



## 2019 Annual Report of Organ Transplantation in Thailand

- Heart and Lung Transplantation
- Kidney Transplantation
- Kidney Transplantation for recipients younger than 18 years old
- Liver Transplantation for adults and children in 2016-2019

# Thai Transplantation Society

## Message from President of Thai Transplantation Society

The information was collected as a report and its purpose to developed organ transplantation in Thailand. As we are aware that organ transplantation is important in medical profession advancement which helps improving their lives from the chronic disease such as chronic kidney disease, cirrhosis, and last stage of heart failure to perform their activities like normal once again. Nowadays, the transplant knowledge has fast evolution in both width and depth related to basic transplant Immunology and new immunosuppressive medication for organ transplant recipients. It is very necessary that physicians who work in this field should follow up with the recent knowledge.

Even though, there are a lot of advantages in organ transplantation but the main problem is the shortage of organ donors when compare to recipients (There are 6,417 of total recipients – 6,125 of kidney recipients, 33 of heart recipients, 14 of heart-lung recipients, 1 of lung recipient, 225 of liver recipients, 2 of liver-lung recipients, 14 of pancreas-kidney recipients and 1 of pancreas recipient as of 31 December 2019) and the large difference amount of waiting list each year.

The shortage of kidney and other organs donation are a major problem in transplantation. The last stage renal disease is important to the public health's problem as the patients have higher risk to death and waste of medical expenses. However, the treatment which is suitable for the long-term quality of the patient life is kidney transplantation.

On behalf of President and committee of Thai Transplantation Society, would like to thank you, the registration subcommittee for report of organ transplantation in 2019 and hope this will be useful for physicians, nurses and medical staffs for future references.

Surazee Prommool M.D.

President of Thai Transplantation Society

## Preface

The Thai Transplantation Society has collecting the transplant information since 2002 and has presenting in annual meeting since 2004 which informed the membership, doctors and nurses to aware of situation in transplantation each year. In 2012, the registration subcommittee first published annual report and present the society website in both Thai and English to make it convenient for information searching and references, as well as make it useful for planning, strategic planning and research.

This Annual Report of Transplantation in 2019 was continuing part from last year report of heart and lung transplantation, kidney transplantation including recipients younger than 18 years old and information for liver transplantation in adults and children. All the information has been supported by transplant coordinator nurses, surgeons, nephrologists, pediatric nephrologists, hepatologists and pediatric hepatologists from organ transplantation centers in order to analyze and aware of transplant situation in Thailand.

The patients of heart- lung transplant information received surgery in 2019 was collected by Dr. Pat Ongcharit and his colleagues, kidney transplantation information was collected by Assistant Professor Dr. Nuttasith Larpparisuth and his colleagues, they also brought out the various information to analyze in several dimensions continuously from previous year, the information of kidney recipients younger than 18 year old was collected by Associate Professor Dr. Pornpimol Rianthavorn, liver transplantation was collected and analyzed CMV serology by Professor Dr. Suporn Treepongkaruna, Assoc.Prof.Dr. Bunthoon Nonthasoot, Assoc.Prof.Dr. Voranush Chongsisawat, Dr.Chomchanat Tubjaroenand and their colleagues.

The registration subcommittee would like to thank Thai Transplantation Society's organizing committee for supporting and establishing annual report of organ transplantation, transplant coordinator nurses for sending patients' information from each institution, Dr. Pat Ongcharit, Assistant Professor Dr. Nuttasith Larpparisuth, Associate Professor Dr. Pornpimol Rianthavorn, Professor Dr. Suporn Treepongkaruna, Assoc.Prof.Dr. Bunthoon Nonthasoot, Assoc.Prof.Dr. Voranush Chongsisawat, Dr.Chomchanat Tubjaroenand and their colleagues for gathering and analyzing information, Ms. Nongnuch Kuttiya and Ms. Pharita Keelee for general coordination, including staffs, doctors and nurses from every kidney institutions which make this report completely successful. With

expectation that 2019 annual report will be useful for surgeons, nurses, stuffs and whose interest for their reference in other fields such as academic, public health economic including strategic planning in future organ transplantation.

The registration subcommittee of organ transplantation

Thai Transplantation Society

Year 2019-2021

# Executive Committee, Thai Transplantation Society

Year 2019-2021

Name	Surname	Position
Dr. Surazee	Prommool	President
Prof. Dr. Yingyos	Avihingsanon	Vice-President
Asst.Prof.Dr. Somchai	Limsrichamrern	Vice-President and Liver and Pancreas Standard and Supportive
Assoc.Prof.Dr. Attapong	Vongwiwatana	Secretary General
Assoc.Prof.LTG.Dr. Praej	Ruangkanchanasetr	Treasurer
Prof.Dr. Adis	Tasanarong	Foreign Relations
LTG.Dr. Adisorn	Lumpaopong	Registration and Information
Assoc.Prof.Dr. Atiporn	Ingsathit	Research Chairman
Asst.Prof.Dr. Kajohnsak	Noppakun	Public Relations Kidney Transplantation Clinical Practice Guideline Development
Asst.Prof.Dr. Natavudh	Townamchai	Scientific Chairman Cardiothoracic Organ Transplantation Standard of Practice Development Thai Red Cross Organ Donation Centre Coordination
Assoc.Prof.Dr. Supanit	Nivatvongs	
Prof.Dr. Suporn	Treepongkaruna	Pediatric and Adult Hepatology Coordination
Dr. Siros	Jitraphai	Pediatric and Adult Gastroenterology Coordinator
Dr. Goragoch	Gesprasert	Committee for Promoting Organ donation

# Organ Transplant Registration Subcommittee

Year 2019 – 2021

Name	Surname	Position
LTG.Dr. Adisorn	Lumpaopong	President
LTG.Dr. Thanom	Supaporn	Advisory
Prof.Dr. Kriengsak	Vareesangthip	Advisory
Assoc.Dr. Supanit	Nivatvongs	Subcommittee
Dr. Pat	Ongcharit	Subcommittee
Assoc.Prof.Dr.Pornpimol	Rianthavorn	Subcommittee
Asst.Prof.Dr. Nutavudh	Townamchai	Subcommittee
Assoc.Prof.Dr. Atiporn	Ingsathit	Subcommittee
Asst.Prof.Dr. Sathit	Kurathong	Subcommittee
Assoc.Prof.Dr. Cholatip	Pongskul	Subcommittee
Ms. Pawinee	Kupatawintu	Subcommittee
Ms. Aroonee	Juengsa-ngasom	Subcommittee
Dr. Sirin	Jiwakanon	Subcommittee
Dr. Thitiya	Puavilai	Subcommittee
Prof.Dr. Suporn	Treepongkaruna	Subcommittee
Assoc.Prof.Dr. Abhasnee	Sobhonslidsuk	Subcommittee
Dr. Goragoch	Gesprasert	Subcommittee
Dr. Tanun	Ngamvichukorn	Subcommittee
Asst.Prof.Dr. Somchai	Limsrichamren	Subcommittee
Asst.Prof.Dr. Kajohnsak	Noppakun	Subcommittee
Dr. Pichaya	Tantiyavarong	Subcommittee
Dr. Nuttasith	Larpparisuth	Subcommittee and secretary

## Liver Transplant Registration Subcommittee

Year 2018-2021

Name	Surname	Position
LTG.Dr. Thanom	Supaporn	Subcommittee Advisory
LTG.Dr. Adisorn	Lumpaopong	Subcommittee Advisory
Assoc.Prof.Dr. Surasak	Leelaudomlip	Subcommittee Advisory
Assoc.Prof.Dr. Yongyut	Sirivatanauksorn	Subcommittee Advisory
Prof.Dr. Suporn	Treepongkaruna	Subcommittee President
Dr. Goragoch	Gesprasert	Subcommittee
Assoc.Prof.Dr. Voranush	Chongsrisawat	Subcommittee
Assoc.Prof.Dr. Bunthoon	Nonhasoot	Subcommittee
Dr. Chalermrat	Bunchorntavakul	Subcommittee
Dr. Ake	Pugkhem	Subcommittee
Asst.Prof.Dr. Sunhawit	Junrungsee	Subcommittee
Asst.Prof.Dr. Somchai	Limsrichamren	Subcommittee and Secretary
Dr. Chutwichai	Tovikkai	Subcommittee and Assistant Secretary

## Organ Transplant Coordinator Nurses

Name	Surname	Hospital
Thararat	Phudpart	Bangkok
Napaporn	Boonnaj	Chulalongkorn
Salin	Wattanatorn	Chulalongkorn
Wongkhae	Kanthawong	Chulalongkorn
Piyaporn	Wanawongsawad	Chulalongkorn
Watcharee	Ratanawong	Chonburi
Supan	Chunhanant	Police General
Sasipim	Pairojkittrakul	Thammasat
Benjaporn	Taenawakul	Thammasat
Ornkamon	Pengkul	Bumrungrad
Panarat	Nopacoon	Bumrundrad
Suwapee	Chantornjetsada	Phyathai 1
Benjawan	Sookruan	Phyathai 1
Kanokporn	Ratanatrisri	Buddhachinaraj
Sunisa	Pikhulkhao	Phramongkutklao
Kaenchai	Pipatpanawong	Praram 9
Nuttakarn	Naitook	Praram 9
Panatchana	Aroonrojsiri	Bhumibol Adulyadej
Anchalee	Saikam	Maharajnakornchiangmai
Kanya	Udomsin	Maharajnakornchiangmai
Jugkree	Korsakul	Maharajnakornratchasima
Panida	Opakawinkul	Rajavithi
Mallika	Sitthisarn	Rajavithi
Ladda	Wudhinitikornkij	Rajavithi
Chutima	Charoentanakit	Ranathibodi
Piyaphorn	Thakoorabutr	Ranathibodi
Napapat	Butsriphum	Ranathibodi
Wararat	Wongwean	Vajira



Jongruk	Pongskul	Srinagarind
Tassanee	Phimsawat	Srinagarind
Nartsiri	Ratchawang	Siriraj
Punika	Pongpisit	Siriraj
Pera	Panprom	Siriraj
Nutjanat	Rintawut	Khonkaen
Monrutai	Thammaroekrit	Songklanagarind
Wanida	Ratanasuwan	Samitvej Srinakarin
Pisinee	Namprom	Samitivej Sukhumvit
Athitaya	Lekpratum	Samitivej Sukhumvit
Phataraporn	Jit-im	Sappasitthiprasong
Jamaree	Pondee	Surat Thani
Kingkarn	Sirikarin	Hatyai
Sasipin	Monkolchai	Udonthani
Amnuayporn	Nammun	Udonthani
Nichakorn	Pasook	Bumirajanagarindra Kidney Institute
Sirilak	Leawseng	Bumirajanagarindra Kidney Institute
Paphanida	Borsuwan	Vejthani
Nitikan	Jaiklom	Chiang Rai Prachanukroh
Wantana	Sempoon	Vichaiyuth
Apaporn	Kaenchan	Vichaiyuth

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## Information of Heart and Lung Transplantation

## Information of Heart and Lung Transplantation

### Intrathoracic organ transplantation

From 2008-2019, 191 patients received heart transplantation from 6 hospitals i.e.

Chulalongkorn, Siriraj, Rajavidhi, Ramathibodi, Central Chest Institute of Thailand and Bumrungrad.

Table 1.1 Number of heart transplant recipients separated by year and hospital.

	Year											
	2551	2552	2553	2554	2555	2556	2557	2558	2559	2560	2561	2562
Chulalongkorn	3	5	3	7	8	6	14	12	10	9	14	15
Siriraj	-	1	2	1	4	4	4	8	4	8	8	13
Ramathibodi	-	-	-	-	-	-	-	-	-	1	4	3
Rajvidhi	1	-	-	-	-	2	5	5	1	3		
Central of Chest Institute of Thailand	-	2	-	-	-	-	-	-	-	-		
Bamrungrad	1	-	-	-	-		-	-	-	-		
Total	5	8	5	8	12	12	23	25	15	21	26	31

In 2019, 31 patients received heart transplantation which increased from 2018 by 5 patients as shown in table 1.1.

In 2019, there was one heart-lung transplantation from 14 patients waiting to receive heart-lungs and no single lung transplantation from 1 patient waiting for the lungs.

## Information of Kidney Transplantation

## Information of Kidney Transplant Recipients

### Number of Kidney Transplant Recipients in 2019

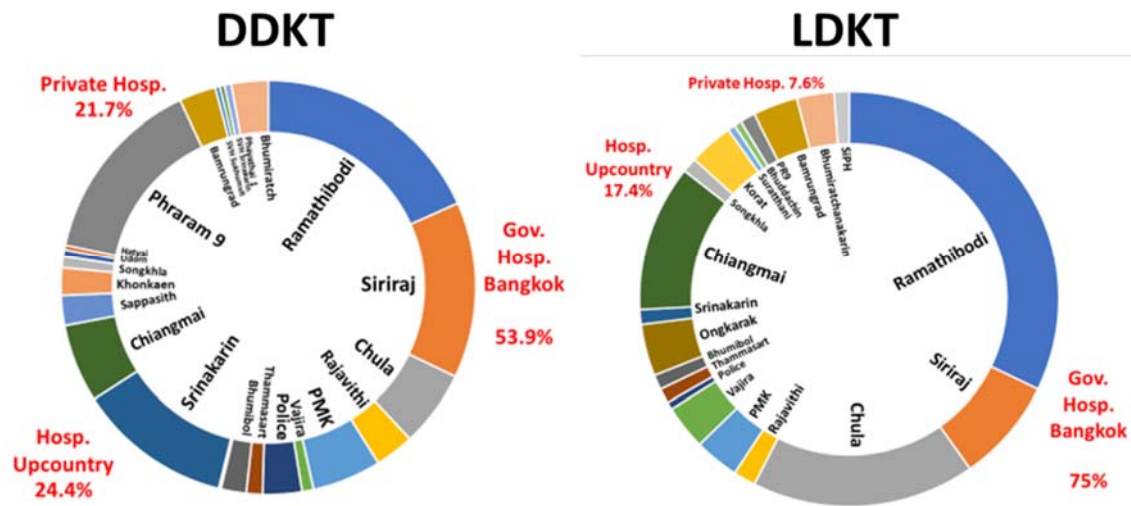
In 2019 (1 January 2019 – 31 December 2019), 729 patients received kidney transplantation from 26 hospitals, by 172 of living donors and 557 of deceased donors, separated by hospitals as shown in table 2.1.

Table 2.1 Number of Recipients in 2019, separated by hospitals.

	Kidney Transplant Recipients from Deceased donors	Kidney Transplant Recipients from Living donors	Total
Ramathibodi	102	56	158
Siriraj	77	14	91
Praram 9	82	2	84
Srinagarind	67	2	69
Chulalongkorn	33	30	63
Maharaj Nakorn Chiangmai	34	20	54
Phramongkutklao	30	6	36
Bumrungrad	16	6	22
Bhumirajanagarindra	16	5	21
Rajavidhi	17	3	20
Police General	17	1	18
Bhumibol Adulyadej	11	2	13
Suphasitprong	13	0	13
Khonkaen	12	0	12
Vachira	5	6	11
Thammasat	7	2	9
Srinakarinwirot Ongkharak	1	7	8
Songklanakarin	5	2	7
Maharaj Nakornrachasima	0	6	6
Phayathai 1	3	0	3

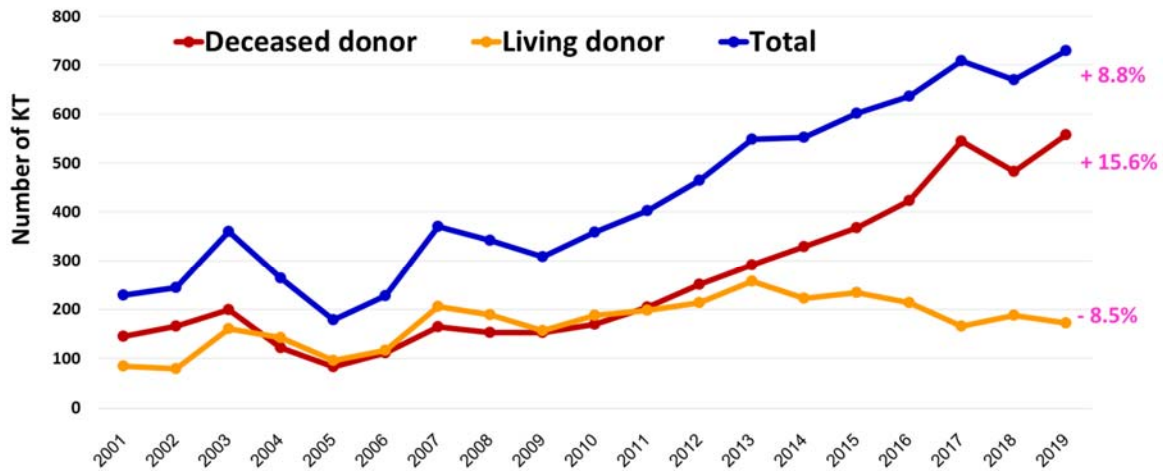
Udonthani	3	0	3
Samithvej Srinakarin	2	0	2
Hat Yai	2	0	2
Samithvej Sukhumvit	2	0	2
Buddhachinaraj	0	1	1
Surat Thani	0	1	1
Total	557	172	729

53.9% kidney transplantation from deceased donor in 2019, occurred in government hospitals in Bangkok and its vicinity, 24.4% were done in provincial government hospitals and 21.7% were done in private hospitals. While kidney transplantation from living donor in 2019, 75% was done in government hospitals in Bangkok and its vicinity and 17.6% at provincial government hospitals. Private hospitals accounted for 7.6% as shown in picture 2.1.



Picture 2.1 Number of kidney transplantation from both brain dead and living donors in 2019, separated by hospitals.

Compare to 2018, found that previous kidney transplant decreased by 8.8% (from 670 to 729), recipients from living donors increased by 15.6% (from 482 to 557) and from deceased donors decreased by 8.5% (from 188 to 172).



Picture 2.2 Number of kidney transplantation from each year since 2001, separated by kidney transplantation categories.

From picture 2.2 showed patients information of kidney transplantation since 2001, who officially registered for kidney transplantation in Thailand. There were a lot of kidney transplant recipients who received kidney transplantation in 2003 and 2007. In 2003, The Kidney Foundation of Thailand established the occasion to give a royal charity dedicated to HRH Princess Galyani Vadhana Kromma Luang Naradhiwas Rajanagarindra for her 80<sup>th</sup> Birthday and in 2007, then established "The kidney is the charity dedicated 80/ 84 years "to give a royal charity dedicated on the occasion of 80<sup>th</sup> Birthday Anniversary for His Majesty King Bhumibol Adulyadej The Great and HRH Princess Galyani Vadhana Kromma Luang Naradhiwas Rajanagarindra on the occasion of 84<sup>th</sup> Birthday Anniversary which caused the increasing of kidney transplant recipients.

