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Wits Transplant Unit Annual Report 2022: Adult and paediatric liver transplantation

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In 2022, the Wits Transplant Unit performed 57 liver transplants: 33/57 adult (58%) and 24/57 paediatric (42%) recipients. At the beginning of 2022, 28 candidates were on the adult waitlist. Forty-six candidates were added to the waitlist during the year. Sixty-five percent of waitlisted candidate were transplanted. Adult candidates remained on the waitlist for longer than previous years, with 52% of them waitlisted for less than one year before undergoing liver transplantation. There was a decrease in adult pretransplant mortality to 9% in 2021 from 25% in 2020. The most common aetiology in waitlist candidates was alcoholic steatohepatitis (ASH)/non-alcoholic steatohepatitis (NASH) (36%) and in recipients cholestatic (primary sclerosing cholangitis (PSC) and primary biliary sclerosis (PBC)) (40%). Most adult recipients received a deceased donor graft (79%). Unadjusted recipient one- and three-year survivals were 75% (95% confidence interval (CI) 65 - 83) and 74% (95% CI 65 - 81), respectively. In the paediatric population, the most common aetiologies for both pretransplant candidates and transplant recipients remained cholestatic disease and acute liver failure. There was a decrease in paediatric pretransplant mortality from 27% in 2017 to 6% in 2021. Unlike the adult cohort, most paediatric recipients received a living donor graft (79%). Unadjusted one-year and three-year survival rates were 85% (95% CI 75 - 92) and 68% (95% CI 56 - 77), respectively.

S Afr Med J 2024;114(3b):e1365. https://doi.org/10.7196/SAMJ.2024.v114i3b.1365

1. Adult liver transplantation: Wits Transplant Unit 2022

1.1 Waiting list

At the end of 2022, 50 adult liver transplant candidates remained on the waiting list, which was higher than in previous years (Fig. 1). Of those on the waiting list, 52% were transplanted within one year of waitlisting (Table 1). Most candidates were in the 50 - 64-year age group (46%) with a slight female predominance (56%) (Table 1). The most common indications for listing for liver transplant were alcoholic steatohepatitis (ASH)/non-alcoholic steatohepatitis (NASH) (36%) and cholestatic causes (primary sclerosing cholangitis (PSC); primary biliary sclerosis (PBC)) (34%) (Table 2).

1.2 Waiting list outcomes

Progressively fewer adult candidates have been listed each year since 2017, with the lowest reported in 2022 (Fig. 1). The decline in numbers of waitlisted adults may be related to decreasing referrals from non-transplant

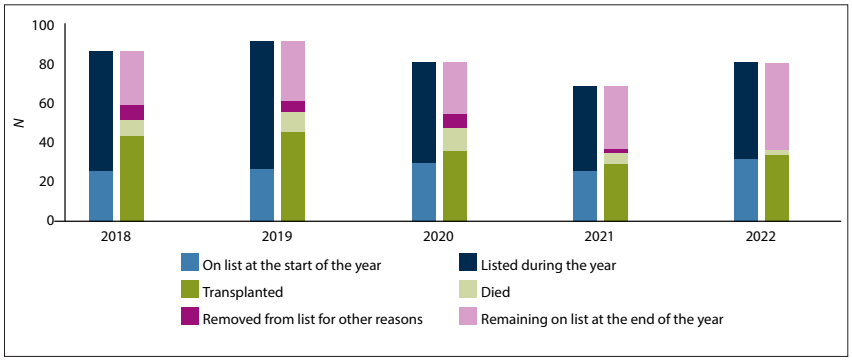

Fig. 1. Adult liver transplant waiting-list candidates: Inflow and outflow of the waiting list.

