 and diagnosed with late invasive primary surgical site infections (IP-SSI) *vs.* those diagnosed with early invasive primary surgical site infections (IP-SSI).**

**![A screenshot of a computer screen

Description automatically generated]()**

**Table S1. Prior published studies assessing the rate of surgical site infections (SSI) among solid organ transplants.**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **First author** | **Study period** | **Study sites (n)** | **Study**  **design** | **Organ types** | **Study population (n)** | **SSI rate (%)** | **Follow-up duration (days)** | **Comments** |
| Shields | 2006-2010 | 1 | Retrospective | Lung | 586 | 5.0 | 90 |  |
| Aguilar | 2010-2014 | 1 | Retrospective | Lung | 232 | 9.0 | 180 | Median time to SSI diagnosis from transplant 25 days (range 7-126). Only one SSI (Aspergillus fumigatus) diagnosed beyond 90 days from transplant |
| Moraes | 2011-2016 | 1 | Retrospective | Lung | 121 | 15.7 | 90 |  |
| Ramos | 2003-2005 | 11 | Prospective | Heart | 292 | 4.8 | 365 | Median time to SSI diagnosis from transplant 14 days (range 3-75) |
| Perdiz | 2000-2006 | 1 | Retrospective | Kidney & Pancreas | 119 | 46.2 | 30 |  |
| Natori | 2000-2015 | 1 | Retrospective | Kidney & Pancreas | 445 | 24.3 | 30 |  |
| Schreiber | 2008-2021 | 6 | Retrospective | Kidney & Pancreas | 108 | 13.9 | 90 |  |
| Abdo-Cuza | 2013-2018 | 1 | Retrospective | Liver, Kidney | 164 | 24.0 kidney  19.0 liver | NA |  |
| Capocasale | 1988-2012 | 1 | Retrospective | Kidney | 1000 | 2.0 | 30 |  |
| Dantas | 2000-2001 | 1 | Prospective | Kidney | 163 | 11.0 | 30 |  |
| Ramos | 2003-2005 | 11 | Prospective | Kidney | 1400 | 4.5 | 90 |  |
| Ho | 2003-2008 | 1 | Retrospective | Kidney | 869 | 18.5 | 30 |  |
| Harris | 2010-2011 | 1 | Retrospective | Kidney | 441 | 15.0 | 30 |  |
| Dos Santos | 2010-2015 | 1 | Retrospective | Kidney | 428 | 2.1 | NA |  |
| Ostaszewska | 2014-2015 | 1 | Retrospective | Kidney | 214 | 5.6 | 365 | No data available regarding median time to SSI diagnosis from transplant |
| Ostaszewska | 2015-2018 | 1 | Retrospective | Kidney | 254 | 3.9 | 365 | No data available regarding median time to SSI diagnosis from transplant |
| Hollenbeak | 1990-1995 | 3 | Prospective | Liver | 777 | 37.5 | 365 | SSI were recorded 4-11 weeks after transplant |
| Iinuma | 2001-2002 | 1 | Prospective | Liver | 111 | 37.0 | Until hospital discharge |  |
| Yamamoto | 2001-2002 & 2011-2012 | 1 | Prospective | Liver | 201 | 30.0 in 2001-02  40.0 in 2011-12 | 30 |  |
| Freire | 2002-2011 | 1 | Retrospective | Liver | 597 | 23.6 | 60 |  |
| Prado | 2003-2006 | 1 | Prospective | Liver | 167 | 33.5 | NA |  |
| Oguz | 2003-2013 | 1 | Retrospective | Liver | 412 | 15.5 | NA |  |
| Banach | 2007-2017 | 1 | Retrospective | Liver | 86 | 9.3 | 30 |  |
| Oliveira | 2009-2015 | 1 | Retrospective | Liver | 156 | 26.9 | 30 |  |
| Viehman | 2010-2014 | 1 | Retrospective | Liver | 331 | 18.0 | 90 |  |
| Natori | 2011-2014 | 1 | Prospective | Liver | 250 | 18.8 | 60 |  |
| Natori | 2011-2014 | 1 | Retrospective | Liver | 229 | 15.7 | 30 |  |
| Hrenczuk | 2016-2017 | 1 | Retrospective | Liver | 60 | 26.7 | 30 |  |

