THE AUSTRALIAN NEPHROLOGY WORKFORCE SURVEY 2007

A REPORT FOR THE

AUSTRALIAN & NEW ZEALAND SOCIETY OF NEPHROLOGY

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Funding Support

ANZSN

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Key issues in this report:

- The response rate for this survey was excellent, almost 80%, which allows reasonable extrapolation of the data and opinions expressed by this cohort to the wider Australian nephrology community.

- 75% of the Australian nephrology workforce is male, who are older than female nephrologists; proportionally more women are working part-time than men.

- Younger nephrologists plan to retire earlier

- Almost 30% of the nephrologist population is over 55 years of age, a group which plans to retire within seven to 10 years, creating a large gap in the future nephrology specialist workforce.

- 40% of nephrologists provide a clinical service to the rural community, although far less (8%, 22) report this as a ***regular*** outer regional/remote practice location.

- About 40% of nephrologists work as full-time staff specialists

Key issues in this report -continued:

- Work practice of the Australian nephrologists is about 50% in direct clinical work, predominantly CKD and dialysis, then other non-renal clinical work followed by research commitments. Teaching and other activities comprised lesser percentage of the average nephrologist's workload. This may have implications for the capacity of senior nephrologists to train the future specialists adequately.

- Workload and clinical demand often outstrips personal work capacity leading to loss of control over work and personal life; this is an important finding, which should be at the forefront of any discussion about future nephrology workforce. Approximately 1 in three nephrologists work 41 to 50 hours per week and a further one in four work 51 to 60 hours per week. In addition, two thirds have more than 30 hours per week on call and one quarter more than 50 hours per week on call.

- The key concerns expressed by nephrologists, in relation to their capacity to deliver the service they would like, are:
    - Lack of manpower
    - Sub optimal remuneration
    - Inadequate infrastructure
    - Poor health service planning for nephrology services

Key issues in this report -continued:

- Part-time work and training needs to be encouraged as these doctors report more control over their work and life, are often engaged in research and report a willingness to increase their work hours.

- In five years time (2013) Australia requires a further ***86 full time equivalent*** (FTE) nephrology positions and ***44 first year advanced trainee posts*** to accommodate the ***conservative estimates*** of growth in end stage kidney disease (ESKD) . If this is to be implemented, there is a requirement to establish at least this number of accredited training posts and appropriate supervision.

Australian Nephrology Workforce Survey 2007

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Some of the data reported have been supplied by the Australia and New Zealand Dialysis and Transplant Registry. The interpretation and reporting of these data are the responsibility of the author and in no way should be seen as an official policy or interpretation of the Australia and New Zealand Dialysis and Transplant Registry.

INTRODUCTION

This survey arose from work related to a PhD thesis examining the nephrology training program in Australia. From an earlier questionnaire in the basic physician trainee population, examining motivators and detractors surrounding a career in nephrology, the issue of excessive workloads and insufficient manpower was highlighted. This was reinforced by a general perception in the nephrology community that workloads were increasing and a concern that nephrology recruitment did not seem to be keeping pace with the workload demands. To deliver good health care there must be an adequate workforce. In a specialty under workforce pressure both locally and internationally, two central themes emerge from the nephrology literature: the inadequacy (and in some cases non-existence) of workforce and workload data and the need for urgent solutions stemming from a combination of improved work-practice design and efficiency and increasing nephrology trainee numbers. [1 2]. Without an accurate assessment of the current workforce it will be impossible to accurately project future workforce requirements. In Australia, prior to this research, the only available nephrology workforce data was from an Australian Medical Workforce Advisory Committee, (AMWAC) [3 4] which apparently (although not explicitly) based the nephrology workforce statistics on information from the ANZSN; and three questionnaire sources, (1) a personal survey undertaken in 2004, by Associate Professor Randall Faull[5], on behalf of the ANZSN, as part of a 2005 submission to the Commonwealth Productivity Commission [6], (2) a workforce analysis of the 2006 census data, and (3) the 2005 data from the Australian Medical Labour Force Surveys

collected by the various medical boards on behalf of the Australian Institute of Health and Welfare. Subspecialty listings were not routinely documented in these latter two questionnaires leading to reporting errors with the nephrology workforce clearly underestimated.

Aims and Objectives

The aim of this survey was to describe the current nephrology workforce in Australia and to accurately represent its socio-demographic profile.

The research sought to be comprehensive, detailing planned retirements and anticipated increases or decreases to workforce participation.

Qualitative information was sought to examine nephrologists' ability to control their work hours and their perception of issues impacting on the workforce in this specialty area.

In Australia there have been some attempts to project the nephrology workload (ANZdata registry reports and AIHW reports [7]). However, without an accurate assessment of the current workforce it will be impossible to accurately project future workforce requirements and develop a comprehensive strategy for tackling this workforce problem.

Limitations

No database exists which accurately captures all practicing nephrologists (or generalist physicians with a nephrology component to their practice). For this reason the total nephrologist population can only be estimated.

The Royal Australasian College of Physicians' (RACP) first began recording subspecialty listings with the implementation of the specialist advisory committees (SACs) in the early 1970's; as a result RACP databases only have accurate specialty listings for the last 15-20 years and all fellows entering the college prior to that were not specialty classified. Also fellows admitted to the College as overseas trained physicians do not appear within the SAC databases [8].

Likewise the various state/territory Medical Boards do not uniformly record or require specialty listings.

It is considered the most complete listing of nephrologists is located with the Australian and New Zealand Society of Nephrology (ANZSN), but it is recognised that membership is voluntary and it is possible the database is not a complete representation of the Australian Nephrology Community.

METHODS

A summary of the research method is provided in box 1.(page 5)

Ethics Approval

Ethics approval was obtained through the University of New South Wales. (HREC 04155). The target of the questionnaire was Australian nephrologists. The most accurate record of the target population was considered to be the Australian and New Zealand Society of Nephrology (ANZSN). Although supportive of this research endeavour, the amendments to the 2001 National Privacy Act restricted disclosure of personal details recorded by private

organisations to third parties. The implications of these amendments for this study meant that an employee from the ANZSN was required to undertake any coding strategy that was to be implemented for follow-up and baseline analysis of non-responders. This work commitment was considered to be in excess of that of the ANZSN secretariat, and therefore non-responder follow-up and analysis could not be undertaken

Box 1 : Research Methods at a Glance

	RESEARCH COMPONENT	WORKFORCE SURVEY
RESARCH PROCESS	DATA	Categorical and free text responses
	SAMPLE SIZE	280 valid responses
	SOURCE DATA	Nephrologists practicing in Australia and listed with the Australian and New Zealand society of nephrology
	METHOD	Instrument designed following review of other international and local workforce surveys. Piloted (n=8) and modified based on this feedback. Technical help for online survey design and delivery through the medicine computing support unit, faculty of medicine. UNSW Questionnaire delivered in both a self-administered mailed and electronic format. Returned paper questionnaires were transcribed into electronic format using the online questionnaire template. The excel data base was imported into SPSS[9] for analysis. To reduce transcription errors free text responses were electronically copied into a microsoft word template and imported into Nvivo 8[10] for qualitative analysis.
	SOFTWARE	Statistical Package for the Social Sciences (SPSS)[9] version 13.0 & Nvivo 8[10] (see chapter 3.0)

Subjects

Members of the ANZSN fulfilling the following criteria

- Living, residing and currently working in Australia as a nephrologist.
- Financial member of ANZSN
- Not retired
- Not a trainee/student member
- Not a corporate sponsor
- Not a life member/Honorary member unless continuing to practice as a nephrologist.

Instrument

The instrument was designed by the principle researcher (Dr Cathie Lane) after reviewing similar surveys delivered to medical practitioners both locally and internationally.

Piloting was undertaken with seven nephrologists and one non-nephrologist from various demographic profiles including members with known workforce interests. Modifications to the instrument were made based on this feedback. The time taken to complete the questionnaire ranged from 7 to 15 minutes with an average of 8.5 minutes.

Procedure

Respondents were invited to participate by offering either a self administered paper copy of the questionnaire or the opportunity to complete the questionnaire electronically

(http://notes1-med.med.unsw.edu.au/surveys/renal.nsf/RecordPrefs?OpenForm)

Technical help for on-line survey design and delivery was provided by the medicine computing support unit, faculty of medicine, University of New South Wales. The self administered questionnaire was printed, collated and inserted as a supplement with the proposed agenda for the annual general meeting for the ANZSN – to be held during the annual scientific meeting. As recommended by researchers in the area of questionnaire design, [11] [12] [13] project association with a respected organisation, in this case ANZSN, was hoped to facilitate the response rate.

Both the initial email and postal questionnaires were sent on the 14th August 2007. To conform to privacy requirements, from the UNSW ethics committee and the ANZSN, the principle researcher was not permitted to review email lists or postal addresses from the ANZSN. Coding was therefore not undertaken as it was felt to place an excessive strain on limited staff resources of the ANZSN. The secretariat of the ANZSN (Mrs Aviva Rosenfeld) posted all email requests and delivered postal addresses to printers. The initial email posting was inadvertently sent to the total ANZSN membership and was recalled from those members not eligible to participate in the study. Despite the immediate recall, ineligible responses were posted and several exclusions occurred. (see below)

When the response rate had fallen to two/day, an email reminder was sent (22.08.07) to non-responders and those responders who had chosen not to identify themselves. The reminder included the link to the electronic version and apologised to members who had already responded, reminding them this was inevitable if anonymity was to be preserved.

A further reminder occurred in September 2007 by inserting a copy of the questionnaire and a reminder note into the conference bag of all delegates of the 43rd Annual Scientific Meeting of the Australian and New Zealand Society of Nephrology with instructions to be completed only by Australian nephrologists. A collection counter was set up at the conference.
The survey went offline on 30.11.07; One hundred and seven days after survey delivery. One further postal reply occurred after this date and was included in the analysis.

Preparation of Results and Exclusions:

All categorical responses were automatically numerically coded and uploaded into the database. Free text responses were uploaded unchanged. All electronic results were exported into an excel spreadsheet by the medicine computing support unit. A total of 82 participants (27%) replied using a postal questionnaire. Postal questionnaire results were transferred into the electronic database once by one support staff member using the online survey instrument. The database was then reviewed for nonsensical entries and multiple variable combinations [names (if provided), birthdates and site of practice] were examined to exclude multiple responses from the same respondent.