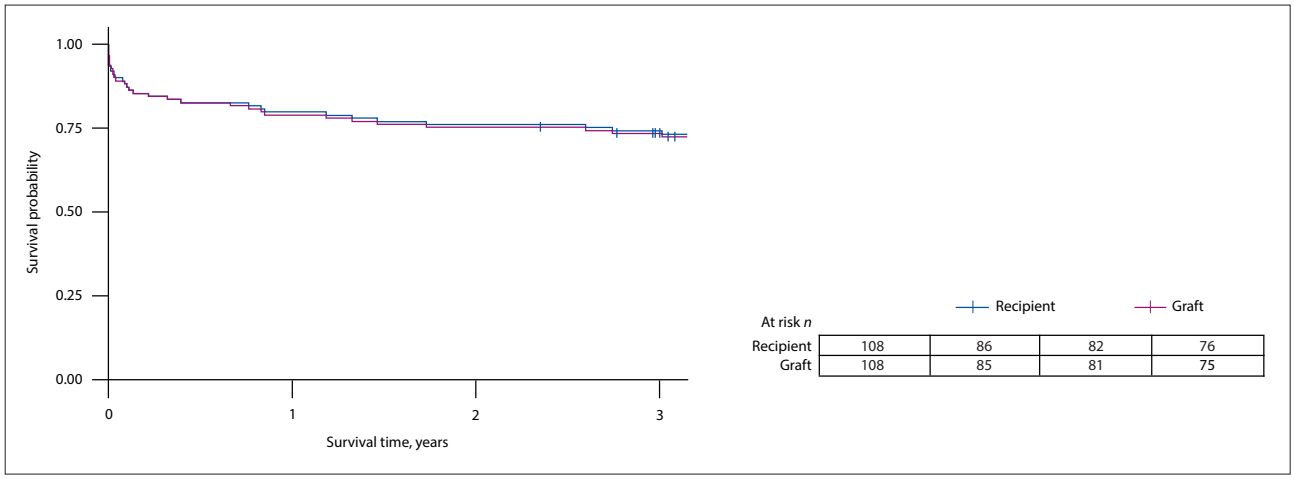

Fig. 2. Three-year adult recipient and graft survival.

Table 1. Characteristics of adult liver transplant candidates on the waiting list at the end of each year

Characteristics	2018	2019	2020	2021	2022
Number of candidates	**27**	**32**	**28**	**33**	**50**
Age (%)					
18 - 34 years	15	28	11	21	16
35 - 49 years	33	28	25	30	28
50 - 64 years	41	38	43	43	46
≥65 years	11	6	21	6	10
Sex (%)					
Female	52	41	57	52	56
Male	48	59	43	48	44
Medical urgency (%)					
Status 1	0	19	0	0	0
MELD ≥35	-	-	-	-	-
MELD 30 - 34	-	-	-	-	-
MELD 15 - 29	-	-	-	-	-
MELD <15	100	81	100	100	100
Wait time (%)					
<1 year	67	72	57	55	52
1 -<2 years	26	19	21	27	22
2 -<3 years	7	6	18	12	16
3 -<4 years	-	3	4	6	10
4 -<5 years	-	-	-	-	-
≥5 years	-	-	-	-	-

MELD = model for end-stage liver disease.

Table 2. Indication for liver transplant in waitlisted adults

Indications		2018	2019	2020	2021	2022
Number of candidates		27	32	28	33	50
Diagnosis of liver failure (%)						
Acute liver failure		4	-	7	6	4
Chronic	ASH/NASH	33	22	39	36	36
	Cholestatic	41	50	39	40	34
	Malignancy	4	6	4	6	4
	Hepatitis B	-	3	-	3	2
	Metabolic	3	3	4	3	-
	Hepatitis C	4	-	-	-	-
	Other	11	13	7	6	18
	Unknown	-	3	-	-	2

ASH = alcoholic steatohepatitis; NASH = non-alcoholic steatohepatitis.

Table 3. Outcomes of adult liver transplant candidates one year after listing

Candidate outcomes	2017	2018	2019	2020	2021
Candidates already on list at start of year	-	25	27	32	28
Candidates listed during year	70	61	66	51	46
Status at 1 year after listing (%)					
Transplanted	66	62	73	49	65
Died	10	13	11	25	9
Removed from list	11	10	8	2	0
Still waiting for transplant	13	15	9	24	26

Table 4. Donor characteristics: Adult recipients

Characteristics	2018	2019	2020	2021	2022
Number of transplants	44	47	34	29	33
Blood type (%)					
A	36	34	35	14	42
B	27	13	15	17	12
AB	5	6	3	3	9
O	32	47	47	66	37
Donor risk index (deceased donors) (%)					
≤1.00	0	0	0	0	0
1.01 - 1.40	23	28	26	18	12
1.41 - 1.60	20	11	18	18	4
1.61 - 1.80	14	22	15	12	11
1.81 - 2.00	14	11	11	23	23
>2.00	27	22	11	23	38
Unknown	2	6	19	6	12
Donor-recipient blood group compatibility (%)					
ABO incompatibility	16	23	9	10	15