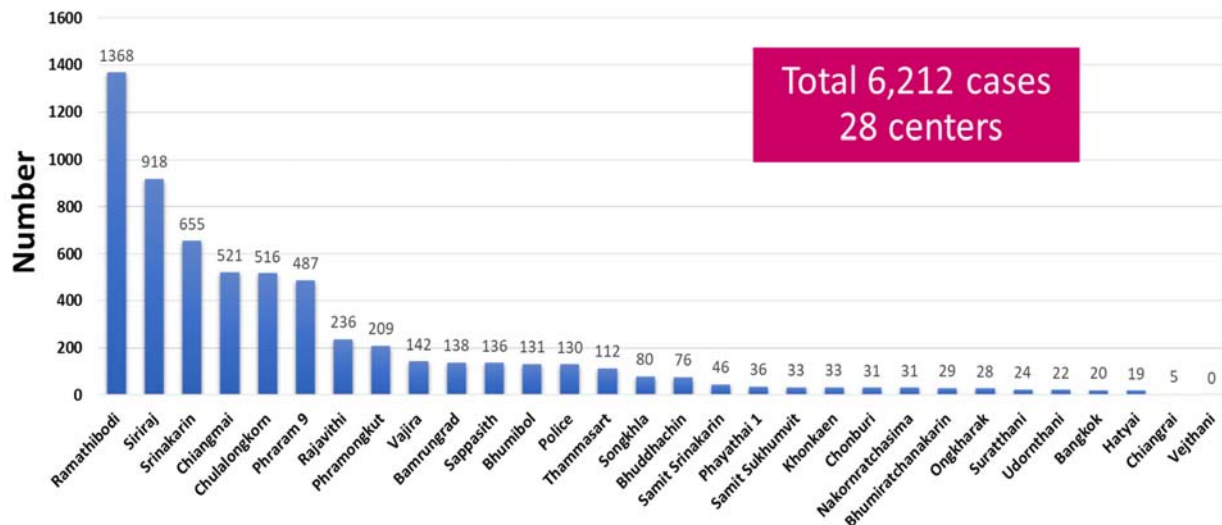
In 2015, in honor of the Celebrations on the Auspicious Occasion of Her Royal Highness Princess Maha Chakri Sirindhorn's 60<sup>th</sup> Birthday Anniversary, Kidney Foundation of Thailand and cooperated parties organizing "the kidney transplant give a royal charity 60 years, Her Royal Highness Princess Maha Chakri Sirindhorn " during 2 April 2015 – 1 April 2016 which encouraged kidney donation campaign, gave additional support to hospital, staffs, harvesting and retrieval team, altogether with covering the cost of special medication for kidney transplant patients by providing medical expenses from original affiliation such as Comptroller General's Department, Social Security Office and National Health Security Office which were cooperated parties of campaign.

In 2004, the Social Security Office implemented kidney transplant coverage for employees and in 2008, National Health Security Office approved to add the kidney transplant in the universal health



care coverage. In addition, the Ministry of Public Health implemented the decreased donor campaign and establishes the donor Hospital which showed that there were more deceased donors than living donors since 2011.

The prevalence of kidney transplant as of 31 December 2019 from 28 institutions were 6,212 as shown in picture 2.3.

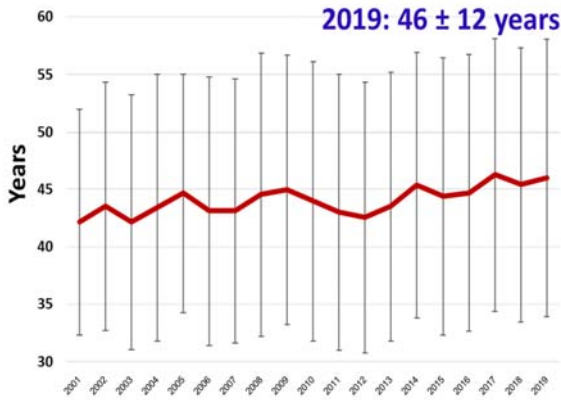


Picture 2.3 The prevalence showed kidney transplant recipients as of 31 December 2019.

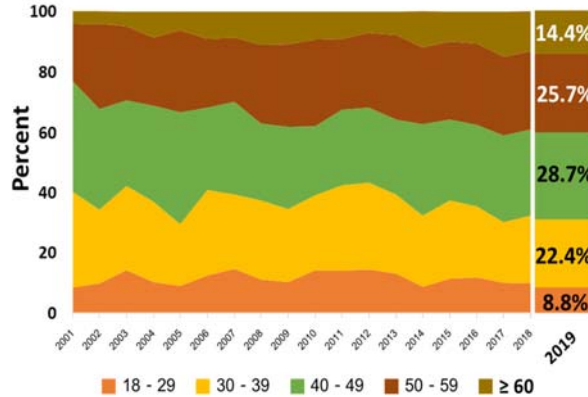
### Information of kidney transplant recipients in 2019

The average age of kidney transplant recipients in 2019 was 18-46 years old, which increased from 2018 equal to 45.4 years old and the maximum age who received the kidney transplant was 40-49 years old. The proportion of kidney transplant recipients in 2019 by span of age, found that 8.8% of recipients ages 18-29 years old, 22.4% of recipients aged 30-39 years old, 28.7% of recipients aged 40-49 years old, 25.7% of recipients aged 50-59 years old and 14.4% of recipients aged more than 60 years old as shown in picture 2.4. When compare to 2018, found that the age of 18-29 was the most increasing in proportion of 1.2% and the age older than 60 years old was secondary increased proportion of 1.2% while the other group are similar as shown in table 2.4.

## Mean age



## Distribution of age



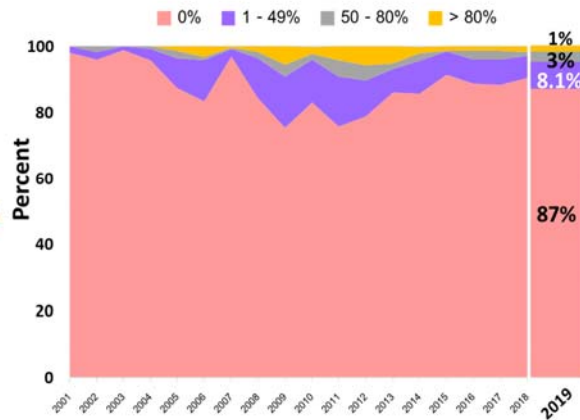
Picture 2.4 The proportion of kidney transplant recipients separated by ages older than 18 years.

When separated by sex, found that there were more male than female kidney transplant recipients by the proportion of 60.3% which near by 2019 which 61.9% in male. 87% had PRA equal to 0, 8.1% had PRA between 1-49, 3% had PRA between 50-80 and 1% had PRA more than 80 as shown in picture 2.5 which recipients who had PRA equal to 0 decreased when compare to 2018, 1.5% who had PRA 1-49 increased and 1.9% who had PRA 50-80 increased.

## Recipient gender: Male

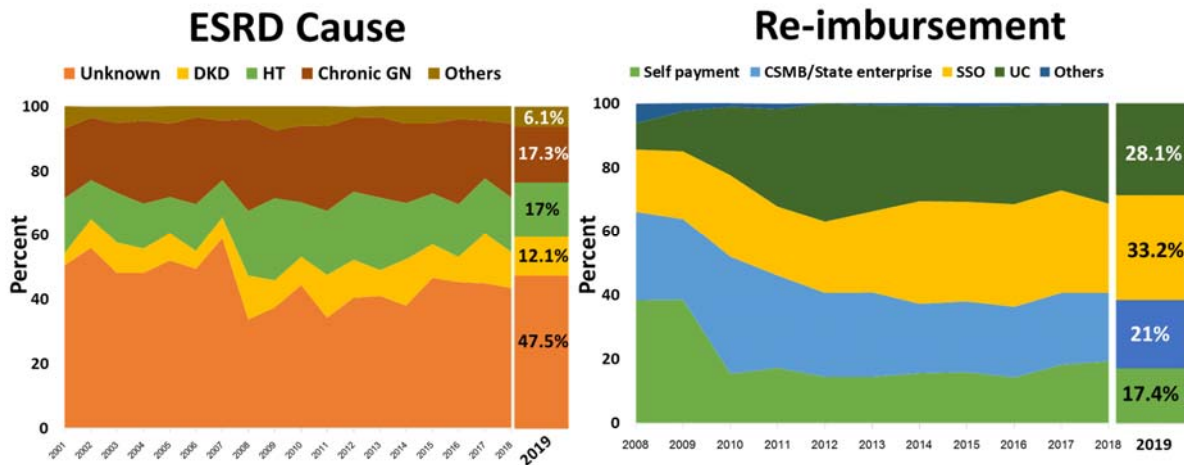


## Peak PRA



Picture 2.5 Sex and Panel Reactive Antibody (PRA) of kidney transplant recipients in 2019.

47.5% of the patients receiving a kidney transplant did not know the cause of end-stage chronic kidney disease. The most common causes were chronic glomerulonephritis (17.3%), hypertension (17%) and diabetes (12.1%). Considering the rights of medical treatment and found that 33.2% of kidney recipients use social security rights, 28.1% use universal health insurance, 21% use government / state enterprise benefits, and 17.4% are responsible for their own expenses. This year, there was a 5% increase in the number of recipients using social security, while universal and self-paid health insurance options decreased approximately 2% as shown picture 2.6.



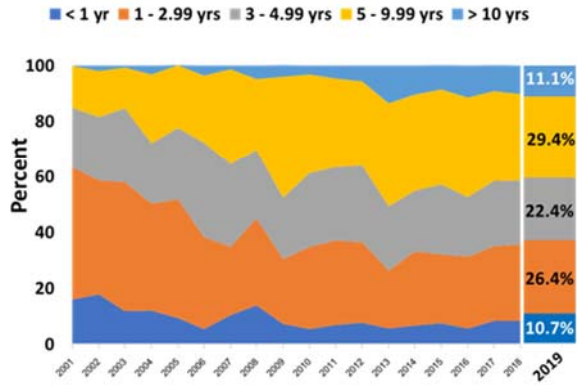
Picture 2.6 Show the cause of chronic kidney failure and the right to receive medical treatment in kidney transplant patients in 2019

The waiting time for kidney transplant recipients in 2019 of living donors were equal to 5.05 years and deceased donors were equal to 5.21 years which decreased when compare to 2017 as shown in picture 2.7. While living donor had a mean waiting period of 2.33 years which is similar to 2018 at 2.17 years, with most patients having a waiting period of less than 1 year as shown in picture 2.8.

## Mean Dialysis Vintage

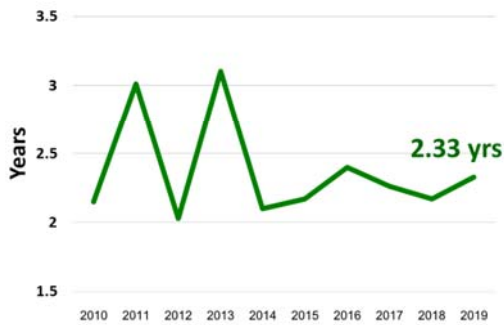


## Distribution of Dialysis Vintage

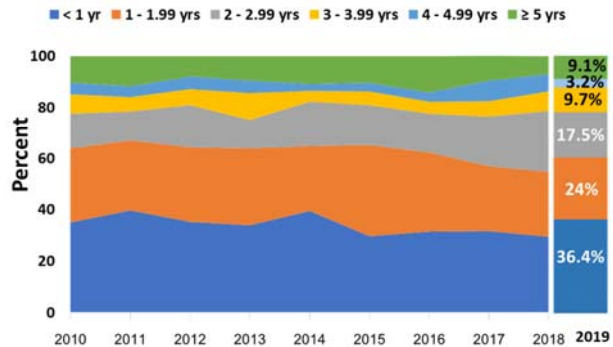


Picture 2.7 The waiting time of kidney transplant recipients of living donors and deceased donors.

## Mean Dialysis Vintage



## Distribution of Dialysis Vintage



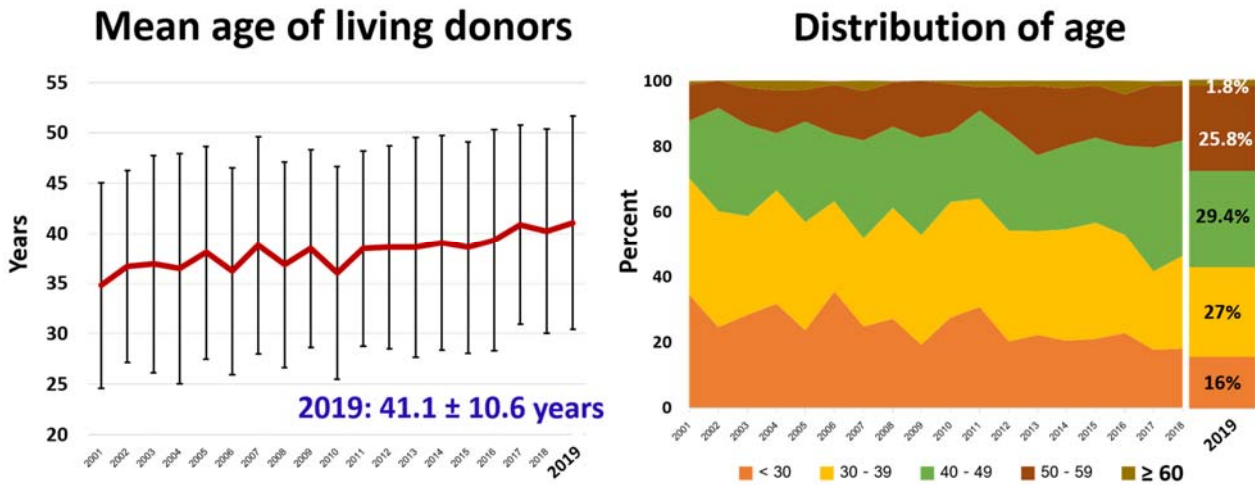
Picture 2.8 The waiting time of kidney transplant recipients of living donors and living donors.

## In Summary of year 2019

- The number of kidney transplants received a higher number than in 2018, with a significant increase of 15.6% of kidney transplants from deceased donors. Living donors decreased by 8.5
- The main age of kidney transplant recipients was between 40-49 and 60% average age higher in male more than females.
- The cause of chronic kidney failure is largely unknown. For treatment rights, use social security rights followed by the universal health insurance system and public welfare / state enterprises respectively.
- The waiting time for kidney transplantation from living donor was 2.33 years and deceased donor was 5.05 years.

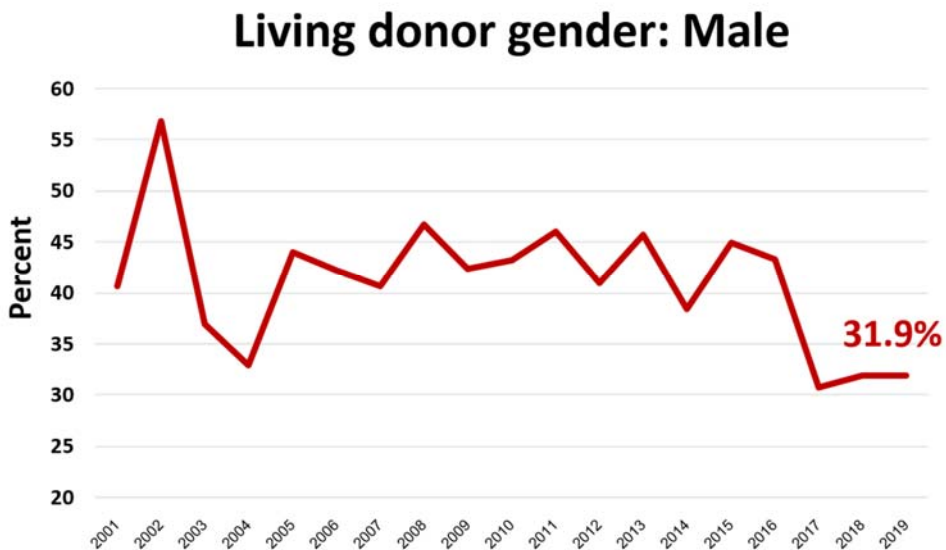
# Information of Living donors

In 2019, the average age of living donors was equal to 41.1 years old which increased from 2010, mostly between 40-49 years old of age by 29.4% in 2019 which was the most increasing age proportion between 50-59 years as shown in picture 2.9.



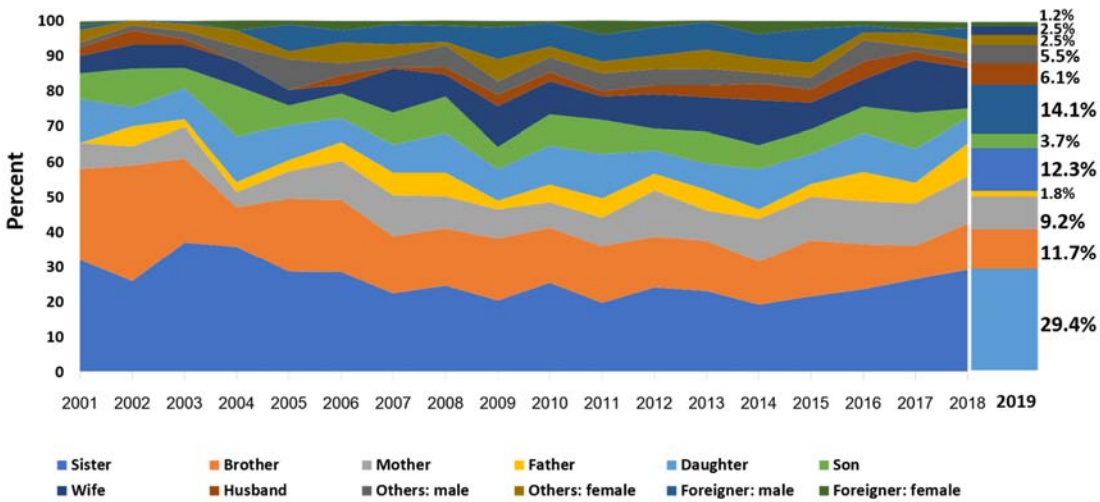
Picture 2.9 The average age and age range of the living donor.

31.9% of kidney living donor are male, with a trend of declining male donor proportion since 2016 as shown in picture 2.10



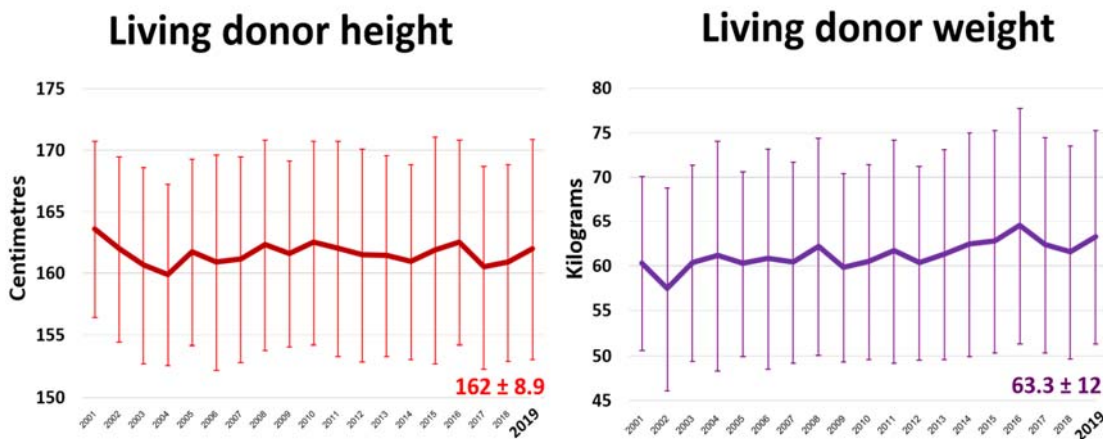
Picture 2.10 The proportion living donor in male.

For the relationship of the donor with the recipient of the kidney the group who donated the most was 29.4% of sisters, followed by wives, 14.1% to husbands and daughters, 12.3% to parents, respectively. For male donors, there was a strong brother or sister relationship. 11.7% followed by husband who donated to wife, 6.1% had foreign donor, 3.7% as shown in picture 2.11.



Picture 2.11 Relationship between donor and kidney recipient.