Geographical Classifications of Work Location

Geographical classifications of work locations were initially collected as postcodes and then further defined based on the Australian Bureau of

Statistics (ABS), Australian Standard Geographical Classification (ASGC) scheme. [14]

The ASGC does not have a definition for metropolitan, outer-metropolitan, rural or remote Australia, instead structures such as Section of State (SOS), Urban Centres and Localities (UC/L) and Remoteness Areas (RA) can be used to create these values. The ABS' Postal Areas (POA).are an approximation of Australia Post Postcodes based on Census Collection Districts (CDs) which are at the moment the smallest geographical unit in the current Australian Standard Geographical Classification (ASGC). Postcodes do not fit the ABS' ASGC so the ABS created POA to help match postcode data to ABS geographies as best as possible. Concordance tables supplied by the ABS, were used to convert postal areas which are an approximation of postcodes into areas defined as Major City, Inner and Outer Regional, Remote and Very Remote. The ABS does not currently have an official definition of 'metropolitan', 'non-metropolitan'. Some sections within the ABS have been using the current statistical geography to create their own version of 'metropolitan/non metropolitan' however; these definitions are not official ABS geographical definitions. The ABS is currently (2008) undertaking a review of statistical geography and the definition of 'metropolitan/non-metropolitan' is part of this review [15].

Statistical Analysis

The on-line results (incorporating electronic and the postal responses - see 'Preparation of Results and Exclusions') were converted into an excel spreadsheet which was imported into SPSS (version 15.0) and analysed using descriptive statistics. For convenience, SYSTAT was used to display two graphics in preference to SPSS.

Simple frequency and percentage were reported for important variables. Relevant univariate associations are presented through bar charts and line graphs. To demonstrate differences of characteristics between two groups, independent sample t-test was used to see whether the group means were equal. If comparisons of means between more than two groups were required the one way analysis of variance (ANNOVA) method was used. Wherever the outcome data did not meet normality assumption non parametric equivalent of t-test and ANNOVA were used to do the analysis (Mann-Whitney U test and Kruskal-Wallis).

Simple and multiple linear regression analyses were used to investigate the association between two variables while adjusting for the effect of others.

Unless non-responses were greater than 10%, the frequency percentage calculations did not incorporate missing values.

Qualitative responses were thematically coded and analysed with NVIVO 7 software support.

RESULTS

Response Rate and Exclusions

The ANZSN membership includes practicing nephrologists, advanced trainees, sponsors, honorary members and other interested clinicians (eg endocrinologists and vascular surgeons). This survey was designed for nephrologists both clinical and non-clinical. Of the total membership (659) at the time, ***355 respondents were eligible to participate***. Respondents totalled 301, however, as the initial email was posted to all members and then recalled from those ineligible to participate there were 21 responses which were subsequently excluded from the analysis. This resulted in ***280 valid responses*** providing a ***response rate of 79%.***

Excluded entries incorporated six postal exclusions (four retirees, one surgeon and one incomplete response converted to a complete electronic response) and 15 electronic exclusions (two responses from New Zealand, six nephrologists currently practicing outside Australia, one incomplete response, four retirees and two nephrology advanced trainees)

Five respondents identified themselves as permanently leaving the workforce but went on to describe various duties they still performed and so were retained in the analysis, all other retirees who did not nominate duties related to the nephrology workload were excluded from the analysis.

Exclusions were made on the following basis:

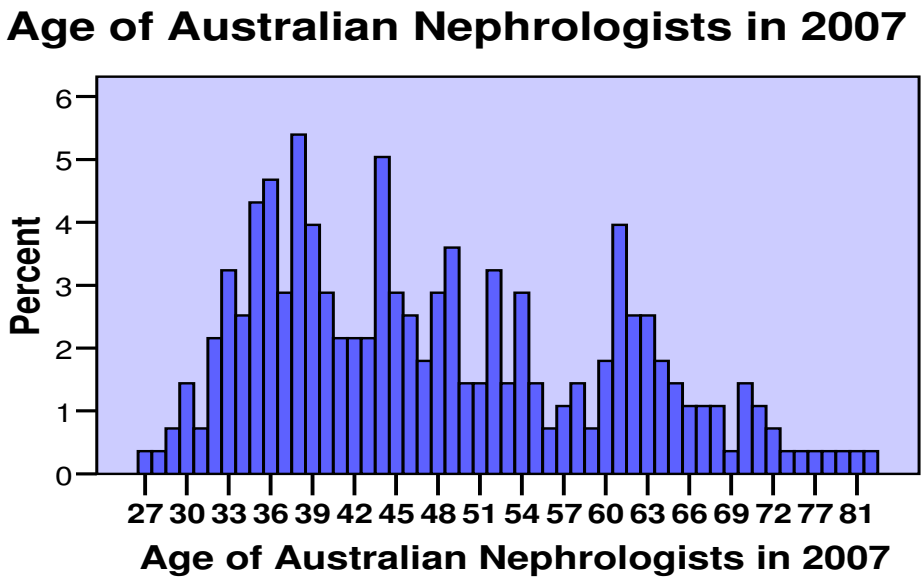
Table 1: Excluded Responses

Basis for Exclusion	Numbers
Retirees	8
Non- nephrologist	1
Incomplete responses	2
Respondents residing outside Australia	8
Advanced Trainee	2

Participant Demographics

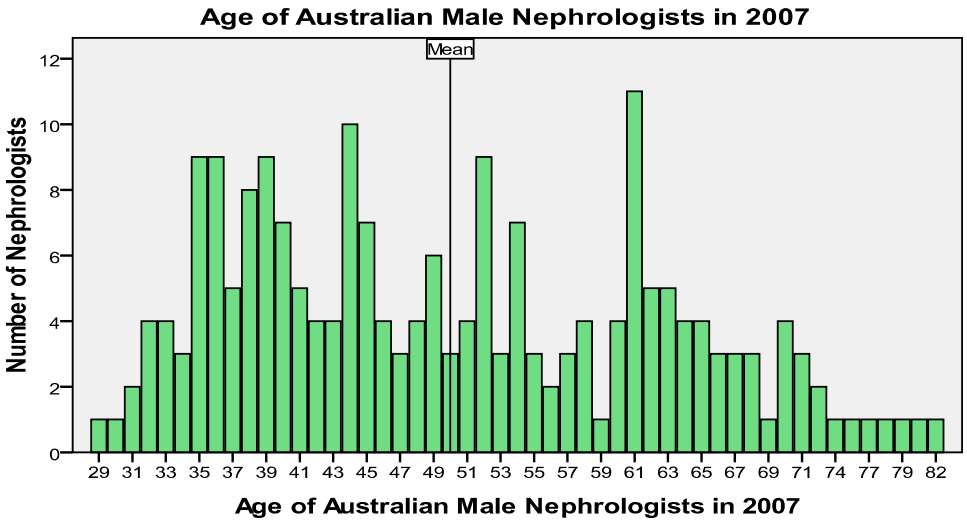
Age and Gender

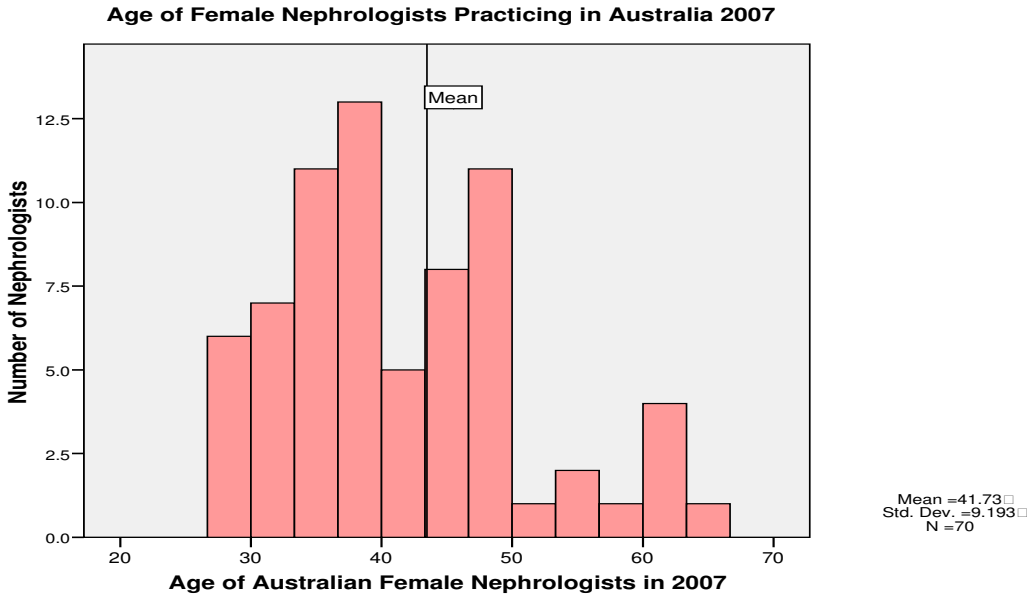
Males comprised 75% of participants (209).



Males were older with a mean age of 50 years compared to females with a mean age of 42 years. The mean difference between gender was 8.3 years and this was statistically significant (t = 5.94,df 161, p< 0.001). Male nephrologists had a modal age of 61 and females 38 years. The median age for males and females was 49 and 39 years respectively.

Figure 1: Age and Gender Profile of Respondents to the 2007 Nephrology Workforce Survey (Australia)





Family Situation and Dependents

The majority of respondents 253 (92%) were married or in a long term relationship of these 76% of partners have working responsibilities. The majority, 227 (83%) also have children.

Of those with children 168 (75%) still had dependents living with them at home. Sixty (27%) had young children requiring day-care facilities and 127 (56%) had school age children; around one third (71) felt that family responsibilities for their children impacted on their work hours.