Table 5. Adult recipient blood group

Blood group	2018	2019	2020	2021	2022
Number of transplants	44	47	34	29	33
Blood type (%)					
A	32	26	23	28	46
B	25	15	21	17	12
AB	7	4	9	0	6
O	36	55	47	55	36

Table 6. Donor-adult recipient serology matching for 2022

Donor/recipient	CMV	Hep B core	Hep B surf. ant.	Hep C	HIV
D-/R-	-	76	64	97	91
D-/R+	18	6	12	-	-
D-/R unknown	6	-	-	-	-
D+/R-	9	6	12	-	-
D+/R+	52	-	-	-	-
D+/R unknown	-	3	-	-	-
D unknown/R-	-	6	6	3	9
D unknown/R+	12	3	6	-	-
D unknown/R unknown	3	-	-	-	-

CMV = cytomegalovirus; Hep B surf. ant. = hepatitis B surface antigen.

care practitioners for review. This decrease may be driven by lack of clarity regarding the work-up and listing process. Another reason may be related to improved waiting list management, particularly with regards to a more robust listing process. Additionally, improved care for pre-listed patients and waiting list candidates has resulted in longer pretransplant-free survival. These factors have most likely contributed to the decline in pretransplant waiting list mortality to 9% in 2021 (Table 3). The 2020 waiting list mortality of 25% was probably related to the SARS-CoV-2 pandemic.

1.3 Donation

For deceased donors, the donor risk index (DRI) has increased over the last five years and ABO-incompatible transplants continue to be performed by the unit (Table 4). Both measures reflect efforts to minimise organ wastage given pervasive deceased donor organ shortages in South Africa. ABO and serology status are depicted in Table 5 and Table 6 respectively.

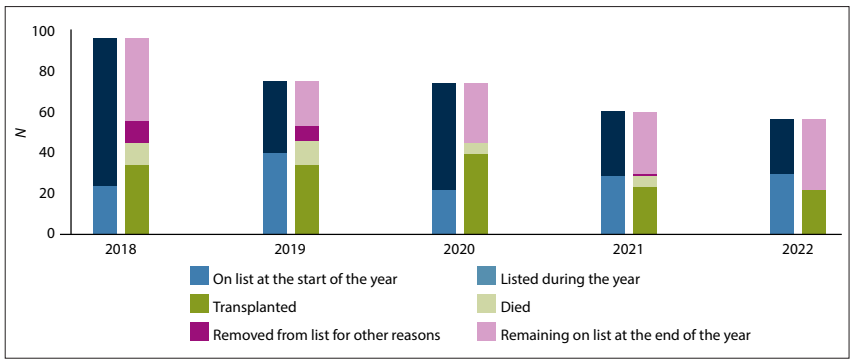

Fig. 3. Paediatric liver transplant waiting-list candidates: Inflow and outflow of the waiting list.

1.4 Transplants

The number of liver transplants performed per year has decreased over the last five years. As with previous years, more deceased donor transplants (79%) compared with living donor transplants were performed in 2022 (Table 7). The most common indications for liver transplant remain cholestatic (PSC/PBC) (40%) and ASH/NASH (39%) in recipients. However, there was a relative increase in the proportion of those transplanted for ASH/NASH when compared with previous years. More recipients received a re-transplant (12%) as compared with previous years. (Table 8).

Table 7. Overview of adult liver transplants per year

Transplant overview	2018	2019	2020	2021	2022
Number of transplants	44	47	34	29	33
Donor type (*n*)					
Living donor transplants	0	1	7	12	7
Deceased donor transplants	44	46	27	17	26
Whole liver	43	44	26	17	25
Split liver	1	2	1	0	1