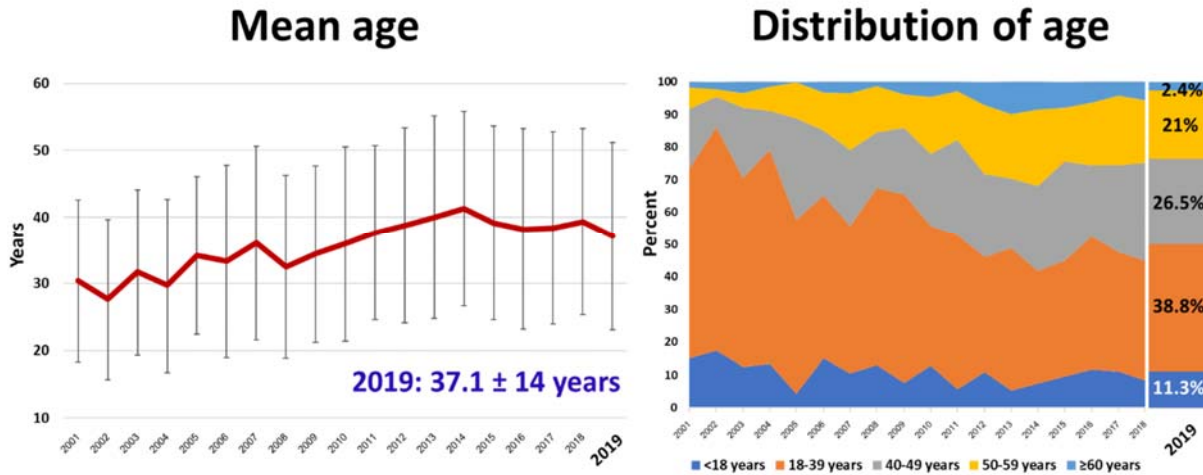
The donor average height 162 cm, average weight 63.3 kg, and average BMI 24.1 kg/sq.m. which has the same trend over the past 5 years as shown in picture 2.12.



Picture 2.12 The average of height and weight of the living donor.

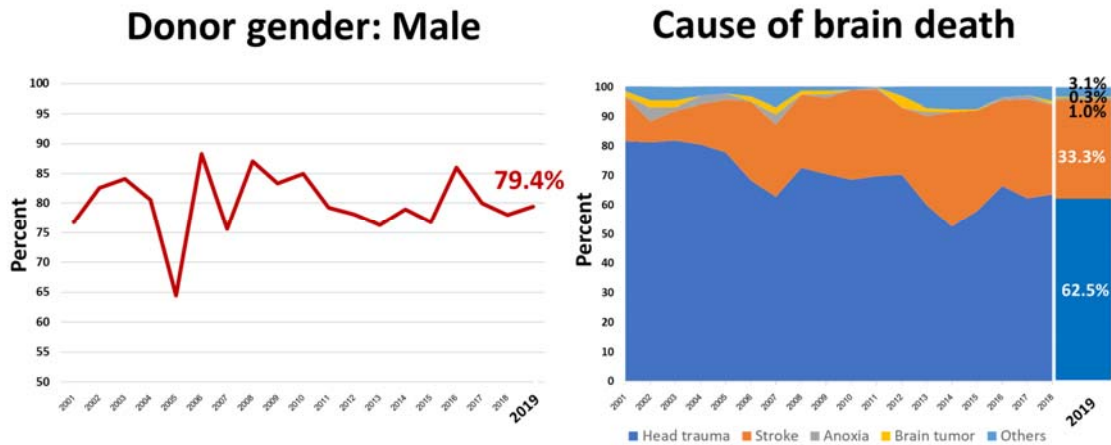
# Information of kidney deceased donors

For the deceased donor group, the average age was 37.1 years, lower than in 2018, the average age of 39 years, with the age group. In this year the highest proportion donor age was between 18 - 39 years, donors aged 40 - 49 years and greater than or equal to 60 years of age decreased from the original. While the younger donor has an increased ratio at as shown in picture 2.13.



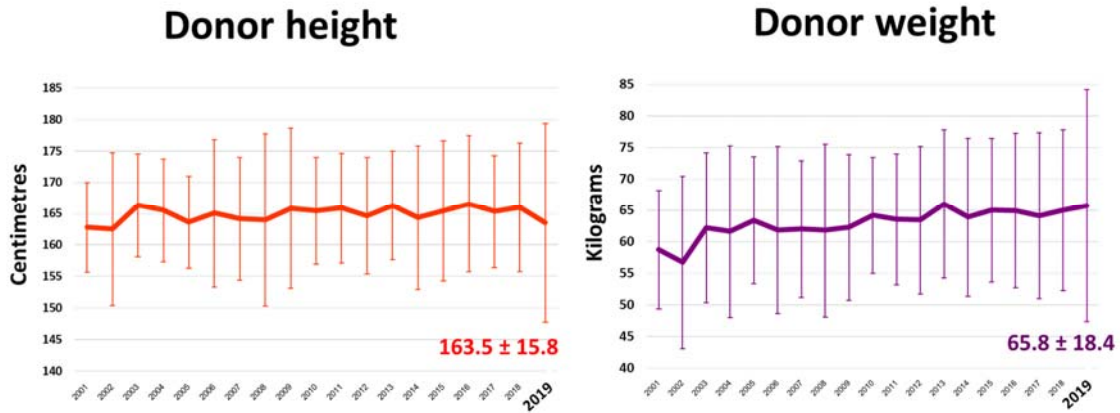
Picture 2.13 The age and average of deceased donor.

79.4% of deceased donors were male, similar to the previous year. The main causes of cerebral death were head trauma and stroke, respectively, as shown in picture 2.14 when compared to 2018. Head injuries are relatively constant while the proportion of deceased donor caused by stroke increased from 27.2% to 33.3%.



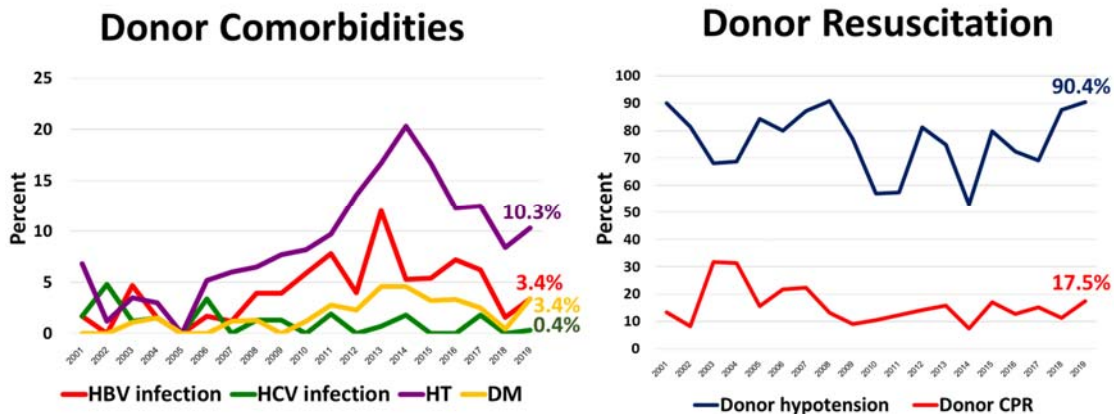
Picture 2.14 The proportion sex and cause of brain death in deceased donor.

The height of the brain death donor in 2019 averaged 163.5 cm. which is close to the average in previous years, while the average weight was 65.8 kg, which has been increasing over the past five years. It is shown in picture 2.15.



Picture 2.15 The average of height and weight of deceased donor.

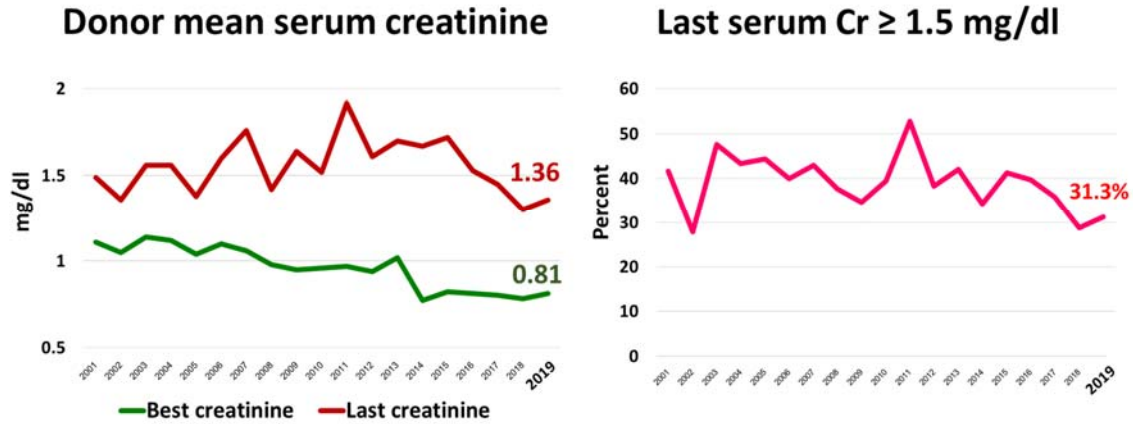
Joint disease found in donor brain death It was found that hypertension was 10.3%, diabetic 0.4%, infected with hepatitis B, 3.4% and hepatitis C virus 0.4%. For the care of donor brain death before organ removal was found to have hypotension pressure less than 90 mm Hg consecutively over 1 hour) in 90.4% of patients, which is likely higher than in the previous year and 17.5% of patients required resuscitation. (cardiopulmonary resuscitation), which is also likely to be higher, as shown in picture 2.16.



Picture 2.16 The prevalence of major comorbidities, hypotension, and need for resuscitation. (cardiopulmonary resuscitation; CPR) in deceased donor.

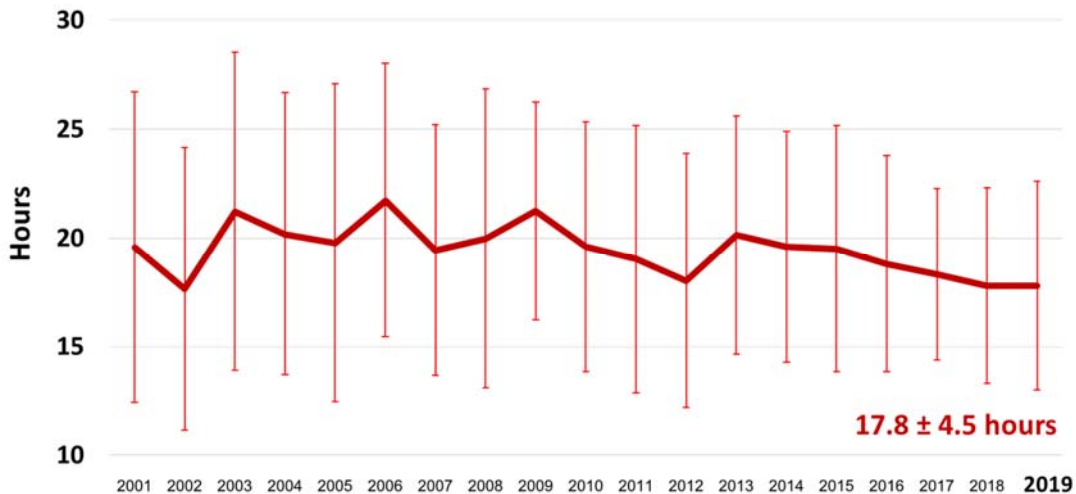


Renal function in deceased donor, when viewed by serum creatinine, the mean optimal creatinine level was 0.81 mg/dL, likely similar in 2018, while creatinine levels prior to organ lead surgery. Exit (last or terminal creatinine) was 1.36 mg/dL, which is similar to the previous year 31.3% of deceased donor had blood creatinine levels greater than or equal to 1.5 mg/dL prior to organ removal surgery as shown in picture 2.17.



Picture 2.17 The optimal mean serum creatinine levels and prior organ removal in deceased donor and the proportion of deceased donor with serum creatinine prior to organ removal was  $\geq 1.5$  mg/dL.

The period of cold ischemic time for donating a deceased donor kidney in 2019 was  $17.8 \pm 4.5$  hours, which is the same as in 2018, as shown in picture 2.18.



Picture 2.18 The period of cold ischemic time for donating a deceased donor

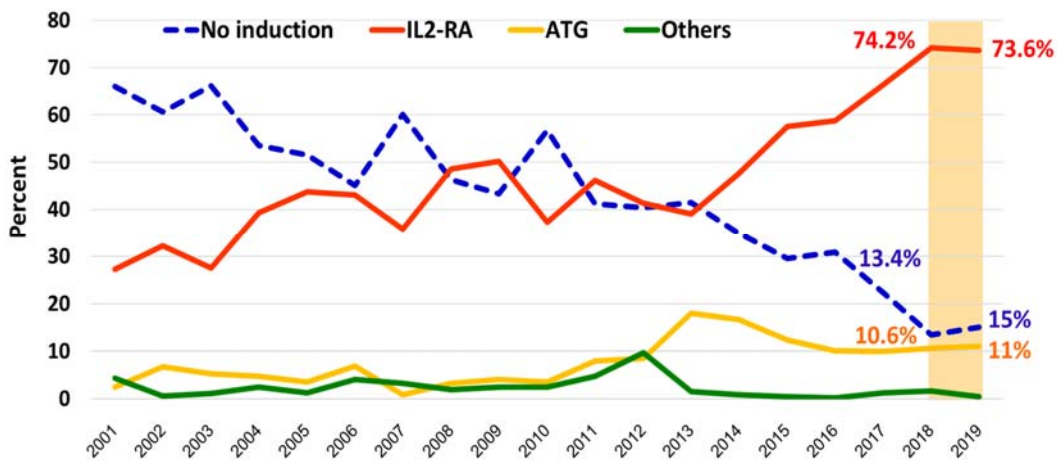
## In Summary of kidney transplant in year 2019

- The kidney living donors and deceased donors had average age between 41.1 and 37.1 years old, respectively.
- The main kidney recipients had blood relation in living donors and spouse related donors which female is the major living donors.
- In deceased donors, found that
  - The major causes of brain death were head trauma and stroke respectively.
  - When compare to 2018, the deceased donors who had serum creatinine and cold ischemic time was similar in the past, but hypotension and the proportion of resuscitation has increased.

# Information of Immunosuppressive medication and Kidney Transplant Results

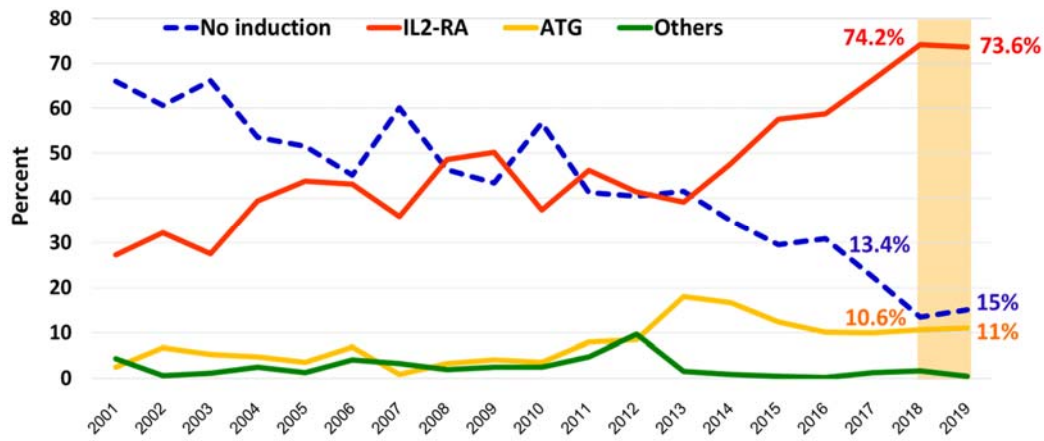
## Immunosuppressive medication

In 2019, it was found that 84.6% of antibody induction therapy was used, which is close to 84.8% in 2018, divided into 100 interleukin-2 receptor antagonist (IL-2RA) 73.6 percent and 11% anti-thymocyte globulin (ATG), which is the same as in 2018, 15% of the patients did not receive antibody induction therapy, as shown in picture 2.19.



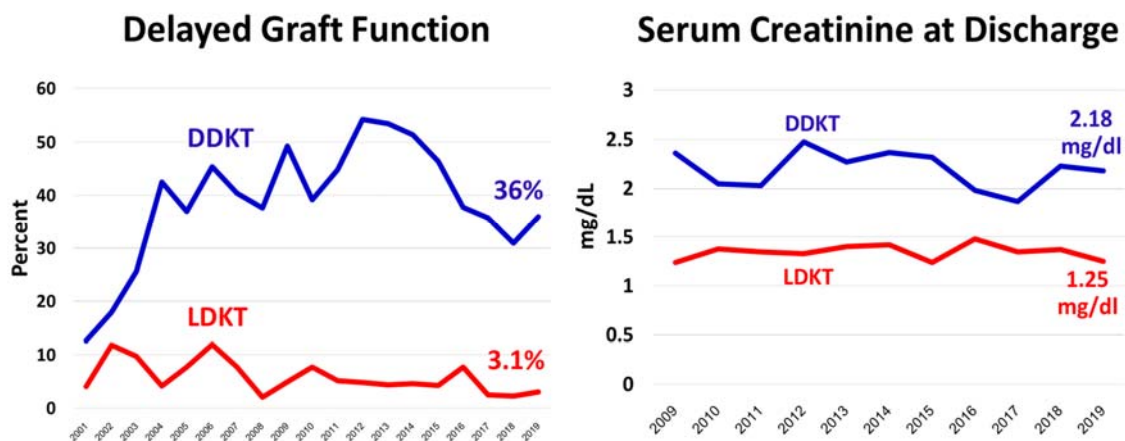
Picture 2.19 The proportion of recipients who received antibody induction therapy, separated by year of transplantation.

The proportions and trends of immunosuppressants as at the discharge date in 2019 are shown in Picture 2.20. For a calcineurin inhibitor, most of the patients (94.6%) received tacrolimus while 5.4% of patients were treated with cyclosporine and anti-proliferative agent, 81.6% of patients were treated with drug group. mycophenolate and none of the patients received azathioprine. 94.3% of the patients received prednisolone and 0.4% of the patients receiving the mTOR inhibitor, sirolimus or everolimus.



Picture 2.20 The proportion of immunosuppressive treatment on discharge date, separated by year of kidney transplantation.

The proportion of delayed graft function (DGF) in living donor kidney transplant recipients was 3.1%, which is similar to the previous one. In deceased donors, 36% was higher than the year 2018 seen in 31% of patients for serum creatinine levels of patients. The living donor is 1.25 milligrams per deciliter. And in brain-dead donors, 2.18 milligrams per deciliter, as shown in picture 2.21.

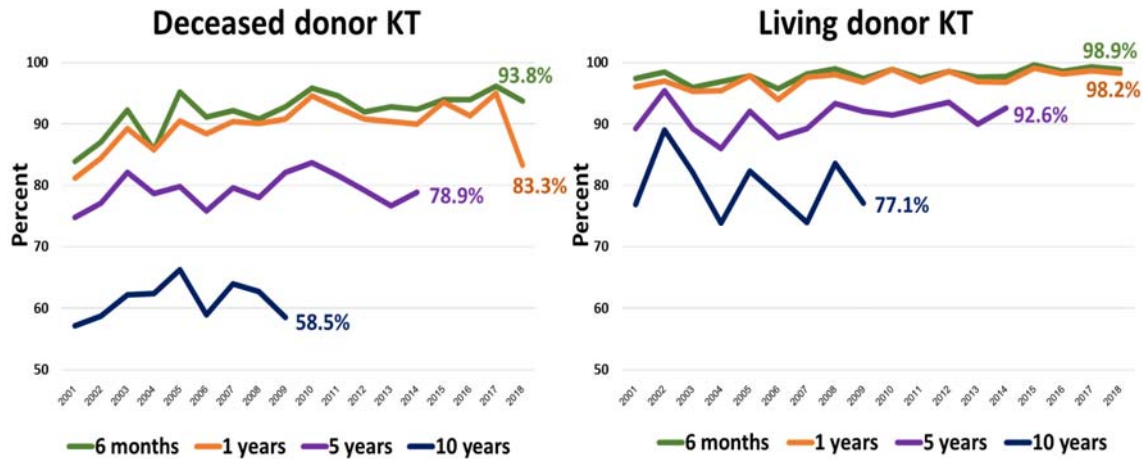


Picture 2.21 Delayed graft function and serum creatinine on discharge date, separated by transplant types.