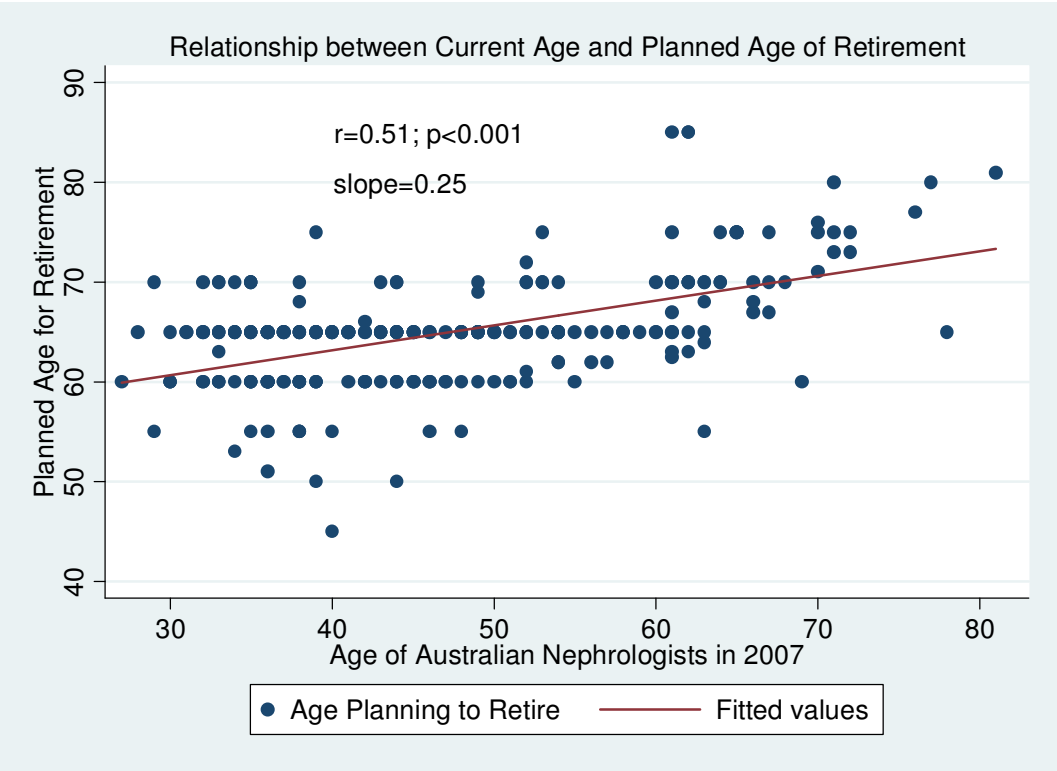
Retirement Plans

When requested to nominate a retirement age, 25 (9%) respondents declined to answer. Three respondents identified themselves as 'retired' but went on to identify teaching, research, administration or small private practice loads and so were not excluded from the analysis.

The average age of planned retirement was nominated as 65 by 43% of respondents with 60 years the next most nominated age by 21% of respondents.

Younger respondents anticipated retiring earlier than older nephrologists. The data shows a statistically significant positive correlation between current age of the nephrologist and the planned age of retirement (pearson correlation coefficient = 0.52, $p<0.001$). Two outliers were excluded from this analysis as they reported their planned age of retirement to be 99 and 100 years, having a current age of 55 and 57 years respectively.

Figure 2: Relationship between Current Age and Planned Retirement



A simple linear regression model using planned age for retirement as the outcome variable and current age of the participant as the explanatory variable results in a slope of 0.25 (95% CI 0.20 – 0.30) and the R^2 for this model was 0.27.

The mean planned age of retirement for those without children was 62 years and on average, those with children planned to retire four years later (66 years). This difference is statistically significant (t=4.2, df 246, p<0.001). Males plan to retire later than females with a mean planned age of retirement of 66 compared with 62 years. (t= 4.5, df = 250, p<0.001). The working status of long term partners had no impact on planned retirement age. To investigate the effect of other important factors on the age of retirement simple linear

regression was fitted separately for each factor. In the regression model, the variables “weekly hours of work” and “state where most of work is done” were fitted as categorical variables.

When all these variables were examined together (by fitting in a single model) the variable that accounted for the majority of the variance was the “participants’ current age”, all other factors were no longer significant. That is, the association between planned age of retirement and the current age of nephrologist was not confounded by any of these other factors.

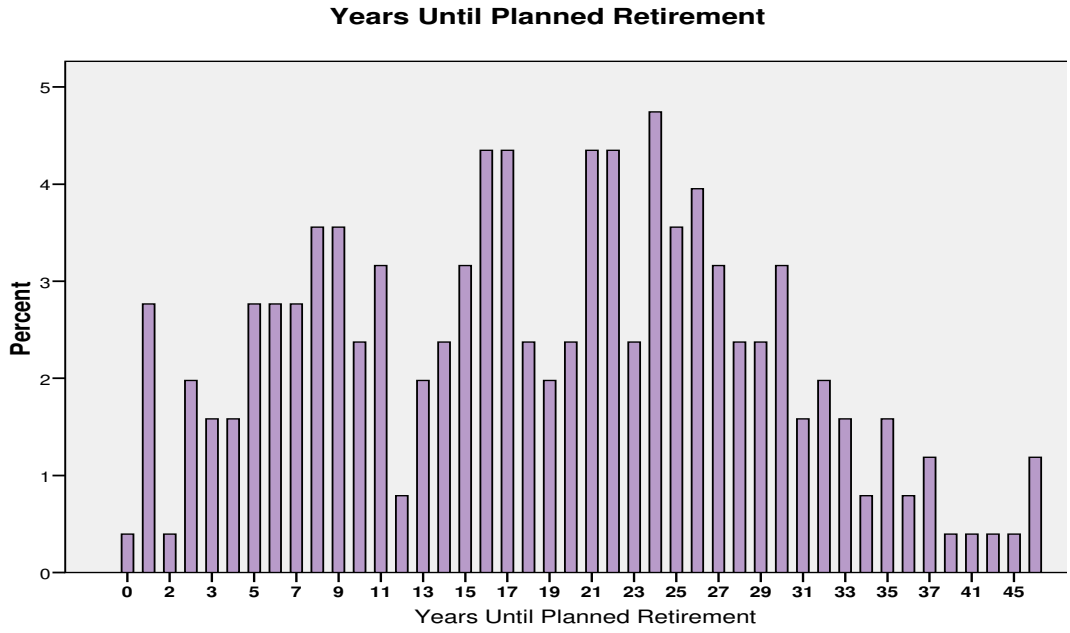
Table 2: Univariate Association for Planned Age of Retirement

Variable	Coefficient (β)	SE of β	Statistical Significance	
			t/F	p
Current Age	0.25	0.026	9.66	<0.001
Gender (Ref-Male)	-3.5	0.78	4.5	<0.001
Have Children (Ref – No Children)	4.00	0.90	4.4	<0.001
Nephrology Training In Australia (Ref-Trained Elsewhere)	-1.78	0.94	-1.9	0.058
Total Weekly Work Hours (Ref - 4-10 hrs)			F=2.6[§]	0.018[ξ]
11-35hrs	-2.7	1.23	2.16	0.032
36-40 hrs	-3.7	1.38	2.70	0.007
41-50	-3.0	1.11	2.74	0.007
51-60	1.8	1.13	1.57	0.119
61-80	0 .69	1.56	0.45	0.656
>80	3.50	2.21	1.58	0.155
Australian States (Ref - NSW)			F=2.30[§]	0.028 [ξ]
ACT	-7.86	2.58	3.04	0.003
Vic	-1.34	0.90	1.49	0.137
Qld	-1.58	1.30	1.22	0.223
WA	1.16	1.47	0.79	0.431
SA	- 2.68	1.38	1.94	0.054
Tas	-1.06	1.06	0.32	0.747
NT	-4.39	3.29	1.33	0.183

[§] is the test statistic (F) for testing the fit of all the categories together
[ξ] is the overall significance of the categorical variable

Around 50% of those nephrologists now practicing plan to retire within the next 18 years and a further 13% in the following four years. 78% of the current workforce aims to retire within the next 26 years. The average interval until retirement is 30 years. It is noteworthy that 26.6% of the surveyed population were **currently** over 55 years of age.

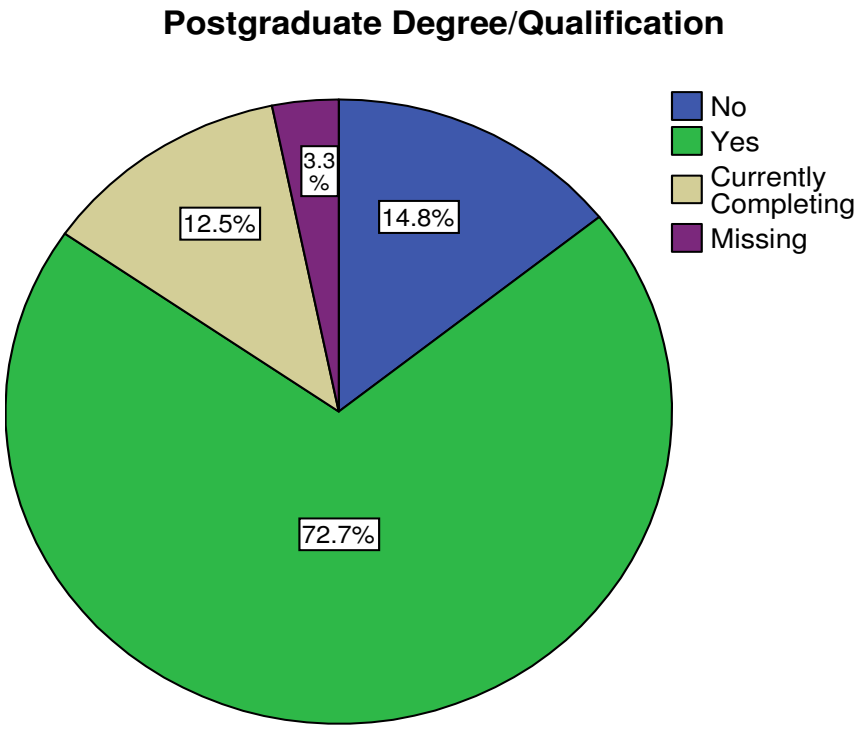
Figure 3: Anticipated Years Until Retirement