Table 8. Adult liver transplant recipient characteristics

Characteristics	2018	2019	2020	2021	2022
Number of transplants	44	47	34	29	33
Age (%)					
18 - 34 years	16	28	21	24	6
35 - 49 years	21	19	35	28	24
50 - 64 years	52	42	32	24	55
≥65 years	11	11	12	24	15
Sex (%)					
Female	43	55	41	41	58
Male	57	45	59	59	42
Primary disease (%)					
Cholestatic	25	36	50	41	40
ASH/NASH	25	21	15	24	39
Acute liver failure	16	13	9	10	9
Malignancy	9	6	11	14	9
Hepatitis B	5	0	3	0	3
Hepatitis C	0	5	3	4	0
Metabolic	4	4	0	4	0
Other	16	15	9	3	0
Transplant history (%)					
First	98	93	97	100	88
Re-transplant	2	9	3	0	12

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Table 8. (continued)Adult liver transplant recipient characteristics

Characteristics	2018	2019	2020	2021	2022
Wait time (%)					
<31 days	45	45	35	34	34
31 - 60 days	21	21	12	7	12
61 - 90 days	11	6	3	10	12
3-<6 months	9	13	29	21	18
6-<12 months	7	4	18	7	15
1-<2 years	7	11	3	21	9
BMI (%)					
<18.5 kg/m^2	0	0	0	4	6
18.5 -<25 kg/m^2	36	43	47	41	30
25 -<30 kg/m^2	30	36	38	34	43
30 -<35 kg/m^2	25	13	6	21	18
≥35 kg/m^2	9	8	9	0	3
Medical urgency (%)					
Status 1	16	13	9	10	10
MELD ≥35	0	0	3	0	0
MELD 30 - 34	2	2	3	0	0
MELD 15 - 29	36	53	38	55	45
MELD <15	45	32	44	34	45
Unknown	0	0	3	0	0
Diabetes (%)	27	37	21	24	24

ASH = alcoholic steatohepatitis; NASH = non-alcoholic steatohepatitis; BMI = body mass index; MELD = model for end-stage liver disease.

Table 9. Adult recipient and graft survival*

Survival	Recipient	Graft
1-month survival		
Number of transplants	82	82
Survival estimate (%) (95% CI)	89 (80 - 94)	89 (80 - 94)
1-year survival		
Number of transplants	82	82
Survival estimate (%) (95% CI)	75 (65 - 83)	75 (65 - 83)
3-year survival		
Number of transplants	108	108
Survival estimate (%) (95% CI)	74 (65 - 81)	73 (64 - 80)

CI = confidence interval.
*All survival estimates are for first transplants and all causes of end-stage liver disease. One-month and one-year recipient and graft survival estimates are based on transplants carried out in the 2.5 years prior to the last 12 months of follow-up (recipients transplanted between 1 July 2019 and 31 December 2021). Three-year recipient and graft survival estimates are based on transplants carried out in the 2.5 years prior to the last 3 years of follow-up (recipients transplanted between 1 July 2017 and 31 December 2019). All values are unadjusted.

Table 10. One-year adult recipient and graft survival by age group*

	Survival (%) (95% CI)	
Age group	**Recipient**	**Graft**
Age (years)		
18 - 34	74 (48 - 88)	74 (48 - 88)
35 - 49	83 (62 - 93)	83 (62 - 93)
50 - 64	77 (56 - 89)	77 (56 - 89)
≥65	57 (25 - 80)	57 (25 - 80)

CI = confidence interval.
*All survival estimates are for first transplants and all causes of end-stage liver disease, based on transplants carried out in the 2.5 years prior to the last 12 months of follow-up (recipients transplanted between 1 July 2019 and 31 December 2021). There were no statistically significant differences in survival between any of the groups.

Table 11. Characteristics of paediatric liver transplant candidates on the waiting list at the end of each year

Candidate characteristics	2018	2019	2020	2021	2022
Number of candidates	40	22	28	30	35
Age (%)					
<1 year	30	32	18	23	17
1 - 5 years	45	41	57	50	57
6 - 10 years	20	9	7	10	9
11 - 17 years	5	18	18	17	17
Sex (%)					
Male	48	50	43	37	46
Female	52	50	57	63	54
Diagnosis of liver failure (%)					
Acute liver failure	5	5	7	10	6
Cholestatic disease	85	64	61	56	54
Budd-Chiari - veno-occlusive disease	0	0	0	0	0
Metabolic disease	0	13	8	0	6
Malignancy	0	0	0	0	3
Other	10	18	24	34	31
Medical urgency (%)					
MELD/PELD ≥35	0	13	11	7	6
MELD/PELD 30 - 34	2	5	3	6	3
MELD/PELD 15 - 29	40	41	25	27	34
MELD/PELD <15	58	41	61	57	57
Wait time (%)					
<1 year	83	32	61	43	34
1 -<2 years	12	50	7	27	20
2 -<3 years	5	14	18	17	23
3 -<4 years	0	4	11	10	12
4 -<5 years	0	0	3	3	11

MELD = model for end-stage liver disease; PELD = paediatric end-stage liver disease.