## Graft Survival Rate

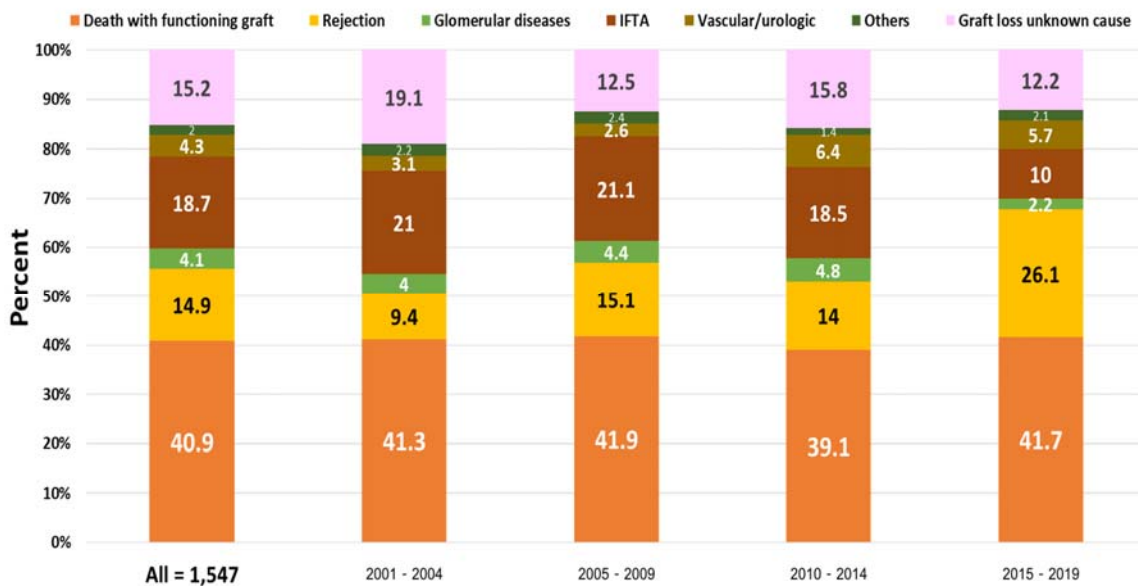
The graft survival rate has increased markedly over the past period. In both living donors and deceased donors, the survival rate of kidneys at one year after kidney transplantation from deceased

donors in 2018 was reduced. From 93% to 83.3% and the survival rate of kidney transplantation at 10 years is likely to decline. The graft survival rate of graft transplants each year is shown in picture 2.22.



Picture 2.22 Graft survival rate separated by types of kidney transplantation.

The causes of graft loss over the years undergoing a kidney transplant are shown in picture 2.23. Approximately 40% of the patients die with the transplanted kidney to function (death with If kidney transplantation was performed more than 5 years prior to 2014, the number one cause was interstitial fibrosis / tubular atrophy (IF / TA). Kidney transplantation less than 5 years between 2015 and 2019, the number one cause of kidney transplant loss is rejection.



Picture 2.23 The causes of patient death in various period of time.

## Patient Survival Rate

The patient survival rate after kidney transplantation increased significantly over the past period, especially the first year survival rate, and the 10 years survival rate after kidney transplantation was as high as 86.2%. And 87.9 in kidney recipients from living donor and kidney recipients from deceased donors, respectively, as shown in picture 2.24.

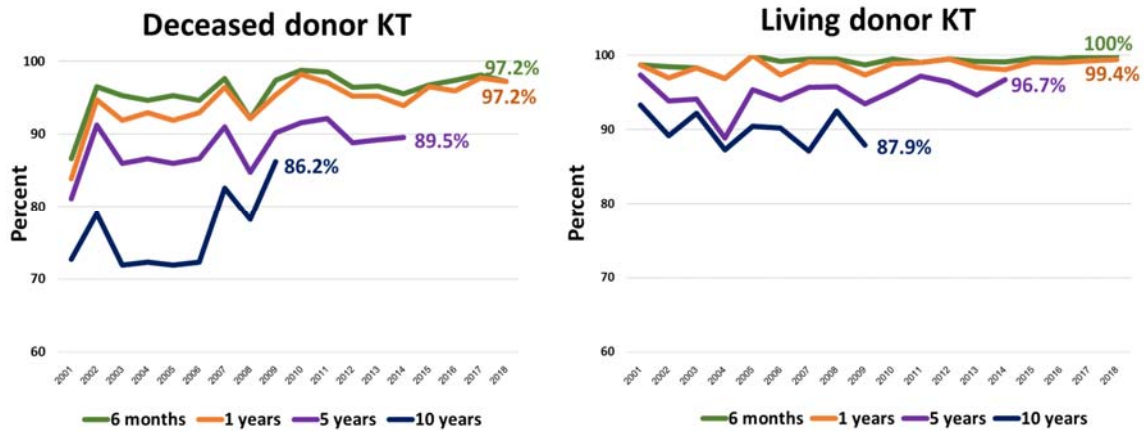
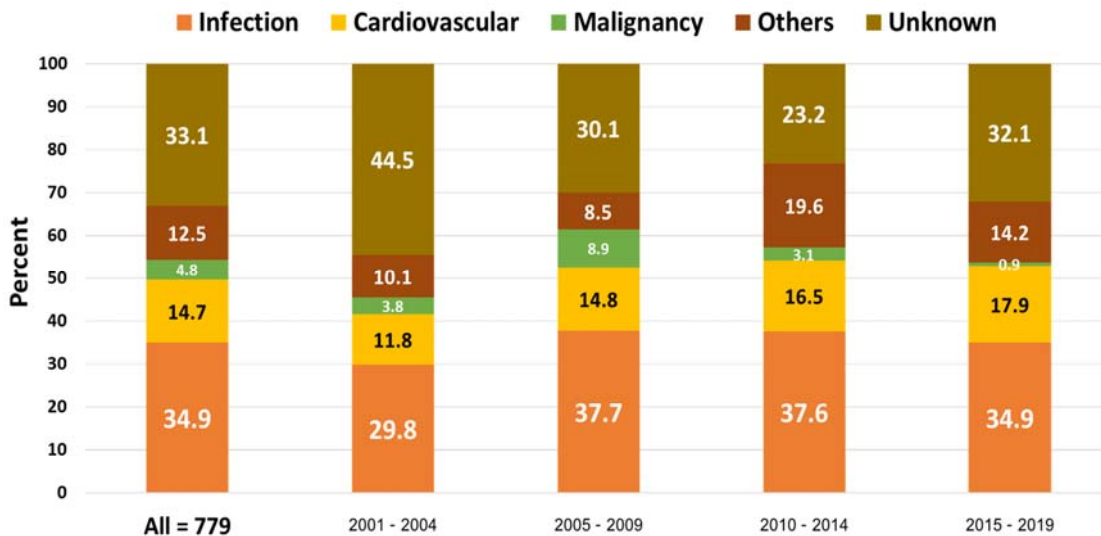


Table 2.24 The patient survival rate each year, separated by types of kidney transplantation.

## Cause of death of the patient

Cause of death in patients after kidney transplantation regardless of the year a patient has had a kidney transplant. Infection followed by cardiovascular disease as shown in picture 2.25.



Picture 2.25 Graft loss of kidney transplant recipients in different year period.

## Kidney transplant 2019 Summary

- Comparing to the past, 84.6% antibody induction therapy had significantly increased.
- Immunosuppressants on the day of discharge from the hospital, it was found that 94.6% of the calcineurin inhibitor group used tacrolimus, and 81.6% of the anti-proliferative group used mycophenolate.
- There are 36.0% and 3.1% of delayed graft function in recipients who received kidney transplant from deceased donors and living donor respectively.
- Infection was the major cause of death.
- The major cause of graft loss was IF/TA and rejection.
- The tendency of patient survival rate and graft survival rate were increased compare to the past, especially from living donors.

Information of Kidney Transplantation in patients younger than  
18 years old



## Information of Kidney Transplantation in patients younger than 18 years old

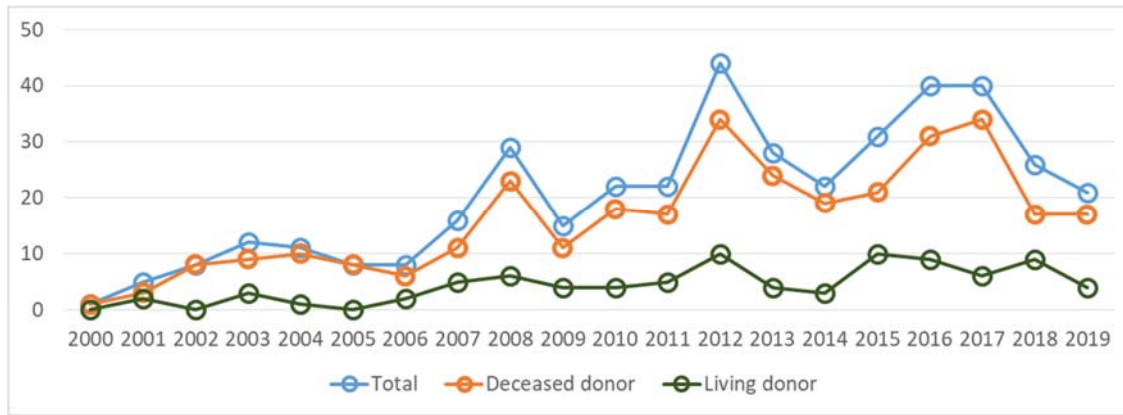
### Number of kidney transplant recipients younger than 18 years old in 2019

From 1 January to 31 December 2019, there were 5 patients of kidney transplant recipients younger than 18 years old which recipients from living donors and 17 recipients from deceased donors, separated by hospital as shown in table 3.1.

Table 3.1 Number of kidney transplant recipients younger than 18 years old in 2019, separated by hospital.

Hospital	Kidney transplant recipients of Living donor	Kidney transplant recipients of Deceased donors	Total
Phramongkutklao	0	3	3
Ramathibodhi	4	7	11
Vajira	1	0	1
Srinagarind	0	3	3
Siriraj	1	4	5
Thammasat	0	1	1
Suphasitprsong	0	1	1
Total	5	17	22

When comparison in 2018, the kidney transplantation for child patients decreased by 19.2% from 2019. (picture 3.1).



Picture 3.1 Number of the kidney transplantation for child patients each year since 2000, separated by transplant types.

### Information of kidney transplant recipients and donors younger than 18 years old in 2019

The kidney transplant recipients who were younger than 18 years old in 2019 which were 16 males (76.2%)

There were 4 kidney recipients from living donors which were 2 males (50%), the average age was equal to  $13.8 \pm 2.6$  years old. The total of first-time kidney transplant for young patients; 2 recipients received hemodialysis, 1 recipient received peritoneal dialysis and 1 recipient received preemptive transplantation.

From the donor information found that 100% were female, the average age as equal to  $41.8 \pm 5.1$  years old (table 3.2)

Table 3.2 Information of kidney transplant recipients younger than 18 years old from living donors.

	Recipient	Donor
Male gender, %	50	0
Age (mean $\pm$ SD), years (range)	$13.8 \pm 2.6$ (10–16)	$41.8 \pm 5.1$ (37–49)
Mode of renal replacement therapy, %		
Preemptive	25	
Hemodialysis	50	

Peritoneal dialysis	25	
Peak PRA (%) median (range)	0 (0-0)	
Last PRA (%) median (range)	0 (0-0)	
Serum creatinine at discharge (mg/dL)	0.88 ± 0.13	

SD, standard deviation

There were 17 kidney transplants from deceased donors which were 17 males (82.4%), the average age was equal to 14.5 ± 2.2 years old. All first-time patients of kidney transplant were 58.8% who received peritoneal dialysis before transplantation.

The deceased donors were 70.6% of male, the average age was equal to 35.1 ± 10.1 years old. The cold ischemic in 2019 was equal to 18.3 ± 5.0 hours as shown in table 3.3.

Table 3.3 Information of kidney transplant recipients younger than 18 years old received from deceased donors.

	Recipient	Donor
Male gender, %	82.4	70.6
Age (mean ± SD), years (range)	14.5 ± 2.2 (10-17)	35.1 ± 10.1 (21-54)
Mode of renal replacement therapy, %		
Hemodialysis	23.5	
Peritoneal dialysis	58.8	
Peak PRA (%) median (range)	0 (0-0)	
Last PRA (%) median (range)	0 (0-29)	
Cold ischemic time (hour)	18.3 ± 5.0	
Serum creatinine at discharge (mg/dL)	1.19 ± 0.91	

SD, standard deviation

The kidney recipients from living and deceased donors in 2019 increased in kidney replacement therapy before transplantation when compare to 2018 which equal to 11.6 and 32.9 months respectively.

## Immunosuppressive medication usage and result of kidney transplant recipients younger than 18 years old in 2019

In 2019, 22 kidney transplant recipients had informed of induction therapy and immunosuppressive medication on discharge date, as shown in Table 3.4 and 3.5 respectively and indicated that 90.5% received basiliximab induction therapy, the rest of recipients did not receive the therapy. The most formula of 76.2% used on discharge date were tacrolimus, mycophenolate mofetil and prednisolone.

Table 3.4 Kidney transplant recipients younger than 18, separated by induction therapy.

Induction therapy	N (%)
No induction	2 (9.5)
Basiliximab	19 (90.5)
Total	21 (100)

Table 3.5 Information of Immunosuppressive regimen on discharge date.

Immunosuppressive regimen	N (%)
Prednisolone + tacrolimus + mycophenolate mofetil	16 (76.2)
Prednisolone + tacrolimus + mycophenolate sodium	3 (14.3)
Prednisolone + tacrolimus	2 (9.5)
Total	21 (100)

In 2019, the kidney transplant recipients of deceased donors had delayed graft function and 4 patients had received peritoneal dialysis after transplantation, but the recipients of living donors did not have delayed graft function.

In 2019, One kidney transplant patient died, 4.8% and graft survival was 95.2%, with graft loss being death with functioning graft.

## Information of kidney transplant recipients younger than 18 years old during 1994-2019

### Number of kidney transplant recipient younger than 18 years old by year of transplantation

From kidney transplant database by Thai Transplantation Society between 1994-2019, there were 408 recipients younger than 18 years old, which divided into 89 recipients from living donors and 319 recipients from deceased donors. The average age was equal to  $14.1 \pm 3.2$  years old, 59.1% were male. Based on the height of 202 kidney transplant patients at the time of kidney transplantation, compared with the mean of Thai children by age and sex. The median values were -0.1 (interquartile range -2.2–0.2). Data of kidney transplant recipients classified by kidney transplantation type are shown in Table 3.6

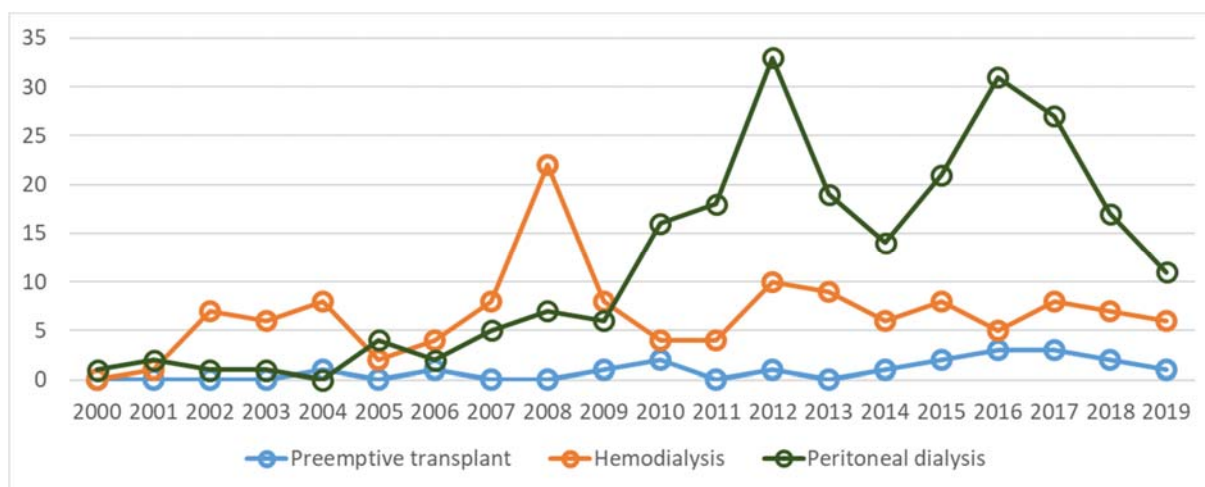
Table 3.6 The information of kidney transplant recipients of living donors and deceased donors.

	Kidney Transplant Recipient of Living donor	Kidney Transplant Recipient of Deceased donor
Male gender, %	57.3	59.6
Recipient age, years (mean $\pm$ SD, range)	$14.1 \pm 3.7$ (1–18)	$14.1 \pm 3.1$ (1–18)
Number of first transplant, %	97.8	98.4
Peak PRA (%) median (range)	0 (0–33)	0 (0–89)
Last PRA (%) median (range)	0 (0–27)	0 (0–55)
Mode of renal replacement therapy, %		
Preemptive transplant	16.9	1.0
Hemodialysis	37.1	32.3
Peritoneal dialysis	40.4	62.1
Missing	5.6	4.6
Waiting time, months (Interquartile range)	$13.4$ (7.0–25.9)	$19.7$ (11.0–30.8)
Payment type, %		

Government Healthcare	.124	7.8
Social Security Office	22.	0.3
National Health Security Office	539.	69.6
State Enterprise Healthcare	.11	.22
Self-Support	.56	.28
Others	24.8	17.3

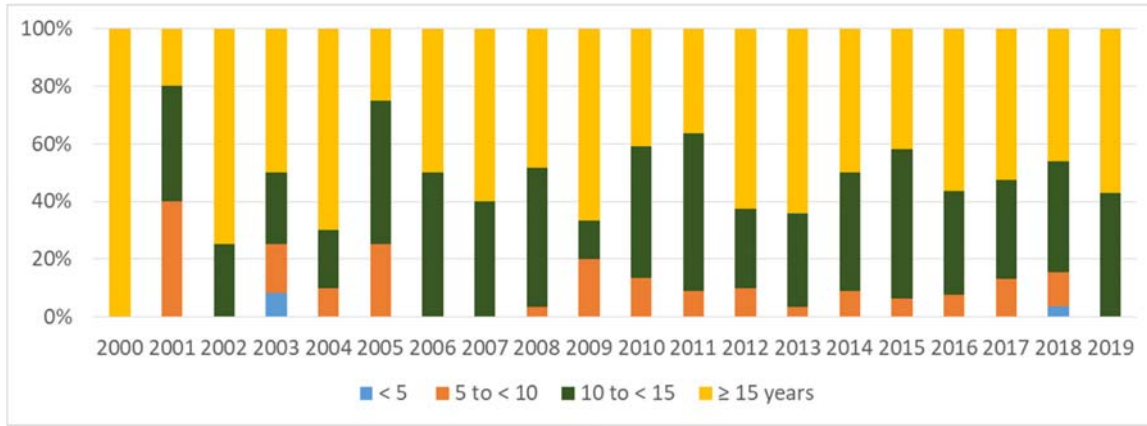
SD, standard deviation

The number of kidney transplant recipients younger than 18 years old, separated by renal replacement therapy before transplantation as shown in picture 3.2. The 57.4% of most child patients received peritoneal dialysis.