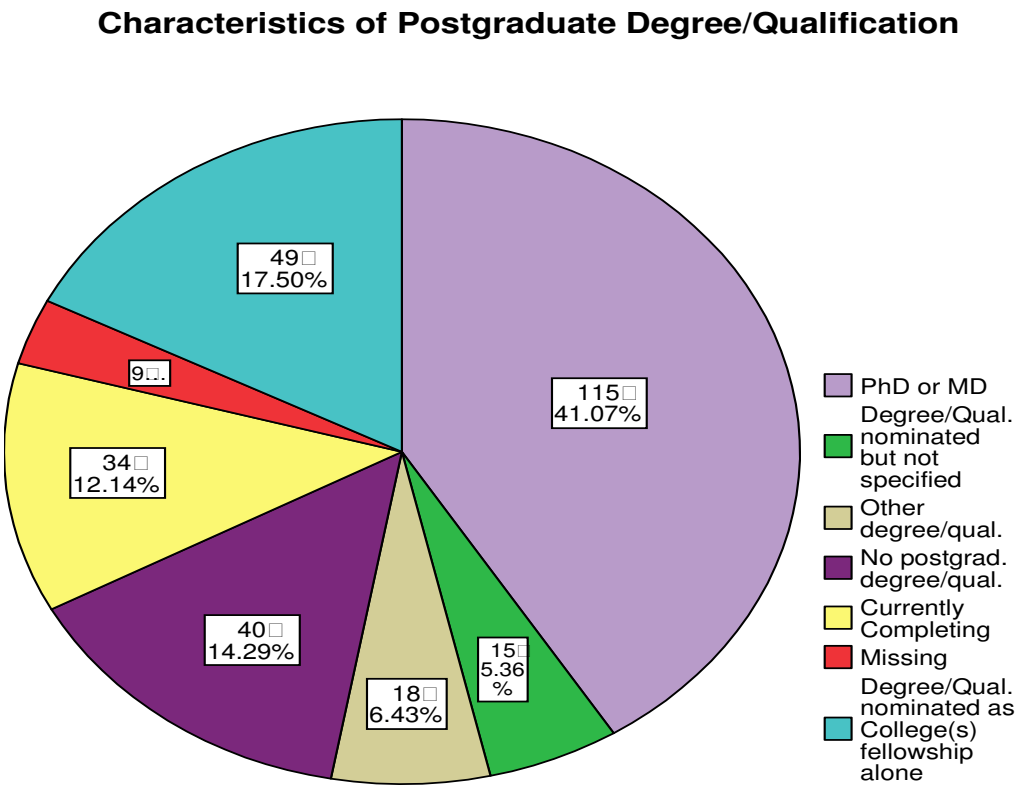
Training and Qualifications

The undergraduate medical degree was completed in Australia by 202 (74%) respondents, with 22% holding a further undergraduate degree or qualification, the majority arising from science related fields of study.
The self identification of a postgraduate degree resulted in some overlap of responses.

Figure 4: Self Reported Postgraduate Degree/Qualification



Some considered College fellowship as a postgraduate qualification but others, trained in Australia and practicing nephrology (so could be assumed to have been previously awarded FRACP) identified as not having a postgraduate qualification. When college memberships were reviewed separately in the analysis, 148 (55%) had been awarded a higher degree or qualification and a further 34 (12.1%) were currently completing such studies.



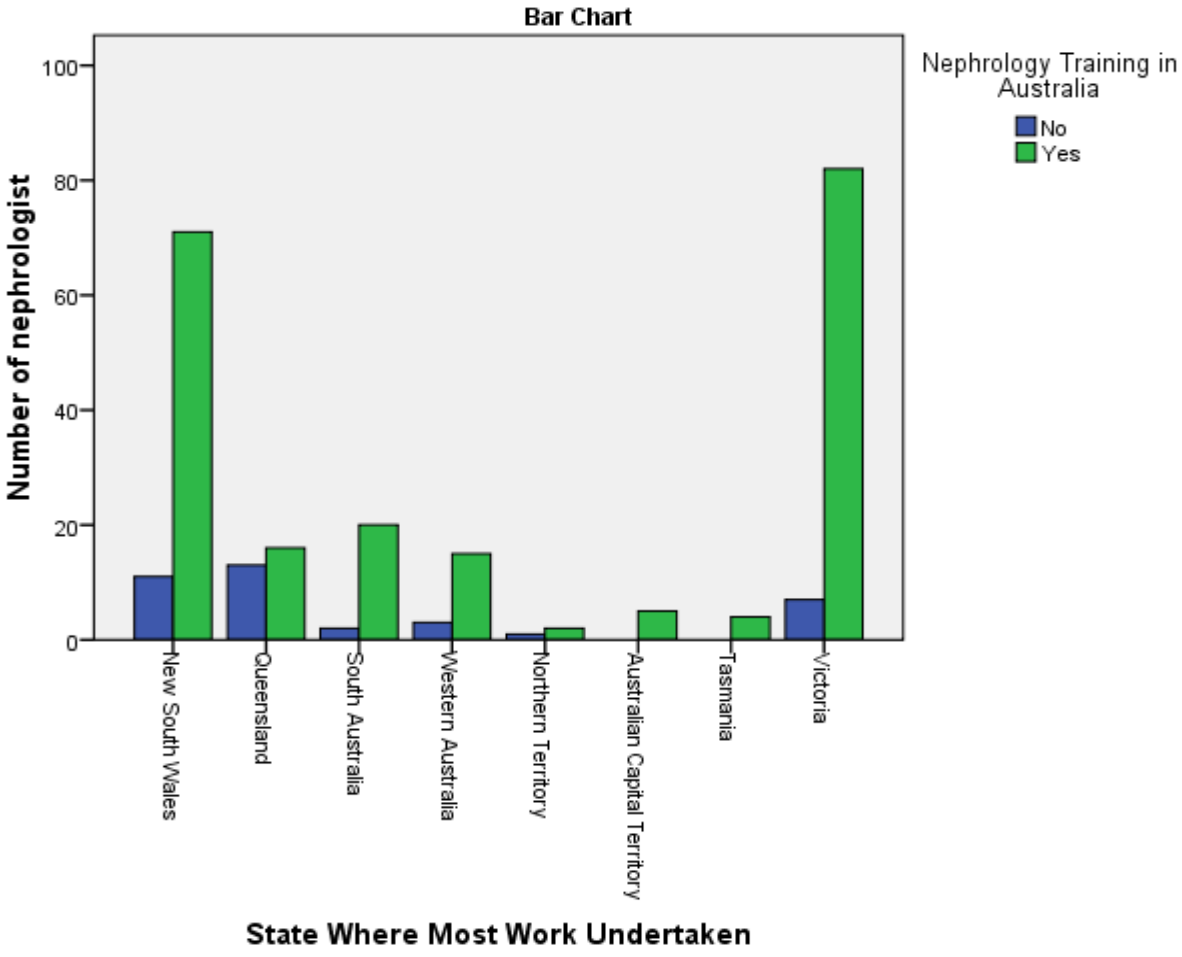
Specialisation

Two hundred and twenty two (82%) respondents had undertaken their nephrology training in Australia, with nine respondents declining to answer this question and 49 (18%) stating they received nephrology training outside Australia. However, this percentage differs significantly among states (X^2=27.432 with 7 df, p<0.001) with Queensland standing out as having a much higher proportion (44.8%) of overseas trained nephrologists. The following bar chart shows the distribution of nephrologists having training in Australia by state.

Only 34 (12.5%) state they have specialty training in another field (excluding

General Medicine) recognised by the Royal Australasian College of Physicians

Figure 5: Location of Australian Practice

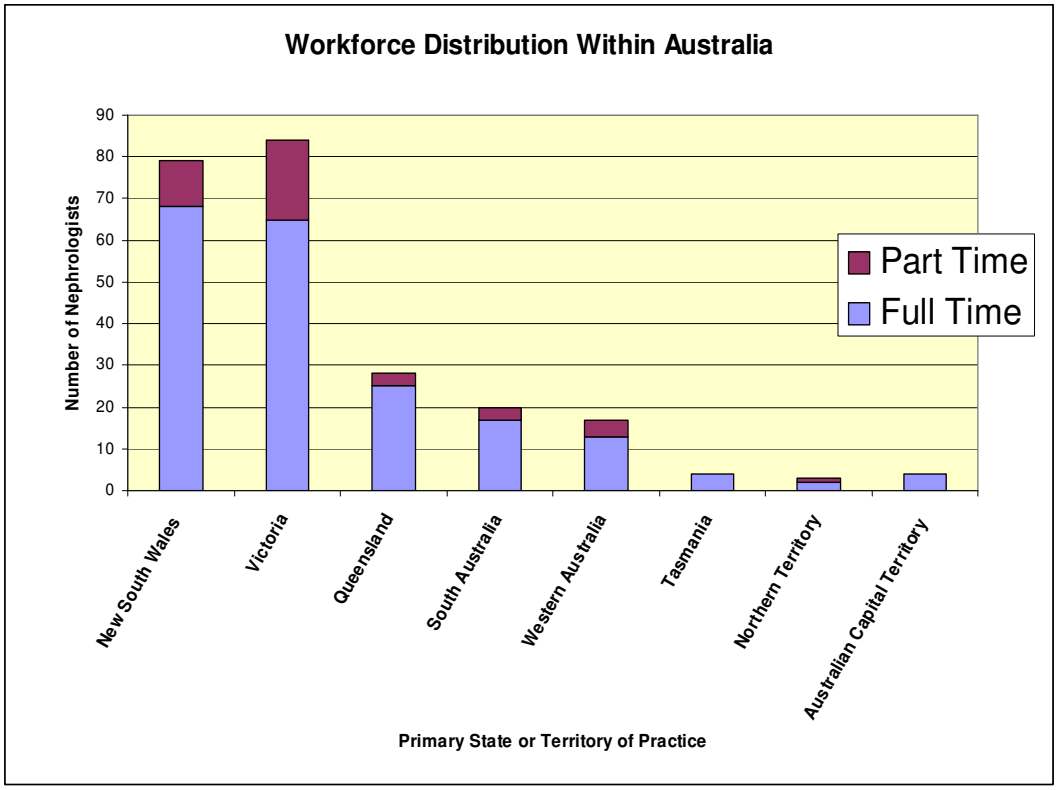


Site of Practice

If those who have temporarily left the workforce are excluded from the analysis, it can be seen most nephrologists work in Victoria 84 (35%), followed by NSW 79 (33%), Queensland 28 (12%), South Australia 20 (8%), Western

Australia 17(7%), ACT 4(2%), Tasmania 4(2%) and Northern Territory 3 (1%).

Figure 6: Australian Distribution of Part Time & Full Time Nephrologists



Geographical Provision of Nephrology Services

Respondents nominated the total number of sites where they personally delivered a nephrology service. As described in the method section, sites were coded into the four geographical subtypes major city, inner regional, outer regional and remote, using an Australian Bureau of Statistics coding strategy [14 15].