Table 12. Outcomes of paediatric liver transplant candidates one year after listing

Outcomes	2017	2018	2019	2020	2021
Candidates already on list at beginning of year	-	25	40	22	28
Candidates listed during year	44	72	35	52	34
Status at 1 year after listing (%)					
Transplanted	41	49	71	67	68
Died	27	18	20	12	6
Removed from list	14	8	3	2	3
Still waiting for transplant	18	25	6	19	23

Table 13. Donor characteristics: Paediatric recipients

Characteristics	2018	2019	2020	2021	2022
Number of transplants	34	34	39	25	24
Blood type (%)					
A	35	29	23	28	21
B	18	18	13	20	8
AB	3	6	5	4	0
O	44	47	59	48	71
Donor-recipient blood group compatibility (%)					
ABO incompatibility – major	8	9	5	20	8
Living donors	14	21	29	20	19
Donor relationship to recipient (%)					
Maternal	79	57	66	45	32
Non-maternal	21	43	34	55	68

Table 14. Donor-recipient serology matching for 2022

Donor (D)/recipient (R)	CMV	EBV	Hep B core	Hep B surf. Ant.	HIV
D-/R-	6	-	67	83	67
D-/R+	6	6	-	-	-
D-/R unknown	6	-	28	11	29
D+/R-	11	6	-	-	-
D+/R+	50	61	-	-	-
D+/R unknown	11	17	-	-	-
D unknown/R-	5	-	5	6	4
D unknown/R+	-	5	-	-	-
D unknown/R unknown	5	5	-	-	-

CMV = cytomegalovirus; EBV = Epstein-Barr virus.

Table 15. Overview of paediatric liver transplants per year

Transplant overview	2018	2019	2020	2021	2022
Number of transplants	34	34	39	25	24
Donor type (*n*)					
Living donor transplants	14	21	29	20	19
Deceased donor transplants	20	13	10	5	5
Whole liver	5	7	7	5	4
Split liver	13	4	3	0	1
Reduced liver	2	2	0	0	0

Table 16. Paediatric liver transplant recipient characteristics

Paediatric characteristics	2018	2019	2020	2021	2022
Number of transplants	34	34	39	25	24
Age (%)					
<1 year	9	9	21	4	8
1 - 5 years	62	59	46	56	54
6 - 10 years	3	20	10	16	17
11 - 17 years	26	12	23	24	21
Sex (%)					
Male	44	38	56	44	37
Female	56	62	44	56	63
Primary disease (%)					
Acute liver failure	26	24	13	20	29
Cholestatic disease	50	50	56	48	50
Budd-Chiari - veno-occlusive disease	3	3	0	0	0
Metabolic disease	9	12	8	20	8
Malignancy	0	3	5	4	4
Other	12	9	18	8	9
Previous Kasai procedure in recipients with biliary atresia (%)					
Yes	47	75	50	73	80
No	53	25	50	27	20
Transplant history (%)					
First	94	94	95	92	96
Re-transplant	6	6	5	8	4
Blood type (%)					
A	29	26	31	32	29
B	29	21	13	16	4
AB	3	9	5	0	0
O	38	44	51	52	67
Wait time (%)					
<31 days	44	38	36	40	50
31 - 60 days	12	3	20	0	8

...continued

Table 16. (continued) Paediatric liver transplant recipient characteristics

Paediatric characteristics	2018	2019	2020	2021	2022
61 - 90 days	6	6	0	24	13
3 -<6 months	20	21	23	16	8
6 -<12 months	3	23	8	8	13
1 -<2 years	6	6	13	12	4
2 -<3 years	6	3	0	0	0
≥3 years	3	0	0	0	4
Medical urgency (%)					
Status 1	29	24	13	20	25
MELD/PELD ≥35	0	3	0	0	0
MELD/PELD 30 - 34	0	0	3	4	4
MELD/PELD 15 - 29	35	26	41	16	25
MELD/PELD <15	35	44	44	60	46
Unknown	0	3	0	0	0

MELD = model for end-stage liver disease; PELD = paediatric end-stage liver disease.