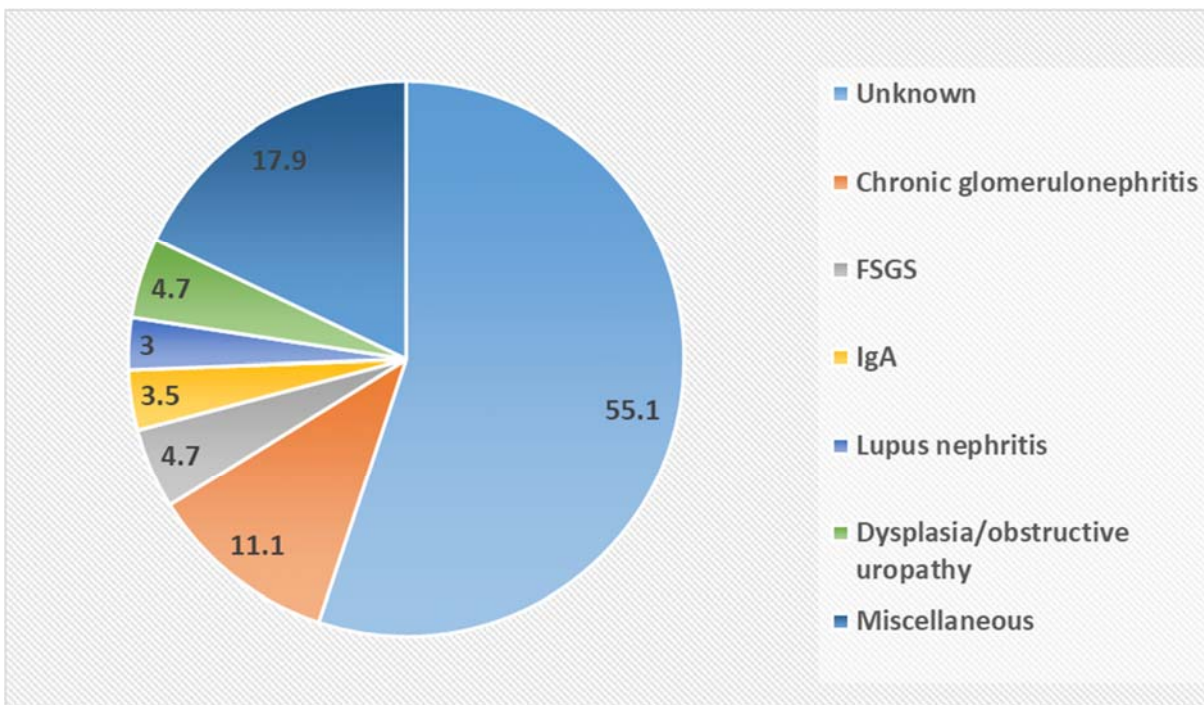
Picture 3.2 The number of child recipients since 2000, separated by renal replacement therapy.

The number and proportion of kidney transplant patients younger than 18 years old by age as shown in picture 3.3.



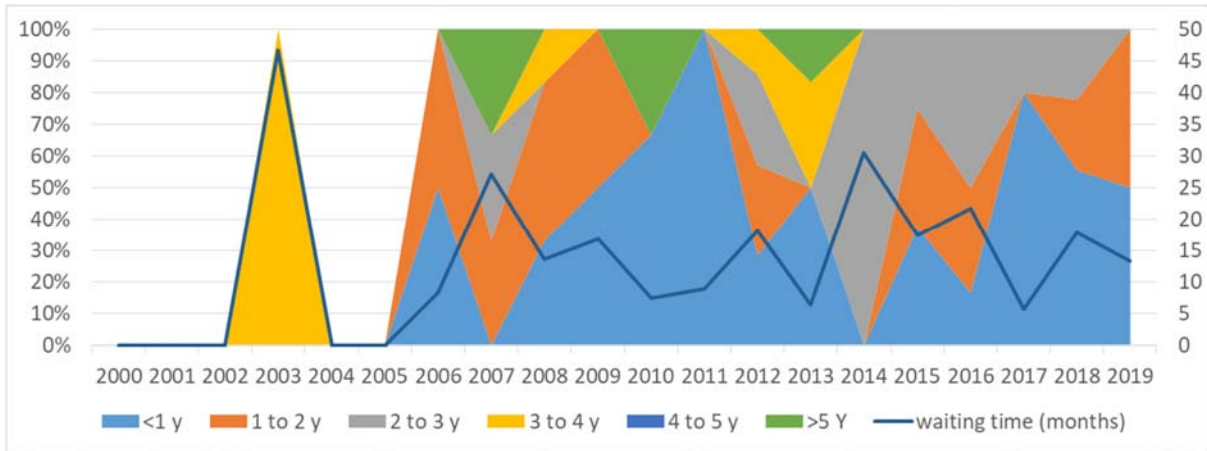
Picture 3.3 The proportion of kidney transplant patients younger than 18 years old, separated by ages.

The major causes of chronic kidney disease were 11.1% of chronic glomerulonephritis, 4.7% of focal segmental glomerulosclerosis (FSGS) and uropathy, 4.7%, 3.5% of igA nephropathy and 3.0% of lupus nephritis and 55.1% of unidentified causes (picture 3.4).

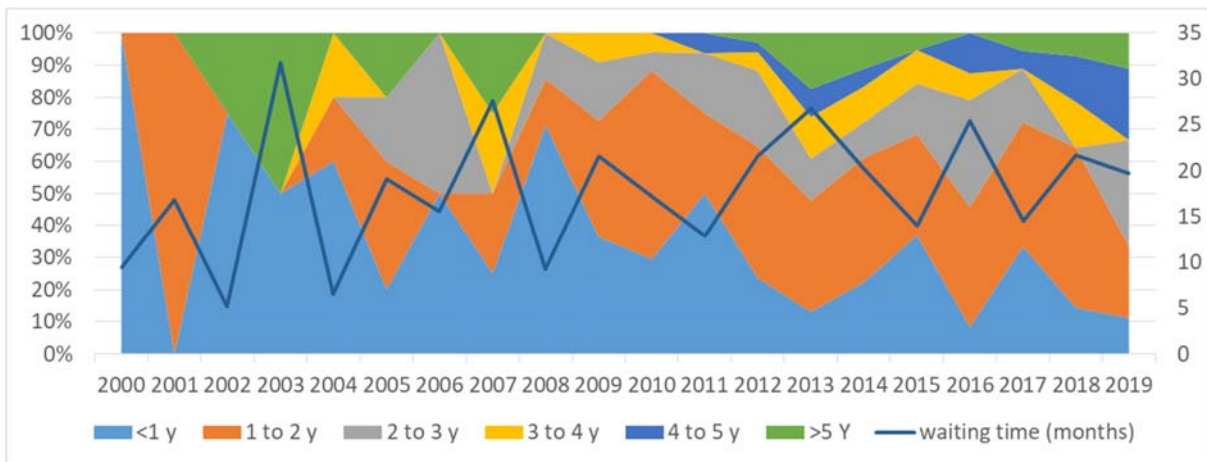


Picture 3.4 Causes of chronic kidney disease in child recipients.

The kidney recipients from deceased donors had longer period of renal replacement therapy before transplantation than living donors (table 3.6). The period of renal replacement therapy before transplantation of child kidney recipients from living donors and deceased donors were separated by year as shown in picture 3.5 and 3.6 respectively.



Picture 3.5 The period of renal replacement therapy before kidney transplantation from living donors.



Picture 3.6 The period of renal replacement therapy before kidney transplantation from deceased donors.

## Information of Donors

The information of kidney transplantation separated by transplant (table 3.7) types of 89 of living donors, 29.2% were male. The relationship between donors and recipients as shown in table 3.8.



Table 3.7 The information of living donors and deceased donors.

	Living donor	Deceased donor
Number	89	319
Male gender, %	29.2	77.1
Donor age, years (mean $\pm$ SD, range)	39.8 $\pm$ 8.3 (20–54)	32.1 $\pm$ 12.3 (3–59)
Donor best serum creatinine, mg/dL	0.81 $\pm$ 0.21	0.98 $\pm$ 1.10
Donor last serum creatinine, mg/dL	0.83 $\pm$ 0.29	1.21 $\pm$ 0.67
Donor hypotension, %	1.1	73.4
Donor CPR, %	0	9.4

Table 3.8 The relationship between living donors and recipients.

Relationship between recipient	Number of donor (%)		
	Male	Female	Total
Parents	18 (69.2)	53 (84.1)	71 (79.8)
Siblings	4 (15.4)	2 (3.2)	6 (6.7)
Others e.g. twin, cousin	4 (15.4)	8 (12.7)	12 (13.5)
Total	26	63	89

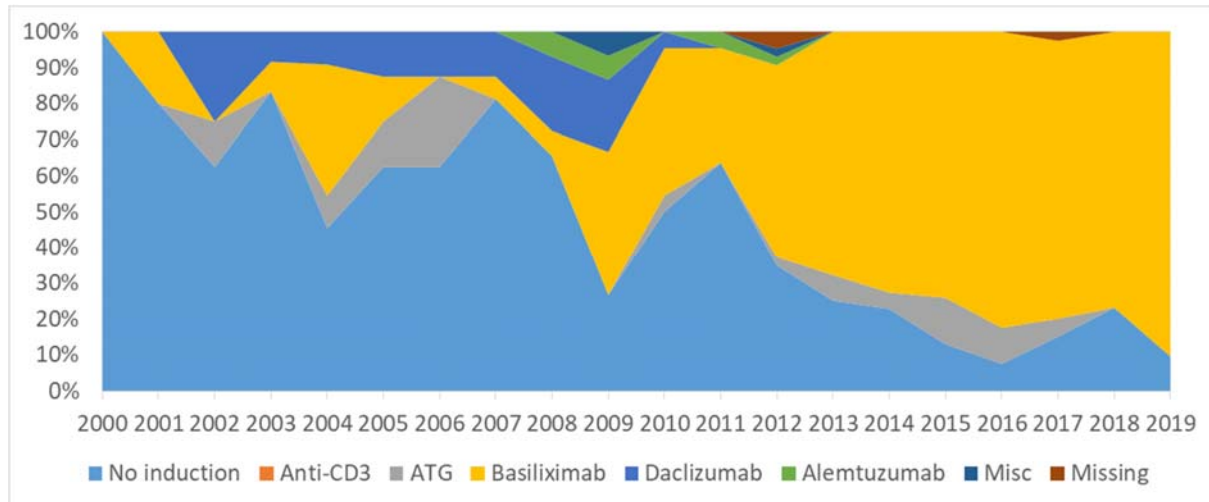
From 319 deceased donors, 77.1% were male and 73.4% had hypotension before amputation, 9.4% had cardiopulmonary resuscitation (table 3.7), The main cause of brain death was car accident as shown in table 3.9.

Table 3.9 The causes of brain death.

Cause	%
Traffic related accidents	63.6
CVA	16.9
Fall	3.1
Gunshot	2.8
Primary brain tumor	0.6
Asphyxia	0.3
Others	5.3

## Immunosuppressive medication used and kidney transplant result.

The patients younger than 18 years old received induction therapy and its significantly increased every year but decreased in non-induction therapy (picture 3.7). The kidney transplant recipients were 44.9% of living donors and 33.9% of deceased donors (table 3.10).

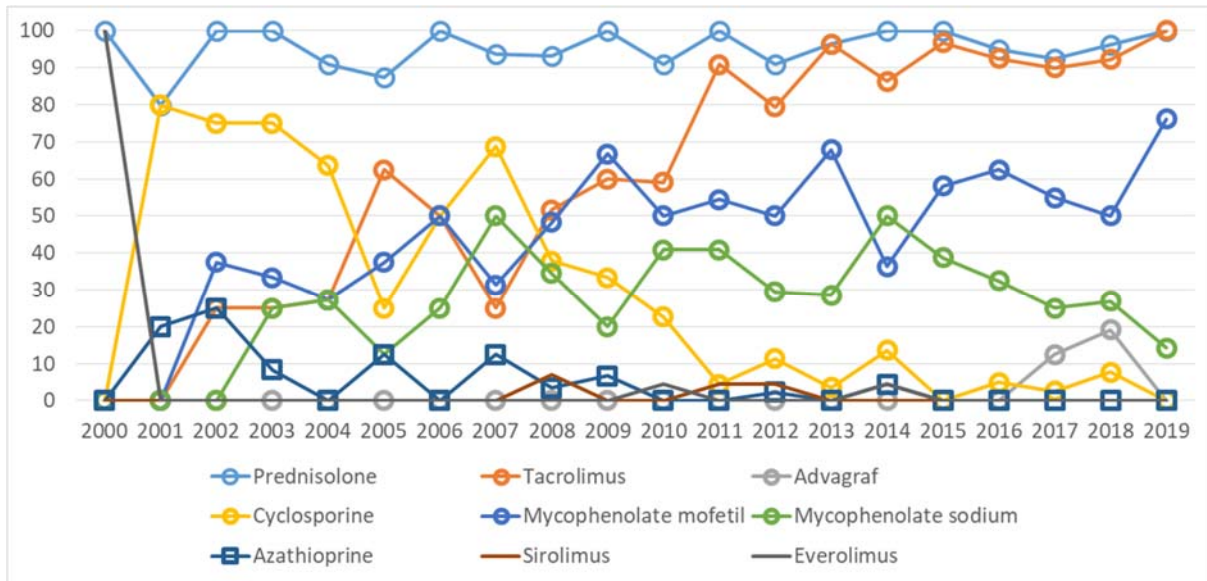


Picture 3.7 The proportion of patients received induction therapy, separated by year of transplantation.

Table 3.10 The proportion of antibody induction therapy separated by transplant types.

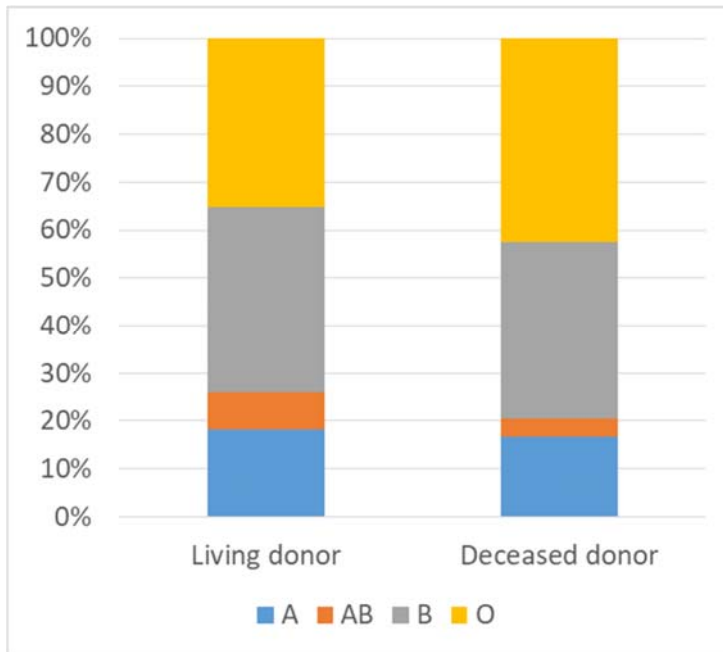
	Number of kidney transplant patients (%)	
	Living donor (N=89)	Deceased donor (N=319)
No induction	40 (44.9)	108 (33.9)
Basiliximab	35 (39.3)	177 (55.5)
Daclizumab	4 (4.5)	13 (4.1)
ATG	5 (5.6)	14 (4.4)
OKT3	0 (0.0)	2 (0.6)
Alemtuzumab	3 (3.3)	2 (0.6)
Others	1 (1.2)	1 (0.3)
Missing	1 (1.2)	2 (0.6)

The proportion and tendency of immunosuppressive medication used on discharge date was shown in picture 3.8. The patients younger than 18 years old received prednisolone, tacrolimus, mycophenolate mofetil or mycophenolate sodium were significantly increased.



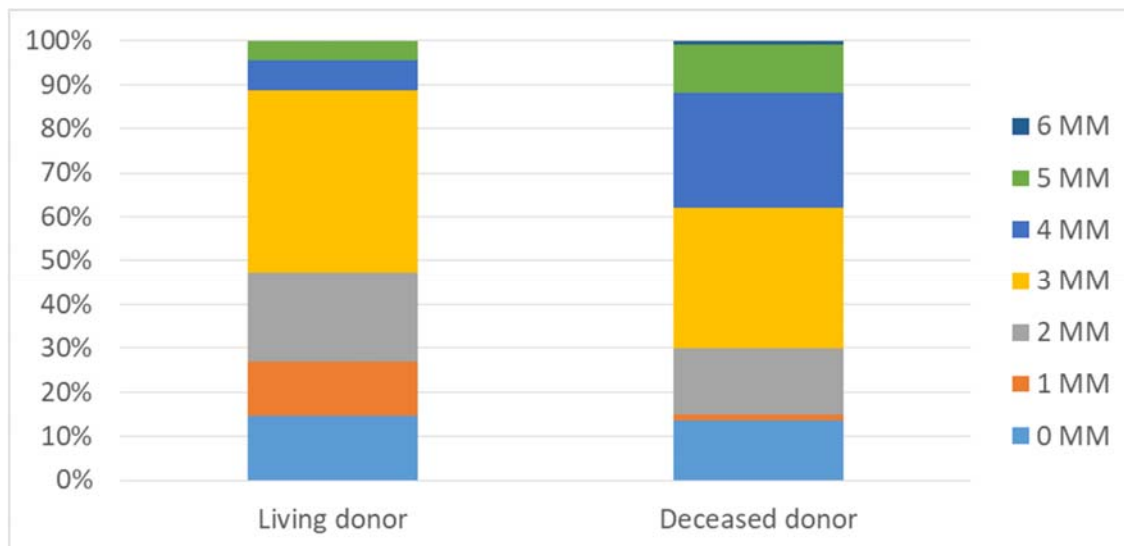
Picture 3.8 The proportion of immunosuppressive treatment on discharge date, separated by year of transplantation.

For blood types of recipients from living donors, type O, B, A and AB which represented 35.2%, 38.6%, 18.2% and 8.0% respectively. On the other hand, blood types of recipients from deceased donors, the percentage were 42.5%, 37.1%, 16.7% and 3.8% respectively (picture 3.9).

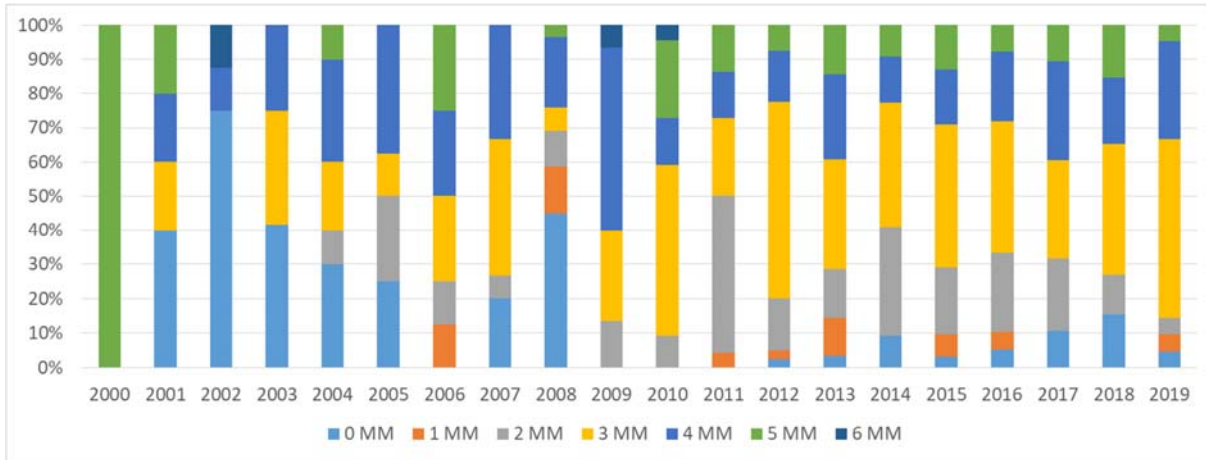


Picture 3.9 The proportion of kidney transplant recipients separated by blood types.