Table 3: Practice Location as Determined by Postcode*

PRACTICE LOCATION	MAJOR CITY (% of total)	INNER REGIONAL (%)	OUTER REGIONAL (%)	REMOTE (%)	TOTAL NUMBER
Primary Site	213 (88)	22 (9)	5 (2)	1 (0.4)	**241**
Second Site	116 (82)	18 (13)	8 (3)	0	**142**
Third Site	42 (71)	11 (19)	5 (8.5)	1 (1.7)	**59**
Fourth Site	15 (68)	5 (23)	2 (9)	0	**22**

* see Geographical Classifications of Work Location

Rural and Remote Clinical Service

Respondents were asked if they personally provided a clinical service to a rural or remote area with 106 (38%) affirming such a service. The rural/remote service appears to be over-reported compared to practice locations, as defined by postcode.This may result from infrequent outreach clinics which are not represented when only the last month is reviewed, as was the case with practice location.

Work Hours

Practice Description

This question was answered by 243 (87%) respondents. A great variation was reported in practice type, however, three categories accounted for 62% of the population. The reported practice types are shown in table 4.

Table 4: Vocational Practice Description

Description	Number (% of respondents)
Full time salaried public hospital appointment	104 (43)
Full time private practice with VMO position	47 (19)
Full time university/research appointment involving clinical nephrology	21 (9)
Part time public hospital appointment and part time research appointment	13 (5)
Part time private practice and part time research	7 (3)
Full time salaried university/research appointment with NO clinical nephrology	7 (3)
Full time private practice without a hospital appointment	6 (2.5)
Other permutations	38 (16%)

Hours Worked

Two variables were collected to measure work hours. The first was a categorical variable (weekly work hours) requesting the participant to nominate a work hour category of either: 4-10hrs, 11-35hrs, 36-40hrs, 41-50hrs, 51-60hrs, 61-80hrs or > 80 hrs.

The second variable was continuous and requested the participant to nominate hours worked during the last month and, citing postcode or name of town/city, identify the different sites in which work was undertaken. It was anticipated the composite of these work sites would give a total monthly value which when divided by four (to give a comparable weekly value) would approximate the value of the first categorical variable (as determined by its midpoint value).

To investigate how well these two measures of work hours correlated with each other we calculated reliability statistics in terms of the interclass correlation coefficient (ICCR) (the measure of exact agreement between two measures).

The mean weekly work hours reported from the first variable (categorical) was 39.1hrs and from the continuous variable 29.5hrs with an ICCR of 0.441 (95% CI 0.22 to 0.59). This shows poor agreement.

For subsequent analysis, the categorical variable was used as the measure of weekly work hours. This decision was made because on review of the continuous variable results it appeared that many participants had most likely reported weekly hours rather than monthly hours. It was also felt that the categorical data better reflected the participants' review of their personal weekly workload and was not relying on a particular monthly report with its inherent potential to describe an idiosyncratic month not reflective of the usual workload.

Most ***full time*** nephrologists in Australia in 2007 worked between 41-50

hours/week ;57, (28%) with a further 52 (26%) working 51-60 hours/week. The average weekly work hours for self defined full time nephrologists (excluding oncall duties) was reported as 44hrs. If full time is defined as working ≥ 35 hours per week then **the average weekly work hour for full time nephrologists practicing in Australia is 52hrs.**

Figure 7: Work Hours of Nephrologists in Australia 2007 (excluding on-call)

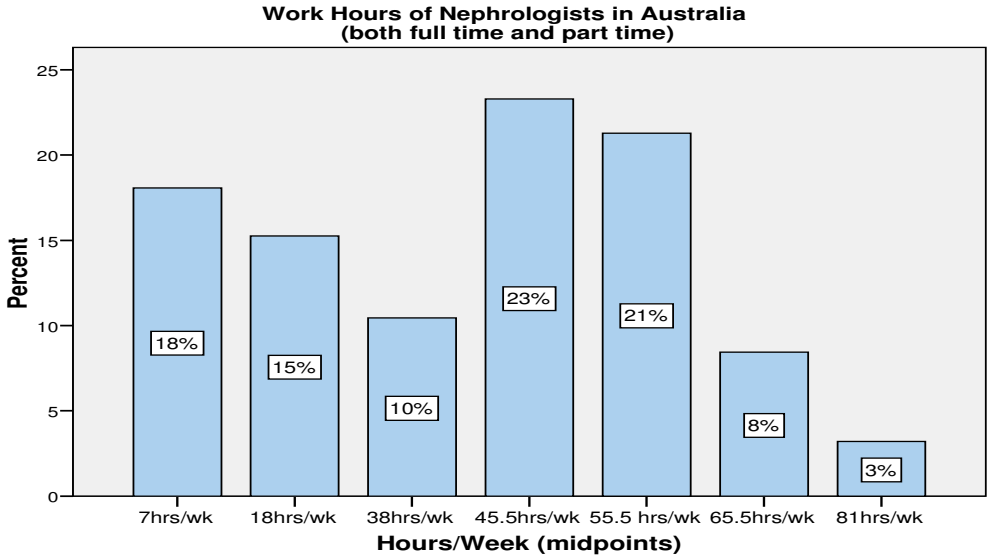
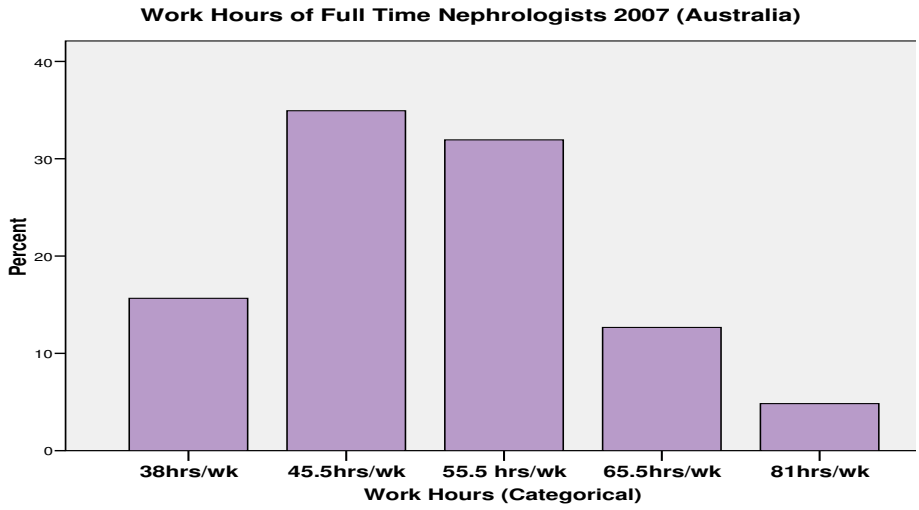


Figure 8: Work Hours of Full Time Nephrologists (Australia) 2007



On-Call Requirements

Two-hundred and six (81%) respondents have additional on-call (after hours) commitments with 62% of these working more than 30 hours/week on call. More than fifty (24%) work more than 50 hours/week on-call in addition to their weekly work commitments. The average weekly on-call commitment from full-time nephrologists is **41.9 hours**

Nineteen (45%) of the part-time nephrology workforce (self defined) contributes to on-call service provision with 32% working more than 30hours/week on call in addition to their weekly part time work commitments.

Work Type – full time & part time workers

This question had a response rate of 89% (249). Respondents were asked to nominate work hours (based on provided categories) excluding on-call commitments. The **majority of respondents**, 206 (83%) described

themselves as undertaking **full time work, f**orty-two (16%) as part time and seven (3%) state they have temporarily left the workforce and a further five (2%) stated they had permanently left the workforce. (see 'Preparation of Results and Exclusions')

Based on this self reported work type (full or part time), there were no significant differences between the groups with respect to respondent's age, children (all categories), marital status, partner's employment status, post graduate degree, Australian specialty training, age of planned retirement, performing procedures (renal biopsy &/or vascular access) or provision of rural/remote services. **Proportionally (but not numerically) more females (25% vs 14%) participated in part time work** (X^2=4.22, df1 p<0.05).

Part time workers were more likely to report control over their work hours (X2=9.27, p=0.002) and be engaged in research (t=-3.50, p=0.002) They were also more likely to report a willingness to increase work hours ($X^{2=}$2,p<0.001). When full time workers are analysed separately, weekly work hours were similar between genders with males working an average of 43.6 hrs and females 45.4hrs. Among part time workers the average weekly work hours for males were 14hrs and 16hrs for females. None of these differences were statistically significant.

Disagreement within Work Type

Although only 42 (15%) of respondents had described themselves as working in a 'part time' capacity; when asked to nominate weekly work hours within

provided categories, 83 (30%) respondents listed their weekly work hours as < 35 hours/week [the Organisation for Economic Co-operation and Development (OECD) definition of part time work]. While comparing work type with reported work hours, four participants who reported work type did not go on to nominate actual work hours.(total 244)

Table 5: Reporting of Part Time and Full Time Status

		Reported Work Type		TOTALS
		Full Time	Part Time	
Actual Work Hours	**>35hrs**	163	3	166
	<35hrs	40	38	78
TOTALS		**203**	**41**	**244**

Full time capacity was reported by 203 (83%) whereas only 166 (68%) actually record work hours as greater than 35hrs/week. Among those who reported being a full time worker, only 163 (80%) recorded their work hours as greater than 35hrs/week (sensitivity).Among those reported as part time workers, 38 (93%) worked <35hrs/week (specificity). Of those defined by the OECD as working in a full time capacity, the most common weekly work hour range, nominated by 58 (35%), was 41-50 hours, followed by 51-60 hours - nominated by 53 (32%). Of full time workers 26% worked 36-40 hours/week and 13% 61-80 hours. Eight respondents (5%) worked greater than 81 hrs/wk.

Of full time nephrologists in Australia 84% worked more than a standard 40 hour week.

Full Time Equivalents

A Full Time Equivalent is defined as one person working 40 hours/week (2080 hours/year) assuming no holidays or leave.

FTE figures can be calculated as fractions for part time workers using the midpoint of the work hour category. This total is then added to the total number of full time workers to get an overall FTE workforce.

Although a large number of nephrologists work over 40 hours/week these workers are still counted individually as one FTE and the hours worked in excess of 40 hours is conventionally referred to as 'overtime'.