**Table S2. Adult solid organ transplants performed at Duke University Hospital in the period Jan 1, 2015 – Dec 31, 2019 and complicated by late surgical site infections.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **All Late SSIa**  **n (%)** | **Late Invasive SSIb**  **n (%)** | **Late Invasive Secondary SSIc**  **n (%)** | **Late Invasive Primary SSId**  **n (%)** |
| **All SOT** (n=2073) | 32 (1.5) | 26 (1.3) | - | 26 (1.3) |
| **Single organ SOT** (n=1955) | 30 (1.5) | 24 (1.2) | - | 24 (1.2) |
| Lung (n=523) | 19 (3.6) | 17 (3.3) | - | 17 (3.3) |
| Heart (n=315) | 7 (2.2) | 6 (1.9) | - | 6 (1.9) |
| Liver (n=381) | 2 (0.5) | - | - | - |
| Kidney (n=728) | 2 (0.3) | 1 (0.1) | - | 1 (0.1) |
| Pancreas (n=4) | - | - | - | - |
| Intestine (n=1) | - | - | - | - |
| Other (n=3) | - | - | - | - |
| **Multi organ SOT** (n=118) | 2 (1.7) | 2 (1.7) | - | 2 (1.7) |
| Lung-heart (n=5) | 1 (20.0) | 1 (20.0) | - | 1 (20.0) |
| Lung-liver (n=5) | 1 (20.0) | 1 (20.0) | - | 1 (20.0) |
| Lung-kidney (n=2) | - | - | - | - |
| Heart-liver (n=4) | - | - | - | - |
| Heart-kidney (n=15) | - | - | - | - |
| Liver-kidney-pancreas-intestine (n=1) | - | - | - | - |
| Liver-pancreas-intestine (n=5) | - | - | - | - |
| Liver-kidney (n=45) | - | - | - | - |
| Kidney-pancreas (n=35) | - | - | - | - |
| Intestine-abdominal wall (n=1) | - | - | - | - |

a Includes all SSI (primary and secondary site infections as well superficial and invasive infections); b Invasive SSI (excludes superficial SSI, primary and secondary are included); c Includes only invasive secondary site infections (i.e. ECMO cannulation sites); d Includes only invasive primary site infections (excludes superficial and secondary infections).

**Table S3. Isolates identified among all solid organ transplant recipients diagnosed with a late invasive primary surgical site infection (IP-SSI) at Duke University Hospital in the period Jan 1, 2015 - Dec 31, 2019.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **2015** | **2016** | **2017** | **2018** | **2019** | **2015-2019** |
| **Gram positive bacteria, n (%)** | 2 (25.0) | 2 (50.0) | 3 (50.0) | 4 (50.0) | 3 (37.5) | 14 (41.2) |
| **Gram negative bacteria, n (%)** | 3 (37.5) | 2 (50.0) | 1 (16.7) | 2 (25.0) | 3 (37.5) | 11 (32.4) |
| **MDR Gram negative bacteria, n (% among Gram neg)**a | 2 (66.6) | - | - | 1 (50.0) | - | 3 (27.3) |
| **Yeasts, n (%)** | 3 (37.5) | - | 2 (33.3) | 1 (12.5) | 1 (12.5) | 7 (20.6) |
| **Nontuberculous mycobacteria, n (%)** | - | - | - | 1 (12.5) | 1 (12.5) | 2 (5.9) |
| **Total isolates, n** | 8 | 4 | 6 | 8 | 8 | 34 |

a Percentages are calculated based on the total number of organisms identified during each period, with the exception of MDR Gram negative organisms where the percentage is calculated on the number of Gram negative organisms isolated during each period.

**Table S4. Length of hospital stay among adult solid organ transplant recipients transplanted at Duke University Hospital in the period Jan 1, 2015 – Dec 31, 2019 by organ population. Length of hospital stay is compared among two groups: patients diagnosed with late IP-SSI and patients without SSI. Patients diagnosed with a surgical site infection other than IP-SSI and patients diagnosed with both an early and a late IP-SSI were excluded from the analysis.**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Length of index transplant hospital stay, median days (IQR)** | | |
| **Late IP-SSI** | **No-SSI** | **p-value** |
| **All SOT** | 39.0 (17.0-97.0) | 15.0 (9.0-28.0) | **<0.01** |
| **Single organ SOT** | 39.0 (17.0-97.0) | 15.0 (9.0-28.0) | **<0.01** |
| Lung | 29.5 (16.3-92.0) | 22.0 (15.0-38.0) | **<0.01** |
| Heart | 47.5 (35.5-117.3) | 42.0 (20.3-60.5) | 0.20 |
| Liver | - | 9.0 (7.0-16.0) | - |
| Kidney | - | 5.0 (4.0-7.0) | - |
| **Multi organ SOT** | - | 11.0 (7.5-34.5) | - |