There were tissue matching of 3 HLA mismatch (34.2%) in most child patients which the proportion was separated by transplantation types as shown in picture 3.10 and separated by transplantation year as shown in picture 3.11.



Picture 3.10 The tissue matching of child patients, separated by transplant types.



Picture 3.11 The tissue matching of child patients, separated by transplant year.

The kidney recipients from deceased donors had both high delayed graft function and serum creatinine level at discharge date than from living donors. The number of recipients from deceased donors had longer stay in hospital than from living donors. (table 3.11)

Table 3.11 The delayed graft function and serum creatinine on discharge date and the number of patient admission, separated by transplant types.

	kidney transplant from living donor	kidney transplant from deceased donor
Delayed graft function, %	5.6	20.1
Serum creatinine at discharge, mg/dL	1.05 ± 1.11	1.39 ± 1.26
Admission days after transplantation, days (median, interquartile range)	15 (11–21.5)	23 (16–33)

### Cytomegalovirus Infection in child patients of kidney transplantation

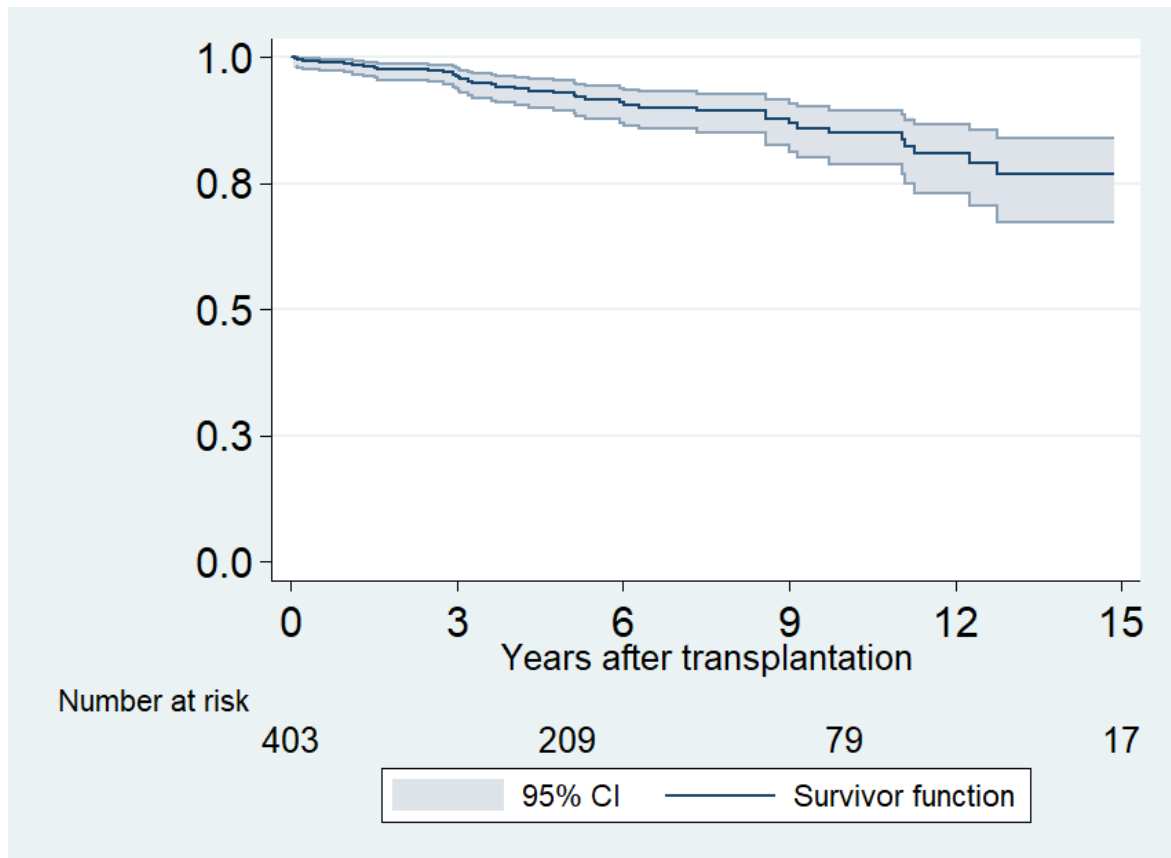
The child patients tended to have Cytomegalovirus (CMV) infection; 294 patients (72.1%) had Anti-CMV IgG positive and 12 patients (2.9%) had Anti-CMV IgM positive; 6 patients had Anti-CMV IgM positive had Anti-CMV IgG negative. The relationship between recipients and donors were separated by CMV infection as shown in table 3.12.

Table 3.12 The relationship between recipients and donors, separated by Cytomegalovirus (CMV) infection.

Recipient	Donor		
	Anti-CMV IgG positive	Anti-CMV IgG negative	Unknown
Anti-CMV IgG เป็นบวก	59.8	3.4	8.6
Anti-CMV IgG เป็นลบ	7.6	4.2	0.7
Unknown	3.4	0.2	12.0

### Patient survival rate

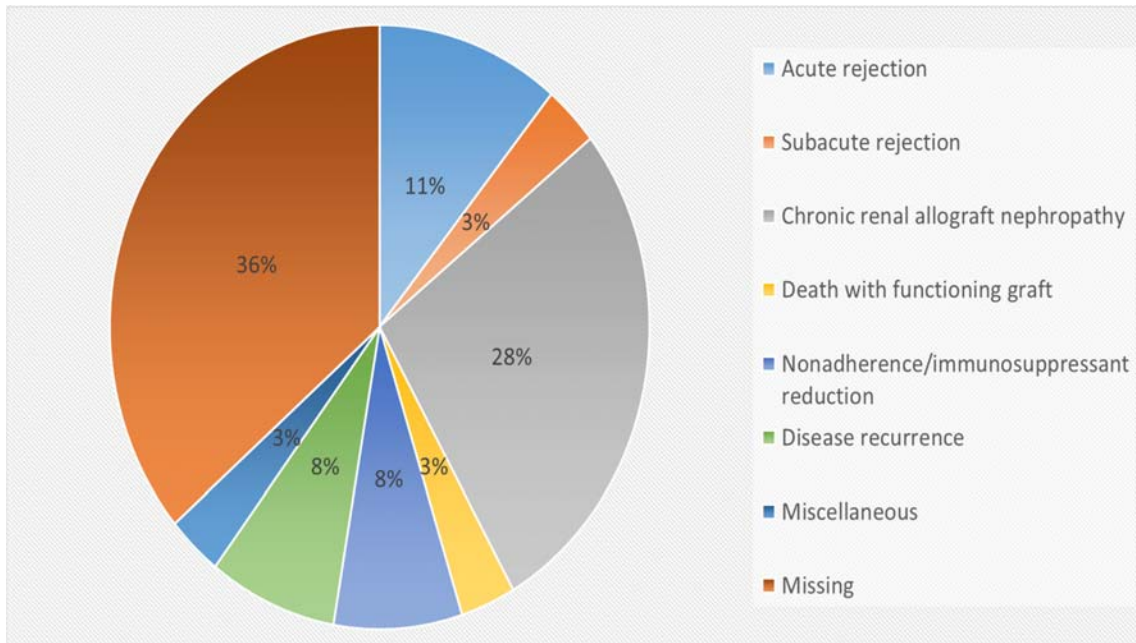
The survival rate after kidney transplant had significantly increased. During 1996 – 2019, 40 patients died after kidney transplantation which was 9.9%. The causes of death were 9 cases of infection, 2 cases of heart failure, 1 case of stroke, 4 cases of kidney failure, 4 cases of others and 20 cases of unknown causes. The patient survival rate of children age at 1,5 and 10 years old were 98.9%, 92.8% and 84.3% respectively. There was no difference between kidney transplant from living and deceased donors in statistic. (picture 3.12)



Picture 3.12 The patient survival rate of kidney transplant in children from living donors and deceased donors.

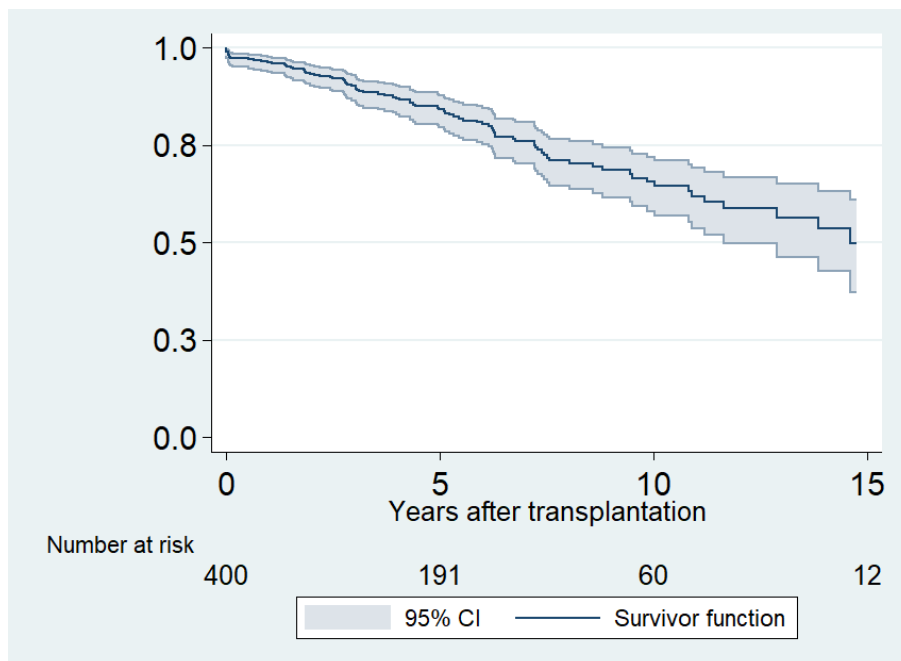
### Graft survival rate

During 1996 – 2019, there were 93 cases lost their kidneys, the causes were chronic renal allograft nephropathy, acute rejection, subacute rejection, withdrawal immunosuppression/nonadherence, recurrence of primary disease, death with functioning graft, renal artery stenosis, renal vein thrombosis and other causes which represented 25, 10, 3, 7, 7, 3, 1, 1, 3 cases respectively and 33 unidentified caused cases (picture 3.13).



Picture 3.13 Causes of child kidney transplant recipients who lost their kidneys.

The graft survival rate at the 1,5 and 10 years were 96.1% ,84.6% and 66.3% respectively when compare in statistic, there were no difference between living donors and deceased donors (picture 3.14).



Picture 3.14 The graft survival rate of child kidney transplant recipients from living donors and deceased donors.



## Liver transplantation

# Information of Liver transplantation

## Annual Report of Liver Transplantation 2019

By Registration of Liver Transplant subcommittee, Thai Transplantation Society

The first liver transplant registration from appointed committee held the meeting in March 2018 to organize the registration and collect the information of recipients, donors, results and immunosuppressive medication used in past three year (2016-2018).

The second report information of transplant in past four years (2016-2018) which collect information from the first report and had edit for more correct report. This report had divided into liver transplant in adults and in children (age less than 18 years old).

### Liver Transplant in adults

There were 341 patients of liver transplantation between 2016-2019 at 77, 96, 77 and 91 respectively. The most patients had liver transplant in 2017 and 2019 more than 90 patients which was consistent to donors to The Thai Red Cross by 300 patients in that year.

Liver transplantation was separated by hospitals: Siriraj, Chulalongkorn, Srinagarind, Maharaj Nakorn Chiangmai, Ramathibodi, Vichaiyuth, Rajavidhi, Bumrungrad and Smithivej Sukhumvit at 96, 89, 80, 21, 27, 23, 13, 9, 2 and 2 respectively as shown in table 1.

Table 1 Number of Liver transplantation in adults between 2016-2018, separated by hospitals.

Hospital	2016	2017	2018	2019	Total
Siriraj	26	28	19	23	96
Chulalongkorn	23	21	16	29	89
Srinagarind	8	23	24	25	80
Maharaj Nakorn Chiangmai	7	8	6	6	27
Ramathibodi	6	8	4	5	23
Vichaiyuth	5	4	4	0	13
Rajavidhi	2	3	3	1	9
Bumrungrad	0	0	1	1	2
Smithivej Sukhumvit	0	1	0	1	2
Total	77	96	77	91	341

The type of liver transplant classified to 322 (94.4%) of first transplant and 19 (5.6%) of repeated transplant (second transplant) and classified to type of donors; 327 (95.9%) from donors after brain death and 14 (4.1%) from living donors.

## Type of Liver Donors

The average age of donor was 53.6 years old, the standard deviation, SD was equal 12.5 years old, the median was equal to 57 years old, the youngest age was 19 years old and the oldest age was 77 years old. There were more male donors than female donors; 255 (74.8%) in male and 86 (25.2%) in female. The most donor had O blood type at 130 (38.1%), secondary had B blood type at 115 (33.7%), A blood type at 66 (19.4%), AB blood type at 30 (8.8%). The body mass index (BMI) was equal to 24.6 kg/m<sup>2</sup>; 28 (8.2%) had BMI between 30-35 kg/m<sup>2</sup> (obesity) and 9 (2.6%) had BMI more than 35 kg/m<sup>2</sup> (morbid obesity), median was equal to 24.2 kg/m<sup>2</sup>; the minimum median was equal to 14.9 kg/m<sup>2</sup> and the maximum median was 39.8 kg/m<sup>2</sup> as shown in table 2.

Table 2 Types of Liver transplant in adult recipients between 2016-2019

	Category	Average, Number	SD (range), %
Age	Year	53.6	12.5 (19-77)
Sex	Male	255	74.8
	Female	86	25.2
Blood Type	A	66	19.4
	B	115	33.7
	O	130	38.1
	AB	30	8.8
BMI	kg/m <sup>2</sup>	24.6	4.4 (14.2-39.8)

The main cause of liver transplant were 165 (48.4%) of Hepatocellular carcinoma, secondary was 104 (30.5%) of acute hepatitis B infection/chronic hepatitis B cirrhosis, 90 (26.4%) of hepatitis C cirrhosis, 53 (15.5%) of alcoholic cirrhosis, 27 (7.9%) of non-alcoholic steatohepatitis cirrhosis and other

causes respectively as shown in table 3. The cause individually had more than one indicator such as hepatocellular carcinoma together with acute hepatitis B infection.

Table 3 The causes of liver transplant in adults between 2016-2019.

Causes	Numbers	%
Hepatocellular carcinoma	165	48.4
Hepatitis B infection/cirrhosis	104	30.5
Hepatitis C cirrhosis	90	26.4
Alcoholic cirrhosis	53	15.5
Non-alcoholic steatohepatitis cirrhosis	27	7.9
Biliary atresia	16	4.7
Acute fulminant hepatic failure	13	3.8
Autoimmune hepatitis	10	2.9
Primary biliary cirrhosis	10	2.9
Primary sclerosing cholangitis	10	2.9
Cryptogenic cirrhosis	8	2.3
Hepatic artery thrombosis	4	1.2
Calori's disease	4	1.2
Budd-Chiari syndrome	4	1.2
Cholangiocarcinoma	3	0.9
Familial amyloidosis polyneuropathy	2	0.6
Wilson disease	2	0.6
Primary graft non-function	2	0.6

The common symptoms and complications from liver transplant were 77 (22.6%) of variceal bleeding, 71 (20.8%) of refractory ascites, 42 (12.3%) of recurrent spontaneous bacterial peritonitis and others as shown in table 4.

Table 4 Symptoms and Complications of liver transplantation in adults between 2016-2019.

Symptom and Complication	Number	%
Refractory ascites	77	22.6
Variceal bleeding	71	20.8
Recurrent spontaneous bacterial peritonitis	42	12.3
Recurrent cholangitis	15	4.4
Hepatorenal syndrome	15	4.4
Hepatic hydrothorax	4	1.2
Hepatopulmonary syndrome	3	0.9
Polyneuropathy	3	0.9

The common comorbidities found in liver transplantation were 95 (27.9%) of diabetes, 24 (7%) of dyslipidemia, 17 (5%) of chronic kidney disease, moreover 2 (0.6%) of previous cancer other than liver cancer i.e. 1 of breast cancer and 1 of ovarian cancer as shown in table 5.

Table 5 The common comorbidities found in liver transplantation in adults between 2016-2019

Comorbidity	Number	%
Diabetes mellitus	95	27.9
Dyslipidemia	24	7
Chronic kidney disease	17	5
Heart disease (CAD, heart block)	8	2.3

Hematologic disease (thalassemia, ITP)	6	1.8
Old cerebrovascular accident	3	0.9
Previous cancer (CA breast, CA ovary)	2	0.6
Pulmonary disease (asthma, old TB)	2	0.6
Hyperthyroid	2	0.6
Gout	2	0.6
Myasthenia gravis	1	0.3

(CAD: coronary artery disease, ITP: idiopathic thrombocytopenic purpura, CA: carcinoma, TB: tuberculosis)

The information of liver transplantation had 2.5 mg/dL of total bilirubin median, 3.1 g/dL of albumin, 0.9 mg/dL of creatinine, 136 mmol/L of serum sodium, 1.4 of INR and 20.4 of model of end-stage liver disease -sodium (MELD-Na) score average, 8.2 of standard deviation (SD), 21 of MELD-Na score median, the lowest equal to 6 and the highest equal to 50. The median of waiting period from the first date of registration to transplant date was 88 days or 3 months has average equal to 247 days or 8 months as the shortest waiting time was 1 day and the longest was 4,010 days or 11 years. The median of ischemic time counted from donor clamp time to reperfusion time was 6 hours 26 minutes. The median of length of hospital stayed after liver transplant counted from date of transplant until discharged date was 16 days (25.5%), the shortest was equal to 6 days and the longest was equal to 395 days. The information did not include the patients who dies during transplantation or hospital stayed as shown in table 6.

Table 6 Liver transplantation database between 2016-2019

	Unit	Median	Average (SD)	Range
Laboratory Test before liver transplantation				
Total bilirubin	mg/dL	2.5	6.8	0.21 –47
Albumin	g/dL	3.1	3.1	1.3 –5.3

Creatinine	mg/dL	0.9	1.3	0.1 –17
Serum sodium	mmol/L	136	135.7	114 –157
INR		1.4	1.7	0.9 –11.6
AFP	ng/mL	3.9	245.2	0.6 – 60,500
MELD-Na score		21	20.4	6 –50
Waiting time	day	88	247	1 –4,010
Ischemic time	hour	6:26		2:17 –16:39
Length of hospital stay*	day	16	25.5	6 –395

\*showed non-normal distribution that median represent “hospital stayed from transplant date until discharged date”, this was not included patients who died during transplant or hospital stayed (SD: standard deviation, INR: international normalized ratio of prothrombin time, MELD-Na: Model of end-stage liver disease-sodium score)

To consider payment method, 45.7% used direct governmental plan, 24.9% used self-support and 13.5% used social security plan, moreover, withdrew from other funds such as fund from hospital foundation as shown in table 7.

Table 7 Payment method for liver transplant in adults between 2016-2019.