Table 6: FTE nephrologists based on 2007 Australian workforce survey

Hours Worked/Week (midpoint)	Hours worked/year / 2080	Number of Nephrologists (% of respondents)	FTE nephrologists
≥ 40	1	140 (56.2)	140
38	0.95	26 (10.4)	25
18	0.58	38 (15.3)	22
7	0.175	45 (18.1)	8
		249 (100) (missing=31)	
TOTAL FTE			**195**

If response rate does not depend on participants' work hours then we can make an assumption that the non-responders to this workforce questionnaire (n=75) and those who did not answer this question (n=31) have a similar work profile to the respondents. In that case there are a further 83 FTE nephrologists working In Australia

The ANZSN nephrology workforce practicing in Australia in 2007 is therefore estimated as **278 FTE**.

Future Work Plans

Almost a third (82) of respondents plan to reduce their work hours by 20% with a further 34 (13%) considering this as a possibility. This was to be implemented immediately by 16 (6%) nephrologists and within 2-5 years by 37 (13%).

Only 22 (8%) were planning to increase work hours with a further 18 (6%) considering this option. Ten (4%) planned to do this immediately and 12 (4.3%) in 2-5 years time.

Ability to Control Work Hours

One hundred and one (40%) respondents (44% if analysis restricted to full time workers) felt unable to control their work hours. More participants (114) provided reasons to explain why work hours were difficult to control. (Please see 'Qualitative Responses' below for detailed explanation of these results.)

Interestingly males were more likely than their female counterparts to report control over their work hours. This was evident in both the total cohort (X^2=3.67, p=0.05) and when restricted to full time workers (X^2=5.17, p< 0.05).

Job Description

The average time nephrologists spent on various duties is summarised in table 7 and graphically in figure 10

Nearly all nephrologists were involved in delivering clinical nephrology services (see page 33) and, with the average just under 50% of total work hours, this area consumes the major component of a nephrologists' time.

Teaching consumed no more than 10% of work time for 220 (85%) with an average of 8% and only 3 nephrologists (1.2%) spent more than 30% of their time teaching.

The average time spent on administrative tasks was similar to the teaching average at 8.4%. Ninety -seven nephrologists (38%) spent between 10 and 20% of their time on administrative tasks.

Table 7 : Work Profile of a Nephrologist Practicing in Australia in 2007

Duties of a Nephrologist	Percentage of Time (Mean)
Clinical Nephrology	48.7
Research	13.7
Other Clinical Specialty Work (non-nephrology)	10
Administration	8.4
Teaching	8.3
Continuing Medical Education	5.7
Other Professional Duties	2.5
Medicolegal Duties	0.2
Other Duties	2.6
Total	100

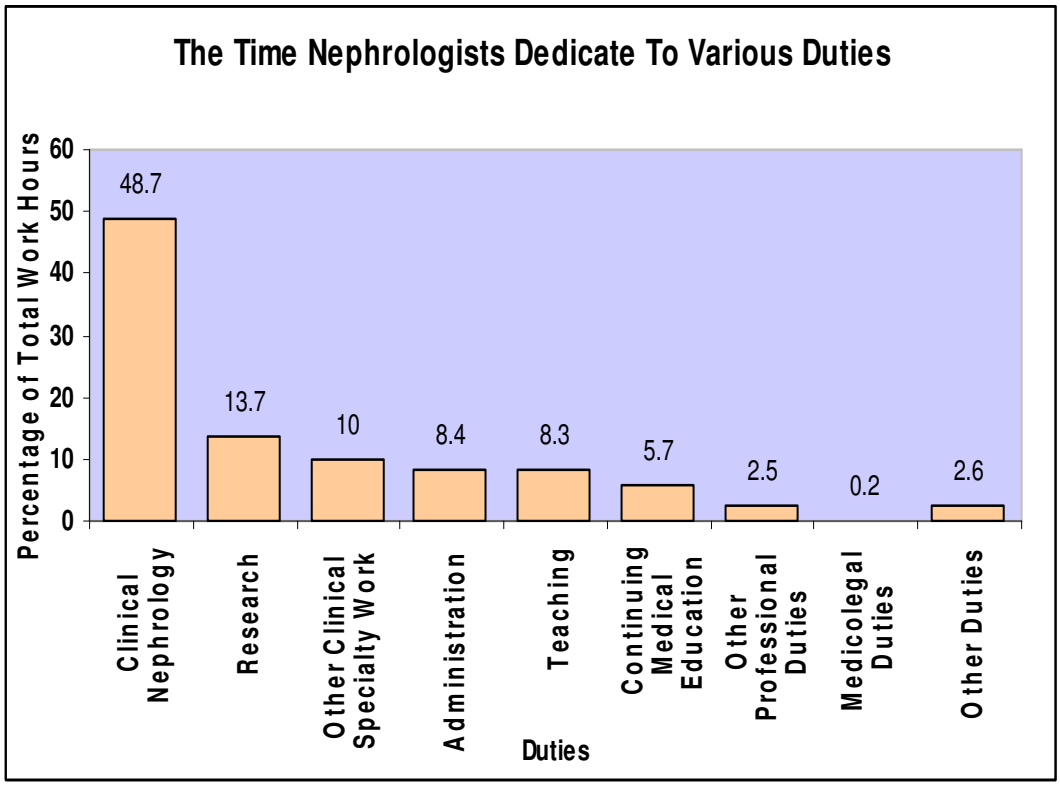
Only 78 nephrologists spent time practicing other subspecialties and about

half of these spend less than 25% of their time in this capacity.

Over half of the respondents (145) spent some time in a research capacity although for most (99) this took up less than 20% of their time.

Time dedicated to Continuing Medical Education averaged 5.7% of nephrologists' time (figure 10)

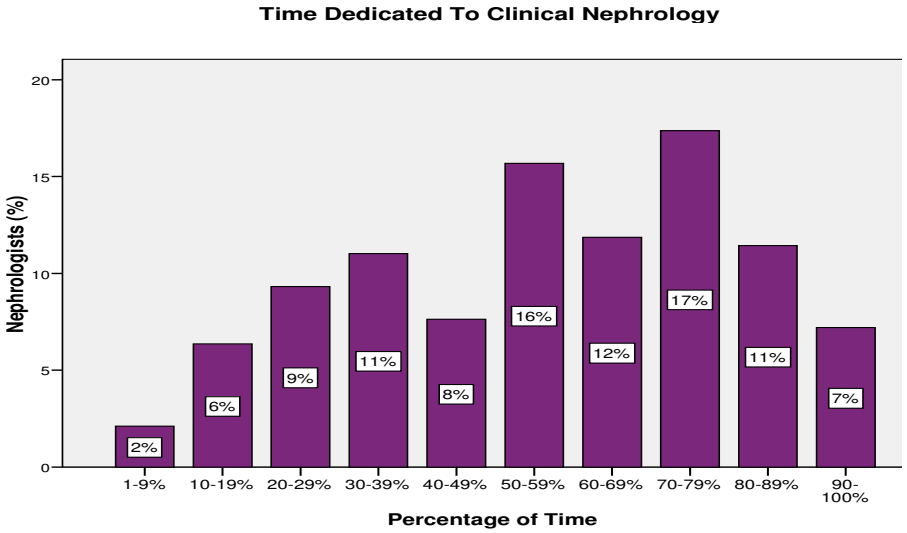
Figure 9: Work Profile of Nephrologists Practicing in Australia in 2007



Clinical Nephrology

Over two thirds of nephrologists (n=194) spent more than 30% of their time directed toward clinical nephrology with the average of 49%.

Figure 10: Time commitment to clinical nephrology



Within clinical nephrology, the management of patients with Chronic Kidney Disease consumed **most of the clinical nephrologists' time** with over 60% of nephrologists dedicating up to 40% of their clinical workload in this area. Nearly all clinical nephrologists (96%) participated in the provision of care for patients with Chronic Kidney Disease..

Dialysis management also had a high participation rate with 94% of clinical nephrologists' involved in this area. Over 50% of nephrologists dedicated up to 30% of their time managing dialysis issues (both haemo- and peritoneal dialysis).

The median percentage of time dedicated to ESKD (the composite of acute

and chronic transplantation and dialysis) was **41% of clinical work hours**, which represented **20% of the total workload of a nephrologist in this study.**

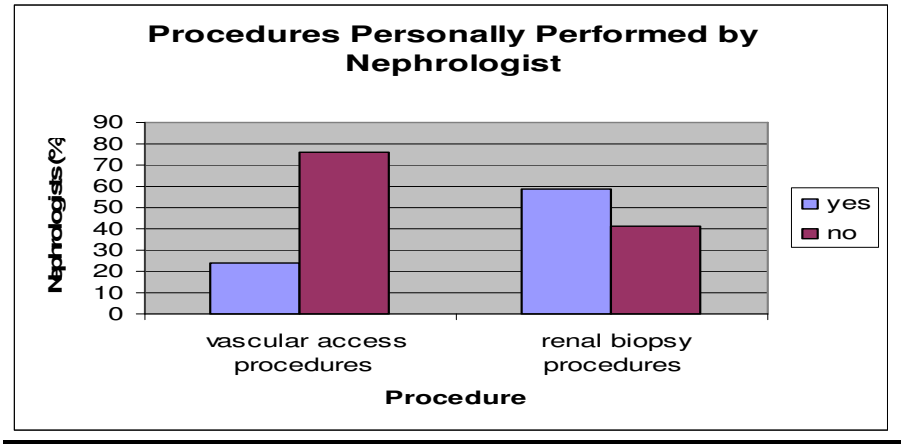
Eleven percent of clinical nephrologists participated in other areas of nephrology identifying these as including lipidology, metabolic nephrology including stone and bone disease, incontinence and urology, pathology and general paediatric nephrology.

Procedures

Two questions were dedicated to determining if nephrologists personally performed renal biopsies and vascular access procedures.

Each of the questions were answered by approximately the same number of people with 25 and 27 respondents failing to answer the question regarding vascular access and renal biopsies respectively. More respondents perform renal biopsies (54.5% n=138) than vascular access (22.4% n=57). Both procedures were performed by 49 nephrologists (19.4%) and 108 (42.7%) nephrologists did neither procedure.