**Table S5. Length of hospital stay among adult solid organ transplant recipients transplanted at Duke University Hospital in the period Jan 1, 2015 – Dec 31, 2019 by organ population. Length of hospital stay is compared among two groups: patients diagnosed with late invasive primary surgical site infection (IP-SSI) and patients diagnosed with early IP-SSI. Patients diagnosed with a superficial surgical site infection and patients diagnosed with early and late IP-SSI were excluded from the analysis.**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Length of hospital stay, median (IQR)** | | |
| **Late IP-SSI** | **Early IP-SSI** | **p-value** |
| **All SOT** | 39.0 (17.0-97.0) | 29.0 (11.3-72.8) | 0.72 |
| **Single organ SOT** | 39.0 (17.0-97.0) | 29.0 (12.0-66.0) | 0.75 |
| Lung | 29.5 (16.3-92.0) | 43.5 (24.0-99.0) | 0.66 |
| Heart | 47.5 (35.5-117.3) | 51.0 (30.0-105.0) | 0.53 |
| Liver | - | 20.0 (11.0-43.0) | - |
| Kidney | - | 7.0 (4.0-13.0) | - |
| **Multi organ SOT** | - | 30.0 (9.0-92.8) | - |

**Table S6. 1-year all-cause mortality and 1-year graft failure among adult solid organ transplant recipients transplanted at Duke University Hospital in the period Jan 1, 2015 – Dec 31, 2019 by organ population. 1-year all-cause mortality and 1-year graft failure are compared among two groups: patients diagnosed with late onset invasive primary surgical site infection (late IP-SSI) and patients without SSI alive at day 90. Patients diagnosed with a superficial surgical site infection and early surgical site infection were excluded from the analysis.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **1-year all-cause mortality, n (%)** | | | **1-year graft failure, n (%)** | | |
|  | **Late IP-SSI (n=22)** | **No-SSI (n=1767)** | **p-value** | **Late IP-SSI**  **(n=22)** | **No-SSI**  **(n=1767)** | **p-value** |
| **All SOT** | 2 (9.1) | 64 (3.6) | 0.19 | 3 (13.6) | 85 (4.8) | 0.09 |
| **Single organ SOT** | 2 (9.1) | 62 (3.7) | 0.20 | 3 (13.6) | 82 (4.8) | 0.09 |
| Lung | 2 (14.3) | 28 (6.7) | 0.25 | 1 (7.1) | 33 (7.9) | 1.00 |
| Heart | 0 (0.0) | 15 (5.8) | 1.00 | 1 (16.7) | 17 (6.6) | 0.35 |
| Liver | - | 9 (2.6) | - | - | 7 (2.0) | - |
| Kidney | 0 (0.0) | 10 (1.5) | 1.00 | 1 (50.0) | 25 (3.7) | 0.08 |
| **Multi organ SOT** | - | 2 (2.8) | - | - | 3 (4.2) | - |

**Table S7. 1-year all-cause mortality and 1-year graft failure among adult solid organ transplant recipients transplanted at Duke University Hospital in the period Jan 1, 2015 – Dec 31, 2019 by organ population. 1-year all-cause mortality and 1-year graft failure are compared among two groups: patients diagnosed with late invasive primary surgical site infection (IP-SSI) and patients diagnosed with early IP-SSI. Patients diagnosed with a superficial surgical site infection were excluded from the analysis.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **1-year all-cause mortality, n (%)** | | | **1-year graft failure, n (%)** | | |
|  | **Late IP-SSI** | **Early IP-SSI** | **p-value** | **Late IP-SSI** | **Early IP-SSI** | **p-value** |
| **All SOT** | 2 (9.1) | 33 (17.2) | 0.54 | 3 (13.6) | 48 (25.0) | 0.30 |
| **Single organ SOT** | 2 (9.1) | 27 (17.5) | 0.54 | 3 (13.6) | 35 (22.7) | 0.42 |
| Lung | 2 (14.3) | 19 (28.8) | 0.33 | 1 (7.1) | 19 (28.8) | 0.17 |
| Heart | 0 (0.0) | 5 (20.0) | 0.55 | 1 (16.7) | 5 (20.0) | 1.00 |
| Liver | - | 2 (8.3) | - | - | 3 (12.5) | - |
| Kidney | 0 (0.0) | 1 (2.7) | 1.00 | 1 (50.0) | 8 (21.6) | 0.41 |
| **Multi organ SOT** | - | 6 (15.8) | - | - | 13 (34.2) | - |