Payment Method	Number	%
Government Healthcare	156	45.7
Self-support	85	24.9
Social Security Office	46	13.5
State Enterprise Healthcare	11	3.2
Others	7	2.1

## Type of Donors

The average age of donors were 33.5 years old, SD equal to 14 years old, the youngest was 7 years old and oldest was 62 years old, there were male more than female; 281 (82.4%) of male and 60 (17.6%) of female. From total donors, 149 (43.7%) from O blood type which were the most donors, 111 (32.6%) from B, 62 (18.2%) from A and 19 (5.5%) from AB respectively which were consistent to donors. The average BMI was equal to 22.8 kg/m<sup>2</sup>; the lowest was equal to 15.4 kg/m<sup>2</sup> and the highest was equal to 35.2 kg/m<sup>2</sup>. The donors of 271 (82.9%) had systolic blood pressure less than 80 mmHg, longer than 60 minutes and 38 (11.6%) had cardiopulmonary resuscitation, CPR. The median of alanine aminotransferase (ALT) at highest was equal to 41 IU/L, ranged between 8-615 IU/L and at last ALT before transplantation was equal to 32 IU/L, ranged between 7-630 IU/L. The main causes of death (except living donors) were brain injury (65.1%), Stroke (19.9%) and asphyxiation (6.7%) as shown in table 8.

Table 8 Donor type of liver transplantation in adults between 2016-2019.

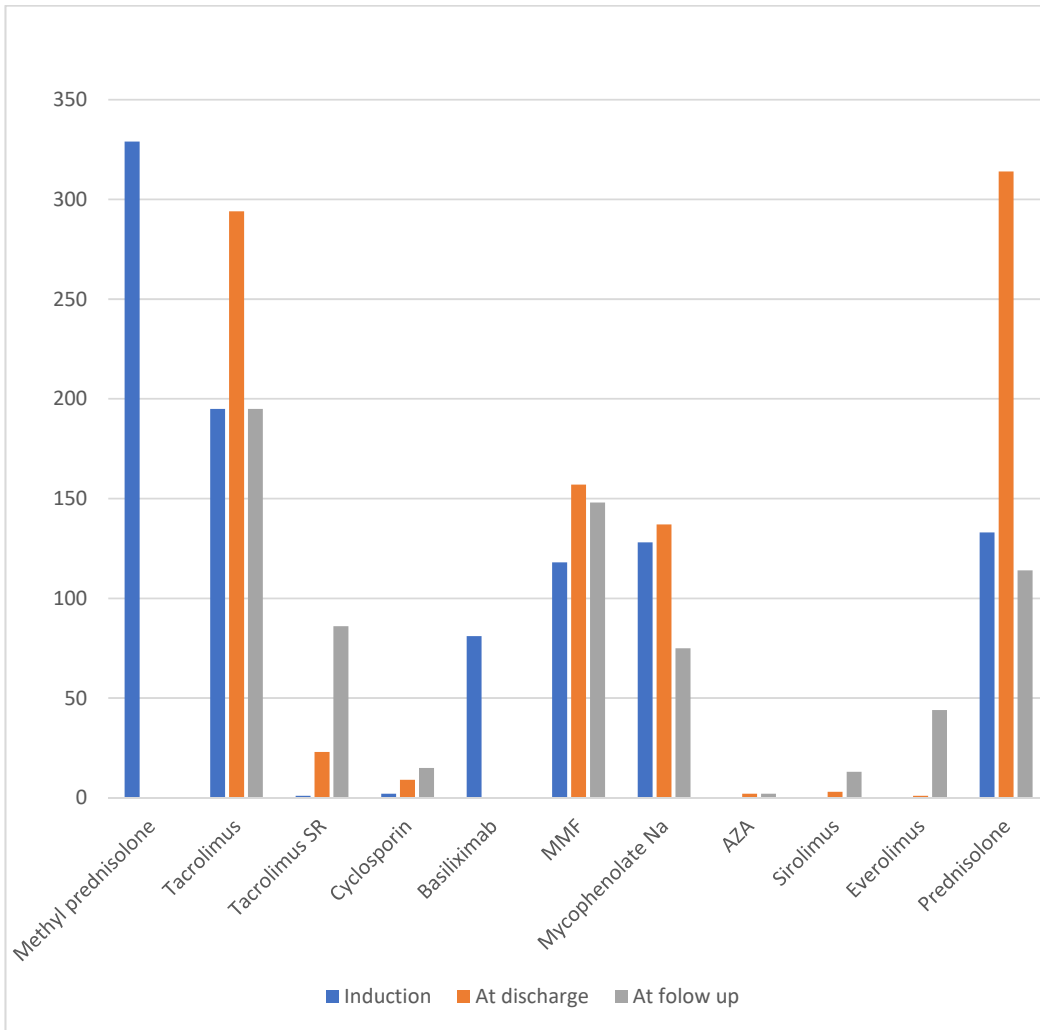
	Unit	Median	Average(SD)	Range
Age	Year	34	33.5 (14)	7 –62
BMI	kg/m <sup>2</sup>	23	22.8 (3.2)	15.4 –35.2
Highest ALT	IU/L	41	70 (87.1)	8 –615
Last ALT	IU/L	32	51.1 (61.4)	7 –630
			Number	%
Sex	Male		281	82.4
	Female		60	17.6
Blood Type	A		62	18.2
	B		111	32.6
	O		149	43.7
	AB		19	5.5



Hypotension			271	82.9
CPR			38	11.6
Cause of Death	Accident		213	65.1
	Cerebrovascular disease		65	19.9
	Fall from a height		22	6.7
	Shot		10	3.1
	Asphyxiation		4	1.2
	Others		13	4.0

## Immunosuppressive medication

The liver recipients received immunosuppressive during first 24 hours of induction, 96.5% received most of methylprednisolone, 57.2% of tacrolimus, 33.4% of basiliximab on discharge date, 92.1% of prednisolone, 86.2% of tacrolimus, 46% of mycophenolate sodium during the latest following up, 57.2% of tacrolimus, 43.4% of mycophenolate mofetil, 33.4% of prednisolone, 25.2% of sustained released tacrolimus, 22% of mycophenolate sodiu, 12.9% of everolimus, 6.2 sirolimus, 4.4% cyclosporin and 0.9% of azathioprine. The immunosuppressive medication used only in a minority of liver transplant patients. Information on the use of immunosuppressants in liver transplant patients at different times as shown in picture 1.

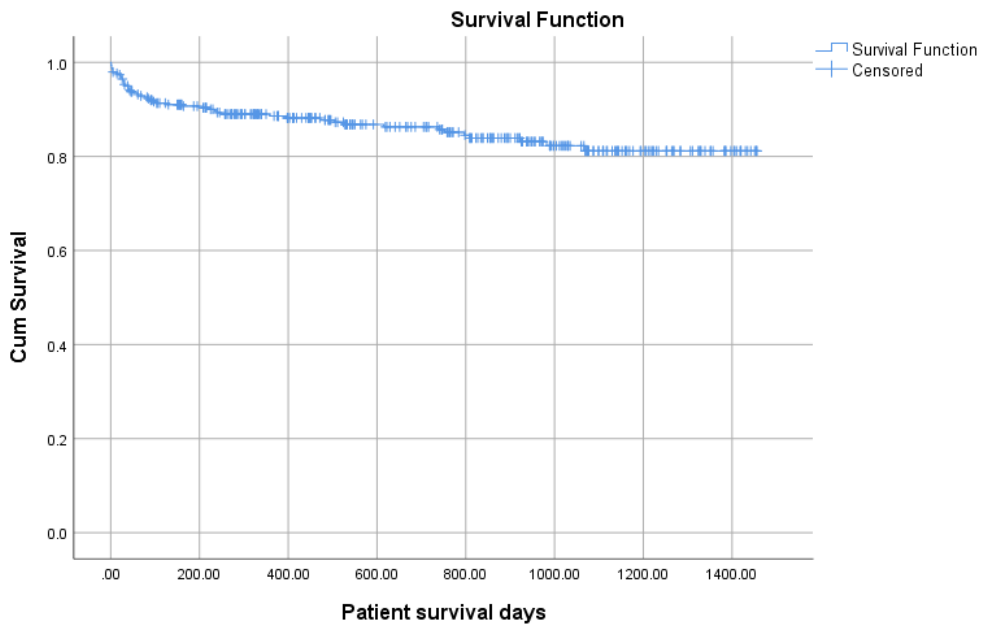


Picture 1 The liver recipients who received immunosuppressive on discharged date at first 24 hours induction and latest follow up for liver transplant between 2016-2019.

## Patients survival rate and graft survival rate

The patient death rate after transplantation between 2016-2019 within 30 days was equal to 4.1% and within 90 days was equal to 7.9%.

The survival rate at 1 year was equal to 88.6% (95% CI: 85.1 – 92.1), patient survival rate at 2 years was equal to 86.3% (95% CI: 82.4 – 90.2) and patient survival rate at 3 years was equal to 81.2 (95% CI: 75.9-86.5) The Kaplan-Meier's survival rate as shown in picture 2 which calculated from the first time and repeated transplantation.



Picture 2 Patients survival rate between 2016-2019, calculated by Kaplan-Meier

Patients death rate within 90 days after transplantation were separated by year: 6.49% in 2016, 5.21% in 2017, 11.53% in 2018 and 8.89% in 2019.

The first-year survival rate as follow: 90.9% (95% CI: 84.4 – 97.4) in 2016, 90.6% (95% CI: 84.7 – 96.5) in 2017, and 84.6 (76.7- 92.6) in 2018. The liver transplantation in year 2019 could not calculate yet due to lack of time following up.

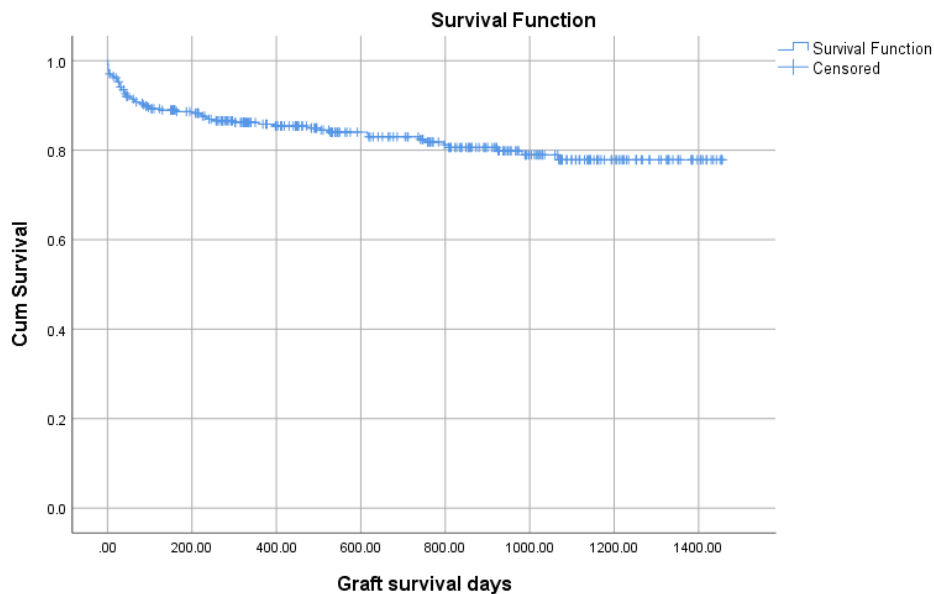
During follow up period between 2016-2019, 52 died from 48.1% of infection and 15.4% of liver failure as shown in table 9.

Table 9 Causes of death in most adult's liver transplant between 2016-2019.

Cause of death	Number	%
Infection	25	48.1
Liver cancer recurrence	8	15.4
Circulatory system and heart	5	9.6
Liver failure	4	7.7
Cerebrovascular	2	3.8
Unidentified causes	8	15.4

The graft survival of liver transplantation between 2016-2019 at 30 days was equal to 94.1% (95% CI: 91.6- 96.6), at 90 days was equal to 89.9% (95% CI: 86.8 – 93.0).

At 1 year was equal to 85.8% (95% CI: 82.1 – 89.5), at 2 years was equal to 83% (95% CI: 78.7 – 87.3) and at 3 years was equal to 77.9% (95% CI: 72.4 – 83.3) The Kaplan-Meier transplantation was shown in picture 3.



Picture 3 Graft survival of liver transplantation between 2016-2019 by Kaplan-Meier process.

Graft survival at 90 days was separated by year: 89.6% (95% CI: 82.7 – 96.5) in 2016, 93.8% (95% CI: 86.9 – 98.7) in 2017, 88.5% (95% CI: 81.4 – 95.6) in 2018 and 87.5% (95% CI: 80.6-94.4) in 2019

The first-year transplantation in 2016 was equal to 87% (95% CI: 77.7 – 93.7), in 2017 was 87.5% (95% CI: 80.8 – 94.2) and in 2018 was 84.6% (95% CI: 76.6 – 92.6). The liver transplantation in year 2018 could not calculate yet due to lack of time following up.

During follow up period between 2016-2019, the causes of graft failure were 8 of vascular complications, 4 of primary graft non-function, 4 of recurrence of the disease, 1 of biliary complications, 1 of chronic rejection and 12 of unidentified causes as shown in table 10.

Table 10 The graft failure in adult liver transplantation between 2016-2019.

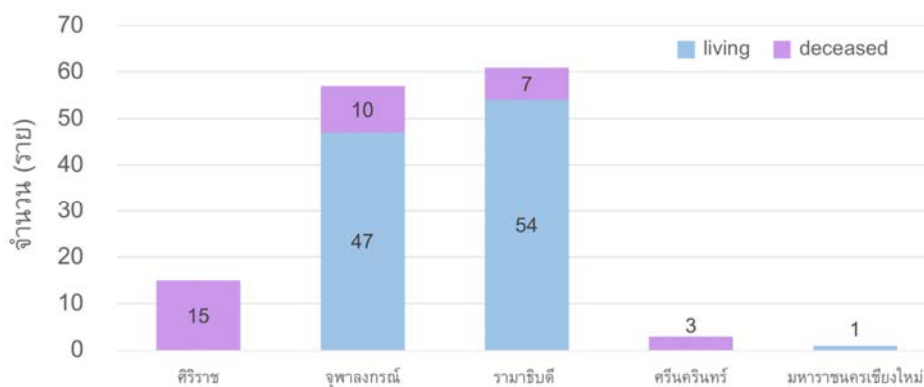
Cause of graft failure	Number	%
Vascular Complications	8	26.7
Primary graft non-function	4	13.3
Recurrence of the disease	4	13.3
Biliary complications	1	3.3
Chronic rejection	1	3.3
Unidentified causes	12	40

## Information of Liver transplantation in children

The information of liver transplantation in children between 2016-2019 found that 137 patients (table 1) counted from the date of transplant were received transplant with 5 hospitals i.e. Siriraj, Chulalongkorn, Ramathibodi, Srinagarind and Maharaj Nakorn Chiangmai: 75 recipients from living donors which were 77.32% (picture 1 and table 2).

Table 1 Number of liver transplantation in children between 2016-2019.

Hospital	Years				Total
	2559	2560	2561	2562	
Siriraj	4	4	3	4	15
Chulalongkorn	11	15	15	16	57
Ramathibodi	15	12	16	18	61
Srinagarind	-	2	1	-	3
Maharaj Nakorn Chiangmai	-	-	-	1	1
Total	30	33	35	39	137



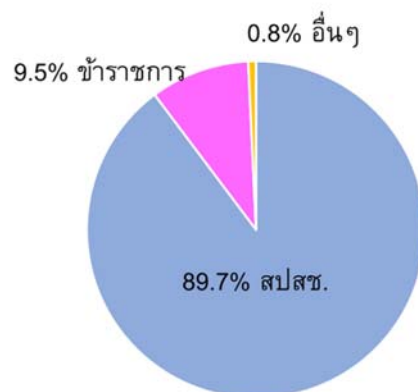
Picture 1 Number of liver transplantation in children, separated by hospitals and type of donors in 2016-2019.

Compared to pediatric liver transplants in 2018, an increase of 11.5% in total number of pediatric patients in 2019 was divided into donor liver transplants increased by 3.5% and deceased donor increased by 42.8% with liver transplant waiting times from 1-3,867 days of waiting for transplant registration with a median of 195 days. Patients who received a liver transplant from a deceased donor. The live donor transplant patients had wait times before receiving liver transplant from 3.9 to 1,416 days and a median of 149 days (table 2,3).

Table 2 Number of liver transplantation in children, separated by type of donors between 2016-2019 and the transplant waiting time from each type.

Type of Donor	Number					Transplant waiting time (Day)		
	2016	2017	2018	2019	Total	Minimum	Maximum	Median
Deceased	6	12	7	10	35	1	3,867	195
Living	24	21	28	29	102	3.9	1,416	149

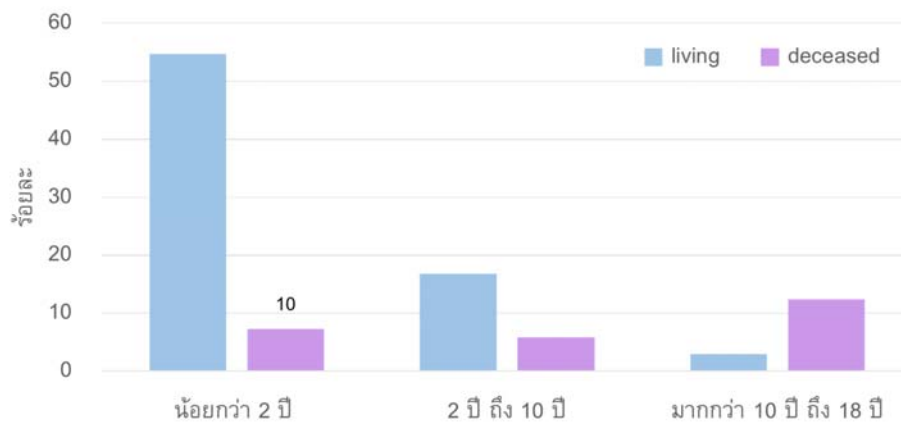
Most of young patients used National Health Security which were 89.7% as the recipients younger than 18 years had liver failure were approved by National Health Security since 2012. The patients who registered before aged of 18 and did not received any transplantation until aged over 18 years old would not get any health care coverage recently. The patients who were over 18 years old will be able to use government/state enterprise scheme and social security only.



Picture 2 Health care coverage for liver transplantation in children between 2016-2019.

## The information of liver transplantation in children between 2016-2019

The youngest child who received liver transplant aged less than 2 years old which was 62.1%, aged 2-9 years old were 22.6% and 10-18 years old were 15.3%. The age median when received transplant was 1.6 years. It was found that the majority of live donor transplant pediatric patients were under 10 years of age (96%) (picture 3). Females were approximately 1.3 times greater than males (table 3) for the ischemic time, from the time the blood was stopped in the donor clamp time to the time of release. The median reperfusion time was 7 hours 50 minutes, with the shortest duration 5 hours and the longest 12 hours 30 minutes (table 3).



Picture 3 The liver transplantation in children, separated by ages.

Table 3 The basic data of liver transplantation in children between 2016-2019.