Figure 11: Procedures Performed by Nephrologists Practicing in Australia



Qualitative Responses

As is typical of questionnaires with an emphasis on categorical data collection, the free text responses were quite brief and did not lend themselves to extensive qualitative analysis. Some responses were so brief (eg 'public hospitals' as an answer to why work hours were difficult to control) as to be meaningless without overlying extensive researcher interpretation and so were deleted from the analysis.

Participants were asked to provide free text responses to three questions:

Do you feel able to control your work hours? –Respondents who felt unable to control work hours were requested to provide an explanation.

More participants (114) gave an explanation as to why work hours were difficult to control than had nominated this area as problematic in the preceding yes/no stem (101).

The most common reason offered was that ***workload and clinical demand outstripped personal work capacity***. Participants cited unacceptable patient waiting periods (>3 months) before review in private practice and one participant calculated their workload to be 120 ESRF pts/nephrologist.

Many cited lack of other staff particularly other nephrologists, as the primary reason for lack of control of work hours.

Personal qualities were seen to also impact on control of work hours, particularly the inability to say 'no' to requests on time. Several described a

professional obligation to provide teaching and other duties such as committee and board memberships, which then further impacted on their time to provide direct patient care.

A tension was evident between the personal burden associated with service delivery and the commitment and responsibility for patient care. Reference was made to the need to take work home. Inflexibility of other commitments such as collecting children from day-care/school resulted in personal stress with the recognition that the latter part of the day also corresponded to the return of results/investigations.

Particular skill sets such as skill in research was seen to increase demands on time from other colleagues.

The structure of the renal departments within the hospital, eg subservient to department of General Medicine, reduced some units' autonomy.

Large on-call requirements impacted negatively on control of work hours. Lack of predictability in workload led to a perceived lack of control by several participants.

Poor clerical support was mentioned by several respondents with the comment that administrative work was then required to be undertaken at home at the expense of continuing medical education.

Several stated the excessive workload meant it was impossible to introduce a work practice change and although the workload was impacting negatively on personal life, to introduce any work practice change (eg reduce on-call commitment) would be unfair to colleagues.

What do you see as the greatest issues impacting on nephrology service provision?

Participants (213) identified **four** central concerns felt to be impacting on the provision of optimal renal services.

The greatest concern, with 170 references, was the **inadequacy of the current workforce to cope with the demand for renal services**.

Participants described the lack of manpower (96 references) more often than the excessive workload (74 references) although many respondents identified an association between these two variables.

Workforce shortages mostly were made in reference to nephrologists although shortfalls in renal nursing and allied health were also recognised. The fact that the nephrology workforce was also ageing was concerning. Within the smaller paediatric nephrologist population, maintaining a critical mass of skilled nursing staff was seen as problematic. The difficulty attracting renal trainees was identified as a direct contributor to the inadequacy of the workforce.

Ability to dedicate time to supervision and training was a concern to nephrologists and several suggested that this role have greater recognition. It was proposed training emphasis should not be toward training academics but toward training clinicians to provide clinical services.

> *"Current nephrology training in Australia is training academics when the demand is for clinical nephrologists-hence the increased employment of overseas trained doctors" respondent no. 123*

Several respondents suggested the current hospital employment model requires reform and that appointments move from a research to service

delivery focus.

The ageing population, increasing prevalence of diabetes and earlier referrals as a result of eGFR reporting were identified as specific contributors to workload. Mention was made of the medical complexity of patients with renal disease particularly as a result of the ageing population and prevalence of much co-morbidity.

The discrepancy between available workforce and workload was identified as impacting on lifestyle and contributed to 'burn-out'. Several participants felt such a situation displayed nephrology to potential trainees in a poor light and impacted further on trainee recruitment. Lack of time to complete all tasks and still respond to non-work commitments was the major factor impacting on service provision (additional 12 references).

The second issue highlighted as detracting from optimal service provision was **poor remuneration** (28 references). Inadequate remuneration was cited as the reason for workforce shortages (deterring trainees) and nephrology income was compared unfavourably with the earning potential of other physician and surgical subspecialties.

Service provision was hampered by lack of sufficient infrastructure (24 references) and dialysis facilities and beds (including satellite units) were the most frequent exemplars. Other examples included insufficient secretarial and administrative support, lack of access to preventive programs, inadequate theatre time for vascular access procedures and inadequate outpatient

facilities and services.

Thirty-five references were coded as inadequate resources and funds; these comments referred to generic funding deficits in renal medicine. State and federal funding was cited as insufficient. Research and paediatric services were mentioned although often these responses did not expand on the theme further.

Other issues impacting on service provision included the maldistribution of renal services between states and between metropolitan and rural regions with poor services to regional Australia (14 references) and particular populations (eg indigenous Australians). Lack of kidney donors were cited by several as an important issue.

The planning and health care delivery models were identified as the major problem by several respondents. A tension was identified in the ability to deliver renal services which are generally provided in the hospital setting but should be serviced through a chronic disease management model which has a focus in the community setting. In the NSW setting institution focussed delivery of care was potentially inequitable and inefficient compared to a more patient or population based focus.

"Delivery is institution-focused rather than patient focused. Services are slow to respond to changes in disease prevalence, population location,etc. and when they do respond [it] is framed through the lens of the interests of a single institution. An approach that centred on the most efficient and equitable delivery of renal services to the population of NSW would, I imagine, deliver quite a different model. "

Respondent 255

Do any current regulations impact negatively on the care you are able to provide to your patients?

Respondents to this question (101) described at least one regulation as impacting negatively on patient care.

The main factor identified by over a third of respondents was restricted access (or the requirement of time consuming paperwork) to required pharmaceuticals under the Pharmaceutical Benefits Scheme (PBS)/Authority Scheme. (36 references). Restrictions mentioned included access to mycophenolate mofetil for treatment of lupus nephritis, agents to control calcium-phosphate balance such as cinacalcet, sevelamer, lanthanum and authority requirements around calcitriol use.

Prescribing restrictions to hospital based services (eg erythropoietin and several immunosuppressants) interferes with the ability to provide private nephrology services. This necessitates that patients who could otherwise be managed in the private sector are forced to remain attending public hospital based clinics.

Another restrictive regulation was noted to be the restriction of peritoneal

dialysis to the public sector. One recommendation was to list peritoneal dialysis fluids and other consumables as PBS items. Hospital restrictions limiting the ability to offer nocturnal haemodialysis as an in-centre service were cited along with dialysis bed shortages limiting patients' dialysis modality choice.

Poor remuneration was seen to be impacting on the provision of care to the regional and rural sectors with current compensation felt to be insufficient for the additional 'after-care' work required. Remuneration associated with dialysis was identified as a separate issue, particularly surrounding the Medicare billing system for dialysis patients and the lack of adequate funding for dialysis supervision. (*recent Medicare amendments have come some way in addressing this situation*)

Several nephrologists felt that treatment costs (medications, travel) were placing a substantial burden on patients with renal disease and felt greater reimbursement was required for particular groups.

DISCUSSION

The aim of this research was to describe the current nephrology workforce in Australia. From this research, which had an excellent response rate of almost 80%, it is hoped that the Australian nephrology community can gain an insight into aspects of the workforce which are impacting on the capacity of renal physicians to provide optimal patient care. It is also anticipated that this work will inform workforce planning in such areas as renal advanced trainee recruitment and overseas trained nephrologist immigration targets.
Finally, marrying these workforce results to workload indices as reported by ANZDATA (ie ESKD) provide the opportunity for preliminary benchmarking of Australian data to countries with similar health care systems.

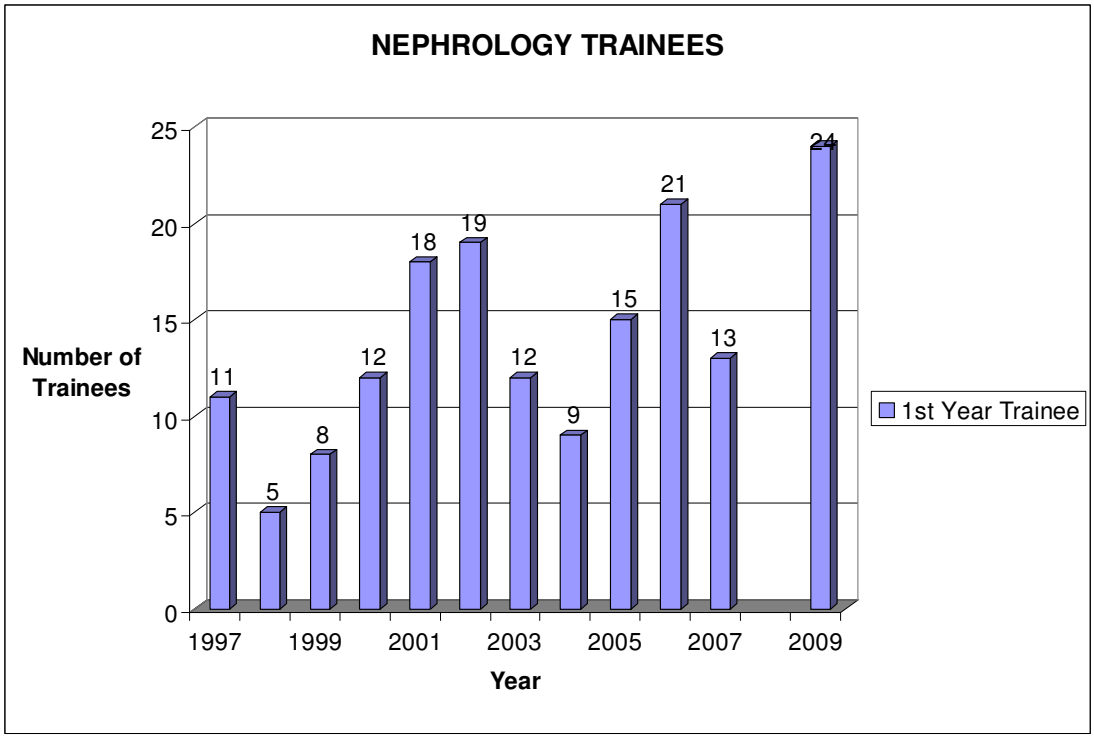
Basic Anticipated Workforce Flow:

Workforce Additions

Trainees

The main source of additions to the nephrologist workforce is the entry of advanced trainees into the workforce. Absolute trainee numbers are misleading since if trainees interrupt training (eg maternity leave) they may be counted year to year but represent only one potential addition to the workforce. From a workforce planning perspective, it would be most informative if that group of final year trainees intending to proceed directly into clinical nephrology practice could be identified; as this is not practical, first year trainee numbers are the next most informative, since although there will

be a lag time before entering the workforce these trainees are only being 'counted once' in any calculation and represent an eventual workforce addition.