Table 17. Nutritional status for paediatric liver transplant recipients

Nutritional status	2018	2019	2020	2021	2022
Recipients aged ≤5 years	23	21	26	15	15
Height Z-score (%)					
-3 - <-2	44	24	39	27	40
-2 - <-1	26	33	19	33	40
-1 - <0	17	14	15	27	7
0 - <1	0	10	19	0	13
≥1	4	5	8	13	0
Unknown	9	14	0	0	0
Weight *Z*-score (%)					
-3 - <-2	4	10	12	13	13
-2 - <-1	18	29	35	7	20
-1 - <0	61	28	27	27	27
0 - <1	13	14	11	33	40
≥1	4	14	15	20	0
Unknown	0	5	0	0	0
Mid-upper-arm circumference *Z*-score (%)					
-3 - <-2	0	0	0	0	7
-2 - <-1	26	43	19	27	13
-1 - <0	35	14	50	20	33
0 - <1	4	14	12	27	13
≥1	9	5	8	0	7
Unknown	26	24	11	26	27
Recipients aged >5 years	11	13	13	10	9
BMI *Z*-score (%)					
-3 - <-2	18	8	8	10	0
-2 - <-1	27	0	23	30	22
-1 - <0	28	54	15	30	11
0 - <1	27	23	31	20	45
≥1	0	15	15	10	22
Unknown	0	0	8	0	0
All recipients	34	34	39	25	24
Malnutrition *Z*-score (%)					
-3 - <-2	9	3	5	4	8
-2 - <-1	26	26	21	28	21
-1 - <0	35	33	38	24	25
0 - <1	12	20	18	28	25
≥1	12	9	15	16	21
Unknown	6	9	3	0	0

Table 18. Unadjusted paediatric recipient and graft survival*

Survival group	Recipient	Graft
1-month survival		
Number of transplants	76	76
Survival estimate (%) (95% CI)	95 (86 - 98)	93 (85 - 97)
1-year survival		
Number of transplants	76	76
Survival estimate (%) (95% CI)	85 (75 - 92)	84 (74 - 91)
3-year survival		
Number of transplants	74	74
Survival estimate (%) (95% CI)	68 (56 - 77)	66 (54 - 76)

*All survival estimates are for first transplants and all causes of end-stage liver disease. One-month and one-year recipient and graft survival estimates are based on transplants carried out in the 2.5 years prior to the last 12 months of follow-up, i.e. recipients transplanted between 1 July 2019 and 31 December 2021. Three-year recipient and graft survival estimates are based on transplants carried out in the 2.5 years prior to the last 3 years of follow-up, i.e. recipients transplanted between 1 July 2017 and 31 December 2019.

Table 19. One-year paediatric recipient survival by selected groups*

	Survival (%) (95% CI)	
Survival group	**Recipient**	**Graft**
Sex		
Female	87 (72 - 94)	87 (72 - 94)
Male	83 (67 - 92)	81 (63 - 90)
Age		
0 - 5 years	88 (74 - 94)	85 (72 - 93)
6 - 17 years	82 (61 - 92)	82 (61 - 92)
Malnutrition *Z*-score (*n*=62)		
<1	79 (53 - 92)	79 (53 - 92)
-1 or better	89 (77 - 95)	87 (79 - 94)

*All survival estimates are for first transplants and all causes of end-stage liver disease, based on transplants carried out in the 2.5 years prior to the last 12 months of follow-up (recipients transplanted between 1 July 2019 and 31 December 2021). There were no statistically significant differences in survival between any of the groups.

1.5 Outcomes

Recipient and graft survival are summarised in Table 9. Unadjusted recipient survival was 75% (95% confidence interval (CI) 65 - 83) at one year, and 74% (95% CI 65 - 81) at three years, with no significant difference between age groups (Table 9, Table 10, Fig. 2).