		Deceased donor (n=35)	Living donor (n=102)	Total (n=137)
Sex	Male	14 (40%)	46 (45%)	60 (43.8%)
	Female	21 (60%)	56 (55%)	77 (56.2%)
Age (Month)	Median	107.1	15.1	18.9
	(IQR)	(18.7, 184)	(12.5, 26.9)	(13.1, 46)
Waiting time (Day)	Median	195	149	156
	(IQR)	(42, 562)	(39, 277)	(40, 299)
PELD/MELD Score	Median	20	19.5	20.5

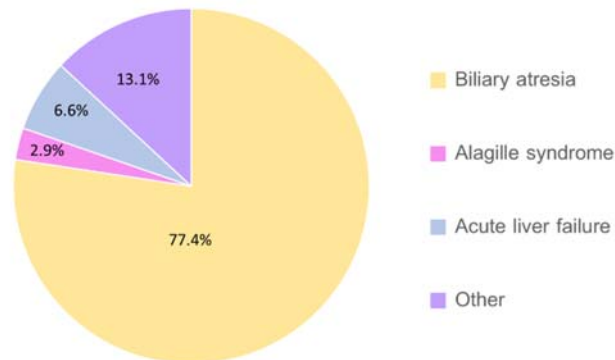


	(IQR)	(16, 25)	(15.7, 26)	(16, 25.5)
Cold Ischemic Time	Median	470	102.5	123
	(IQR)	(390, 529)	(70.8, 130.3)	(91, 306.5)
Graft type	Partial (n, %)	14 (40%)	102 (100%)	116 (84.6%)
	Whole (n, %)	21 (60%)	-	21 (15.4%)

Non-normal distribution data showed the median (Quartile range)

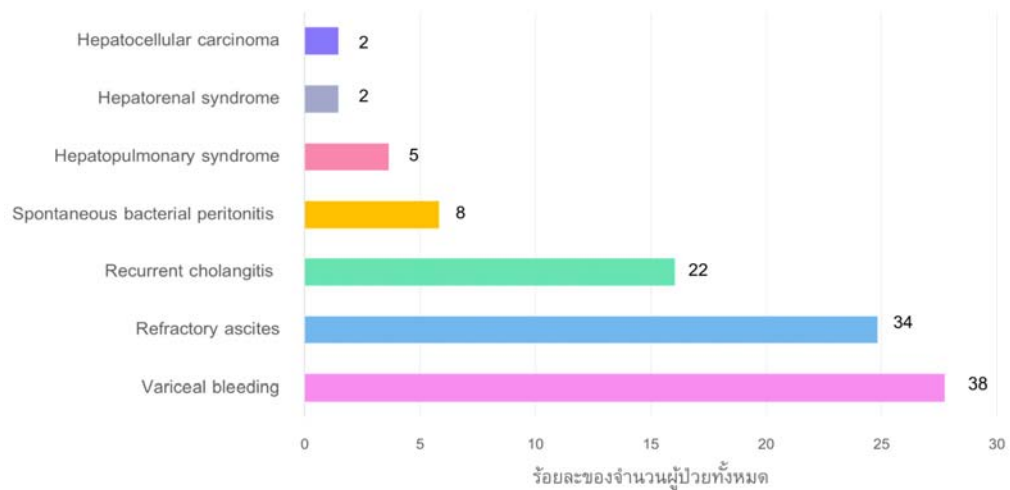
PELD: Pediatric End-Stage Liver Disease, MELD: Model for End-Stage Liver Disease

The most causes of liver failure in children were 77.4% of biliary atresia, 6.6% of acute renal failure and 2.9% of Alagille syndrome respectively. (Picture 4) The other causes were 4 patients of cirrhosis unknown cause, 2 patients of choledochal cyst, 1 patient of Abernethy malformation, 2 patients of autoimmune hepatitis, 2 patients of progressive familial intrahepatic cholestasis (PFIC), 1 patient of Wilson's disease, 1 patient of bile acid synthesis defect, 1 patient of non-syndromic paucity of interlobular bile duct, 1 patient of hepatocellular carcinoma and 1 patient of Budd–Chiari syndrome.



Picture 4 Cause of liver transplantation in children between 2016-2019.

Given the severity of the disease prior to liver transplant surgery by the PELD / MELD-Na score, there was no difference between the cohort who had surgery from live donors and brain-dead donors. The three most common pre-transplant complications were variceal bleeding (27.7%), refractory ascites (24.8%) and recurrent cholangitis (16.1%). Other less common complications were hepatopulmonary syndrome (3.6%), hepatorenal syndrome (1.5%) and hepatocellular carcinoma (1.5%) (picture 5).



Picture 5 Complications of pediatric liver disease before transplantation.

\*Number of patients

When comparing the growth of children according to their age, it was found that More than half of children with donor livers live significantly slower than normal ( $<-2.0$  SD), while about half of children with donor livers are growing normally. (table 4), which may be explained by the majority of live donor liver patients under 2 years of age and with chronic liver disease, particularly biliary atresia, resulting in malnutrition. Chronic affects growth in contrast, 45% of patients with donor liver died of acute liver failure, maintaining normal weight and height. However, it is cautious to assess weight in patients with ascites or enlarged spleen. It may cause the weight to be measured more than the reality is. In practice, nutrition monitoring of these children was preferred by measuring the mid-upper arm circumference.

Table 4 Patients' height and weight vs age norms.

Z-score	Height-for-age		Weight-for-age	
	Deceased	Living	Deceased	Living
More than -1.5 S.D.	20 (57.1%)	16 (15.7%)	18 (51.5%)	20 (18.8%)
-1.5 S.D. to -2.0 S.D.	4 (11.4%)	19 (18.6%)	5 (14.2%)	22 (21.6%)
Less than -2.0 S.D.	11 (31.5%)	67 (65.7%)	12 (34.3%)	58 (56.9%)

Data on laboratory results of pediatric patients undergoing liver transplantation from live donor and brain death donors. The mean values for total bilirubin, albumin, creatinine, INR, and sodium were

not different. Alpha fetoprotein (AFP) was examined in a small minority (32%) of patients with wide distribution. The lowest value was 0 IU / ml and the maximum were 7,568 IU / ml. Serological examination found most patients with cytomegalovirus (CMV) IgG was 86.4% positive compared to donor serology, 10.4% D + / R- group and 86.6% D + / R + group (table 5).

The blood type of pediatric patients who received liver transplantation was O (40.2%), followed by B (35%) (table 6), where all patients were Rh + in the transplant. A total of 137 liver cases were 7 ABO incompatibility transplants (5.1%). The median age of these patients was 11.8 months (youngest at 5.5 months and at most 12.9 months) upon follow-up of treatment for these patients. One death was found from severe sepsis. While other patients had no problems with blood vessels or liver function.

Table 5 Laboratory results of pediatric liver transplant patients 2016 – 2019.

	Deceased donor (n=35)	Living donor (n=102)	Total (n=137)
Recipient seropositivity			
HBsAg	0% (0/34)	0% (0/100)	0% (0/134)
Anti-HBs	57.1 % (20/35)	83 % (83/100)	83.1% (103/135)
Anti-HBc	19.4 % (6/31)	5.1 % (3/59)	10% (9/90)
Anti-HCV	0 % (0/34)	0 % (0/96)	0% (0/130)
Anti-CMV IgG	85.3 % (29/34)	89 % (89/100)	88.1% (118/134)
Anti-EBV IgG	72 % (18/25)	58.7 % (57/97)	61.5 % (75/122)
Anti-HIV	0 % (0/35)	0 % (0/102)	0% (0/137)
CMV serology (Donor/Recipient)			
D- / R-	2.9 %	1 %	1.5 %
D- / R+	5.8 %	0 %	1.5 %
D+ / R-	11.7 %	10 %	10.4 %
D+ / R+	79.6 %	89 %	86.6 %
Pre-transplant chemistry, mean ± SD			
Total bilirubin (mg/dL)	19.4 ± 10.7	18.5 ± 10.5	18.8 ± 10.6
Albumin (g/dL)	2.8 ± 0.6	2.7 ± 0.7	2.8 ± 0.7
Creatinine (mg/dL)	0.35 ± 0.13	0.19 ± 0.08	0.23 ± 0.18
Sodium (mmol/L)	136.3 ± 4.5	135.3 ± 4.1	135.6 ± 4.2
INR	1.8 ± 1.2	1.4 ± 0.6	1.6 ± 0.8

The data are presented in amounts (percent) and mean  $\pm$  standard deviation (CMV: cytomegalovirus, INR: international normalized ratio of prothrombin time).

Table 6 The blood type comparison between recipients and donors of liver transplantation in children between 2016-2018 (ABO incompatibility represents in bold number)

Blood group		Recipient				Total
		A	AB	B	O	
Donor	A	17 (12.4%)	3 (2.2%)	1 (0.7%)	3 (2.2%)	24 (17.5%)
	AB	-	2 (1.4%)	1 (0.7%)	-	3 (2.1%)
	B	-	4 (2.9%)	34 (24.8%)	2 (1.4%)	40 (29.1%)
	O	8 (5.9%)	-	12 (8.8%)	50 (36.6%)	70 (51.3%)
Total		25 (18.3%)	9 (6.5%)	48 (35%)	55 (40.2%)	137 (100%)

The MELD/PELD score used to consider for severity of disease level before transplantation found that there were no different between living donors and deceased donors which had MELD/PELD score average at 20.36 and 23.36, respectively. The most liver complications were variceal bleeding (25.8%) and refractory ascites (22.7%) respectively, (picture 8).

## Information of Donors

The most donors were live donor (75.3%). Male donors were approximately 3.3 times greater than females, while donor lives were 1.8 times more likely than males. The mean age of donors with brain death was  $7.6 \pm 2.3$  years ( $p = 0.002$ ) The youngest and greatest among brain death donors were 6 years and 54 years, respectively. Young age and the highest among living donors were 18 years and 56 years, respectively. The mean BMI of both liver donor groups. There were no differences, with the total mean of  $20.1 \pm 4.4$  kg / m<sup>2</sup> (the lowest value was 16.8 and the most 30.4 kg / m<sup>2</sup>). Three brain-dead donors were resuscitation. (cardiopulmonary resuscitation, CPR) and 13 cases of systolic blood pressure (systolic blood pressure less than 80 mm Hg over 60 minutes), which resulted in a higher baseline of ALT in brain-dead donors than that of those with cardiopulmonary resuscitation (CPR). Live

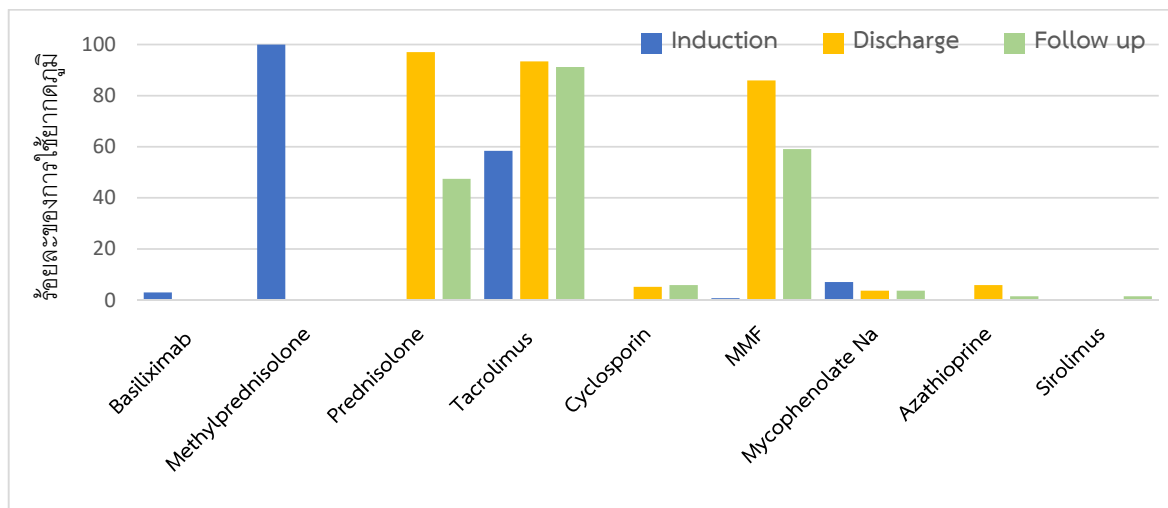
donation There are two main organ preservation reagents: University of Wisconsin (UW) solution (64.3%) and Custodiol (35.7%) (table 7).

Table 7 The information of donors of liver transplantation and organ preservation reagents in children between 2016-2019.

Information		Deceased donor (n=35)	Living donor (n=102)	Total (n=137)
Sex	Male (%)	27 (77.1)	36 (35.3)	63 (45.2)
	Female (%)	8 (22.9)	66 (64.7)	74 (54.8)
Age (years)	Mean ± SD	24.6 ± 12.8	32.2 ± 7.6	30.3 ± 9.8
BMI (kg/m <sup>2</sup> )	Mean ± SD	19.2 ± 5.4	20.3 ± 4.1	20.1 ± 4.4
Hypotension	n (%)	13/24 (54.1)	-	-
CPR	n (%)	3 (8.5)	-	-
Anti HBc +ve	n (%)	6 (17.1)	14 (13.7)	20 (14.6)
Peak ALT (IU/L)	Median (IQR)	38 (22, 62)	20 (14, 35)	22 (15, 40)
Last ALT (IU/L)	Median (IQR)	28 (18, 54)	18 (13, 26)	20 (13, 31)
Perfusate	UW solution (%)	33 (96)	55 (54)	88 (64.3)
	Custodiol (%)	2 (4)	47 (46)	49 (35.7)

## Immunosuppressive Medication

All children receiving liver transplant immunosuppressants during the first 24 hours (induction) with methyl prednisolone were most used with tacrolimus (55.5%). basiliximab while discharged from hospital, the most common use of tacrolimus with prednisolone and mycophenolate mofetil (MMF) (89%) was observed with prednisolone decreased to 47.4%. However, tacrolimus was used the most (91.2%), followed by MMF (59.1%) during this follow-up period. Liver transplant Liver function value and drug side effects However, concomitant use of the three drugs, tacrolimus prednisolone and MMF (35.7%), remained the most popular (picture 6 and table 8).



Picture 6 Percentage of liver transplant patients who received various immunosuppressants during the first 24 hours (induction), when discharged (discharge) and during the most recent follow-up treatment of pediatric patients with Received a liver transplant between 2016 and 2019.

Table 8 The percentage of immunosuppressive medication used during treatment period.

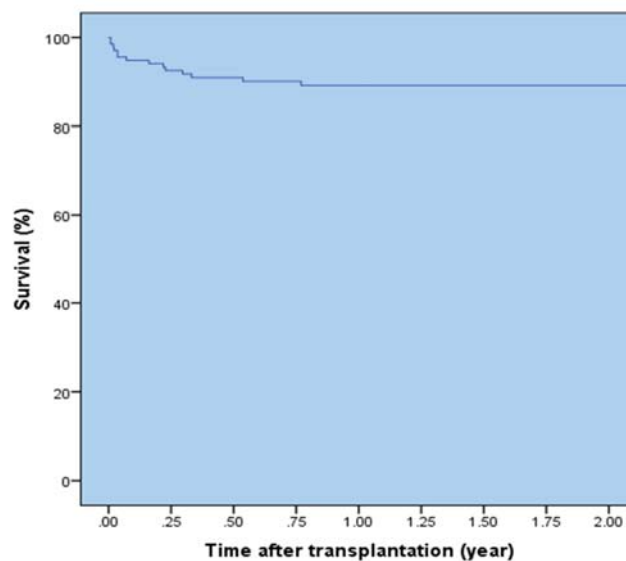
Immunotherapy formulas used in each period	Number	%
<b>Induction</b>		
Methylprednisolone	54	39.4
Methylprednisolone + tacrolimus	76	55.5
Methylprednisolone + mycophenolate sodium	5	3.7
Methylprednisolone + mycophenolate sodium + basiliximab	2	1.4
<b>Discharge</b>		
Prednisolone + tacrolimus	33	24.1
Prednisolone + cyclosporin	7	5.2
Prednisolone + tacrolimus + MMF	89	64.9
Prednisolone + tacrolimus + azathioprine	8	5.8
<b>Follow up</b>		
Tacrolimus	27	21.9
Tacrolimus + prednisolone	12	9.8
Tacrolimus + sirolimus	2	1.6
Tacrolimus + MMF	32	26.1
Tacrolimus + MMF + prednisolone	44	35.7

Cyclosporin + MMF + prednisolone	2	1.6
Cyclosporin + azathioprine + prednisolone	1	0.9
Tacrolimus + azathioprine + prednisolone	3	2.4

## Graft survival rate and patient survival rate

The mortality rate of patients following pediatric liver transplant surgery between 2016 - 2019 within 30 days equals 4.4% and within 90 days equals 7.3%.

The first year survival rate was 89.1%, which is equal to second years survival rate. Patient survival was calculated using the Kaplan-Meier method, shown in Figure 7. Patients calculated from first patient liver transplant patients. And exclude patients who have had repeated transplant surgery.



Picture 7 The patient survival rate in children of liver transplantation between 2016-2019

14 patients died in the first year after the surgery, 10 of whom died within 90 days of liver transplantation. The survival rate of patients after surgery within 90 days, separated by year, was 96.6%, 93.9 and 94.3% in 2016, 2017 and 2018, respectively, and patient survival at first year after implantation Liver transplants were 90%, 93.9% and 88.5% in 2016, 2017 and 2018, respectively. According to reports, no patients died more than first year after a liver transplant, resulting in second years survival rate. Liver transplantation was equal to first year survival rate (picture 7). The first year survival rate of

the liver transplant patients in 2019 was not able to calculate because Not having long enough tracking time.

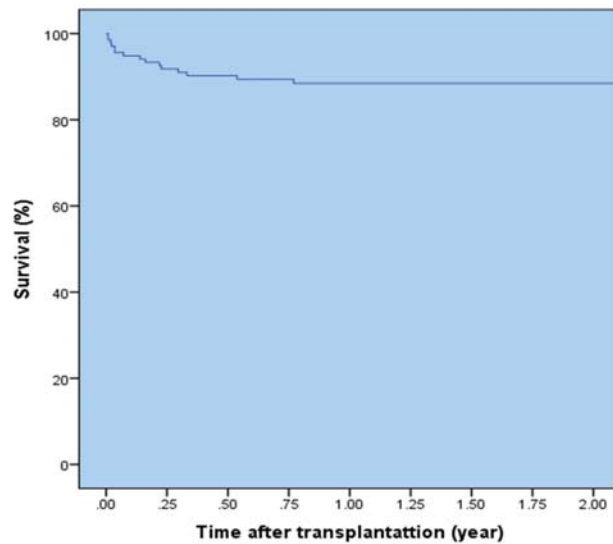
10 patients who died during 90 days after surgery were caused by hepatic artery thrombosis, 1 case, portal vein thrombosis, 1 graft non-function, brain hematoma, and 6 infection. There were four cases of death after 90 days. The cause of death was one infection, two post-transplants lymphoproliferative disorder (PTLD), and one idiopathic (table 9).

Table 9 Causes of death in pediatric patients who received liver transplant between 2016 and 2019.

Cause of death	Number	%
Infection Sepsis	7	50
Vascular complication	2	14.5
Post-transplant lymphoproliferative disorder (PTLD)	2	14.5
Primary graft non-function	1	6.5
Others	2	14.5

The graft survival rate at 90 days after transplantation, separated by year, was 96.6, 93.9 and 94.3% in 2016, 2017 and 2018, respectively (picture 8) and the survival rate for liver transplants at first year was 90%, 93.9% and 88.5% in 2016, 2017 and 2018, respectively. Second years survival rate after liver transplantation was the same as the first year survival rate (picture. 8).





Picture 8 The survival rate of liver transplanted into pediatric liver transplant patients 2016 – 2019.

There was loss of liver after transplantation in 15 pediatric patients with 3 cases of vascular complication, 1 case of graft non-function. 7 cases, 2 PTLDs, and 2 others in this group, the patients received repeated liver transplants. (Second liver transplant) 1 case and the remaining 14 deaths (table 9).

The graft survival rate at 90 days after transplantation, separated by year, was 96.6, 93.9 and 94.3% in 2016, 2017 and 2018, respectively (picture 8) and the survival rate for liver transplants at 1 year was 90%, 93.9% and 88.5% in 2016, 2017 and 2018, respectively. Second years survival rate after liver transplantation was the same as the first year survival rate (picture. 8).

The survival and survival rates of transplanted liver among pediatric patients in 2016-2018 were the same as the patients died with the loss of the transplanted liver. According to the report above, it was seen that only one patient lost a liver transplanted from parenteral complications in 2019 and had a repeat liver transplant in the same year. The follow-up period was not long enough to calculate the survival rate or liver survival rate in 2019.

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