2. Paediatric liver transplantation: Wits Transplant Unit 2022

2.1 Waiting list

At the end of 2022, 35 candidates remained on the waiting list reflecting a steady year-on-year increase (Fig. 3). Most candidates were between the ages of 1 and 5 years (57%) with a slight female predominance. The most common indication for listing for liver transplant was cholestatic disease (54%) (Table 11).

2.2 Waiting list outcomes

There was a decrease in the number of candidates listed from 2019. In part, this may reflect the impact of the SARS-CoV-2 pandemic (Fig. 3). Mortality while on the waiting list has decreased compared with previous years and 68% of those waitlisted were transplanted within one year. (Table 12). Like the adult populations, the improvements noted may be related to improved waiting list management and pretransplant care.

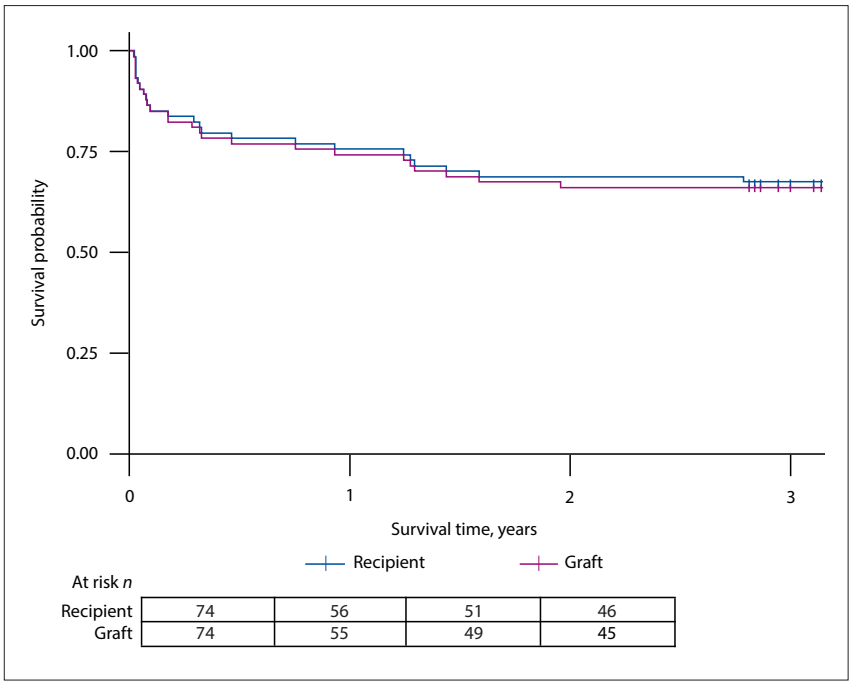

Fig. 4. Three-year paediatric recipient and graft survival.

2.3 Donation

Similar to previous years, the majority of donors were living donors (79%). However, fewer living donors were maternal, contrasting

with trends in previous years (Table 13). Donor and recipient serology matching is depicted in Table 14.

2.4 Transplants

Compared with previous years, the overall number of paediatric liver transplants performed in 2022 decreased, potentially affected by the SARS-CoV-2 pandemic. From the donor pool, most were living donors, reflecting a persistent trend in the paediatric programme. Of the deceased donor transplants, most were whole grafts (Table 15). Recipient sociodemographic and clinical characteristics are summarised in Table 16. Of note, there was an increase in the proportion of transplants for acute liver failure from 20% to 29% and the most common cause of acute liver failure remains acute viral hepatitis from Hepatitis A. Most recipients (71%) in 2022 were on the list for less than 90 days. Nutritional status at the time of transplant is summarised in Table 17 and reflects ongoing challenges in the unit with respect to optimising pre-transplant nutrition for paediatric candidates. Many children with chronic liver failure are diagnosed and/or referred late in their disease process, which further complicates capacity to optimise their nutrition.

2.5 Outcomes

Recipient and graft survival are summarised in Table 18 and Fig. 4. Unadjusted recipient survival was 85% (95% CI 75 - 92) at one year, and 68% (95% CI 56 - 77) at three years. There were no significant differences in recipient one-year survival when comparing sex, younger (<5 years) v. older children, and nutritional status (*Z*-score >1 v. other) (Table 19). These groups were selected for analysis as they have, in previous years, demonstrated significant survival differences.