Source :Provided by the Royal Australasian College of Physicians[16].2008 data unavailable.

Since 1997 the average intake of first year trainees has been 13 and as can be seen from the above graphical display, there has not been a constant growth in first year trainee numbers despite a documented growth in renal replacement therapy of around 5.9%/year since 1990 [17]

Although the overall numbers of medical students will increase exponentially this increased medical student output won't have impact on specialty numbers for 10-12 yrs after intake. The first increase in medical graduates in Australia occurred in January 2007; even with uninterrupted progress to specialty practice over seven years post graduation, the impact of this new cohort on

the nephrologist workforce will not be experienced until at least 2014.

Trainees with Occupational Training Visas (OTV's)

During 2006 & 2007 there were 15 & 7 trainees respectively with Occupational Training Visas – these trainees are in addition to the College of Physicians Specialist Advisory Committee (SAC) trainee cohort. It is as yet unclear what impact the new Commonwealth of Australian Governments (COAG) regulations for national registration will have on the recruitment of OTV doctors [18]

Migration (Overseas Trained Doctors)

According to the Programme Statistics and Monitoring Section Support Branch of the Department of Immigration and Citizenship [19], occupation information of all passengers is collected using the "Australian Standard Classification of Occupations" as recorded on the passenger card. Occupation level is recorded down to a 4 digits unit group level. The author has been advised that Nephrologists would be recorded under the 4 digit unit group level as 'Specialist Medical Practitioners' and no further classification regarding subspecialty is available. As such, at the time of writing this report, it is impossible to determine how many OTDs are recruited to Australia as specialist nephrologists.

Workforce Re-entry

Seven nephrologists had temporarily left the workforce during the 2007 nephrology workforce questionnaire. This has a relatively small effect on total workforce calculations

Workforce Attritions

Work Hour Reduction

Table 8: Anticipated Changes to Work Hours

		Increasing work hours by 20% (n)	Decreasing work hours by 20% (n)
Definite Plans	**Full Time**	4	59
	Part Time	18	23
Considering/Unsure		18	34
TOTAL		**40**	**116**

The workforce appears to be 'tiring' with a substantial number of nephrologists planning to decrease their work hours far outweighing those who intend to increase hours. From this questionnaire a **net loss of 20% of current work hours by 60 workers (ie 12 FTEs)** (conservative figures) within the **next five years** is anticipated. This is likely to be an underestimate since the majority of those planning to decrease work hours have definite plans whereas those planning to increase work hours are less certain. In addition those planning to decrease work hours are largely coming from the full time pool whereas those planning to increase work hours are part time workers.

Retirement

Sixty -seven nephrologists (26%) plan to retire within the next ten years. Moreover, younger respondents anticipate retiring earlier than older nephrologists – this may reflect younger cohorts' decreased income and

personal commitments, a greater emphasis placed on lifestyle and/or difficulty anticipating and predicting a distant event. However, almost **one third** of the surveyed population are **currently over 55 years** and retirement plans of this group are likely to be more reliable with 28 nephrologists (over 40% of this older group) planning to retire within the next 5 years.

It is also relevant to note that over 80% of this older group (>55 years) are working in a full time capacity and represent a component of the workforce with a large base of experience, it is estimated by the Australian Medical Association [20] that **1.6 physicians are required to replace 1 departing physician from this experienced workforce cohort.** This estimation has not been incorporated into table 8 and so represents a conservative estimation of workforce attrition.

Death and Migration

These variables are not known for nephrology but will be expected to have a small impact on overall numbers The ANZSN has data on those living overseas who maintain membership, the list is not a complete representation of all renal physician migrants and there is no time frame to the duration of expatriation but it provides some reference point and perspective to the potential magnitude of this variable. In 2007 there were only 21 full members in the ANZSN database living outside Australia/New-Zealand.

Table 9: Australian Nephrology Workforce Inflows & Outflows (averaged)

	AVERAGE WORKFORCE **INFLOWS/YR** (FTEs)	AVERAGE WORKFORCE **OUTFLOWS/YR** (FTEs)
Trainees listed with SAC	13	-
Overseas Training Visas	11	-
Retirement	-	5.6
Re-entry/ Change in Wk Hrs	-	2.4
Migration/Immigration	?*	?
Subtotals	24 +Immigration	8.0
Totals excluding (im)migration	24	8

* The programme statistics and monitoring section of the dept. of immigration and citizenship collects occupation information using a coding system which identifies specialist medical practitioners as a collective. Specific subspecialty listing is not available.

Workload

The workload facing nephrologists is difficult to quantify. The number of patients with End Stage Kidney Disease (ESKD) is one often cited indicator and has been adopted by several countries. ESKD has benefits as an indicator, particularly for Australia since as a result of the ongoing diligence of nephrology clinicians and those directly involved in the management of the database, Australia has registry data accessible to all clinicians, outlining statistics collected over more than thirty years regarding the ESKD population. As with most registry collections there is a reliance on voluntary reporting and so it is vulnerable to reporting & response bias.

From this questionnaire it is clear that the management of patients with ESKD

is only one component of workload, forming around 40% of the clinical workload and a fifth of the total workload. Any international comparison makes the potentially erroneous assumption that nephrologists have the same ESKD workload distribution across various health systems. This is highlighted if the United States report of nephrologist work practices is reviewed. This often cited paper ,published in 1997 [21],.found that 35% of a nephrologists' time was dedicated to the management of ESKD, quite different from the Australian experience, eleven years later, reporting 20% of work time dedicated to this aspect of nephrology

If ESKD is used as a benchmark then in Australia in 2007, it is estimated, 278 (FTE) nephrologists provide care for 16 751 (797 per million population) patients with ESKD [22] or **60 ESKD patients/nephrologist (2.9 patients per million population/nephrologist)**

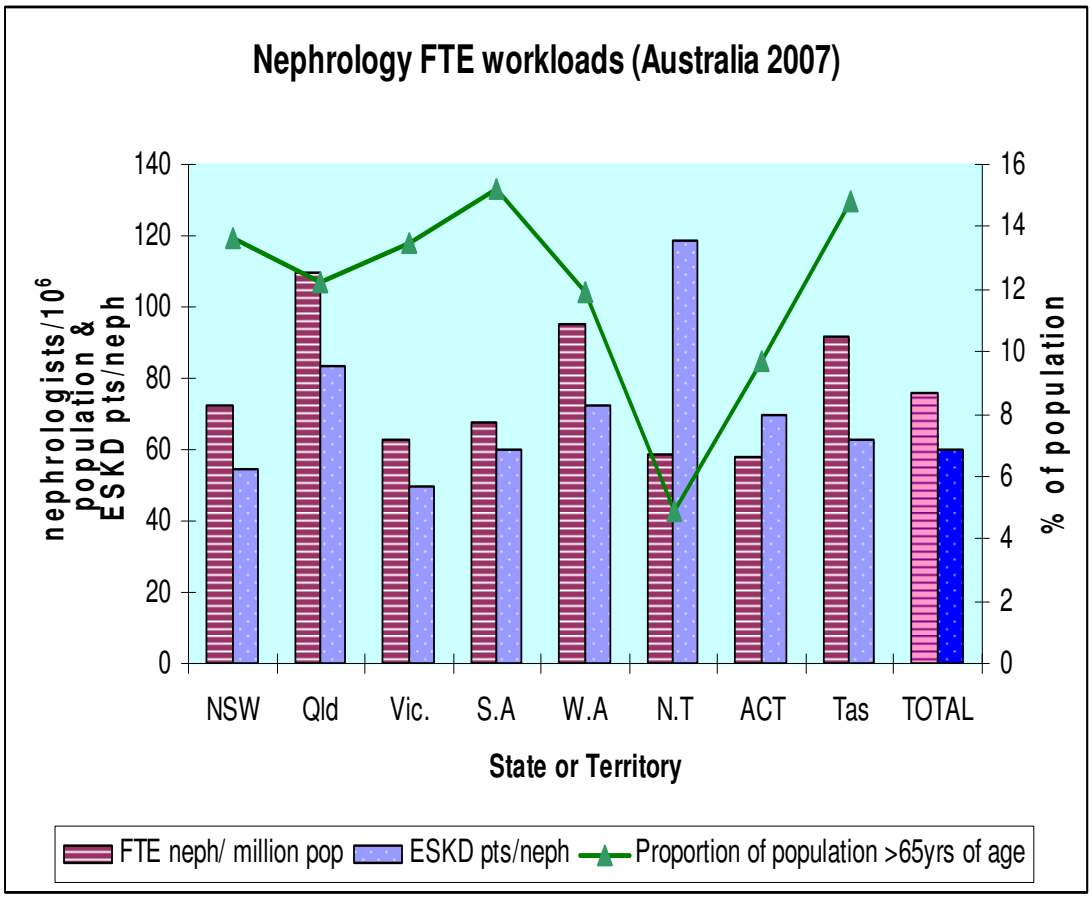
Table 10: Distribution within Australia of Workforce and ESKD workload (2007)

State or Territory	Nephrologists FTE* from Survey (% total)	Estimated Total Nephrologists (FTE)	FTE Nephrologists per 10^6 population§	ESKD patients per estimated FTE nephrologists†	% of pop. >65yrs of age§
NSW	64.1 (34.4)	95.6	72.3	54.3	13.6
Qld	25.9 (13.8)	38.4	109.4	83.2	12.2
Vic.	56.1 (30.0)	83.4	62.7	50	13.5
S.A	15.7 (8.4)	23.4	67.9	60.1	15.2
W.A	15.0 (8.0)	22.2	95.4	72.7	11.9
N.T	2.5 (1.3)	3.7	58.5	118.9	4.9
ACT	4.0 (2.1)	5.9	57.7	69.7	9.7
Tas	3.6 (1.9)	5.4	91.6	62.8	14.8
TOTAL	**186.9 (100)**	**278**	**75.8**	**60.3**	

*FTE estimation based on n=240, 40 respondents had EITHER state or work hours missing. Assuming state/territory of practice is independent of response status.
§Australian Bureau of Statistics. *3101.0 - Australian Demographic Statistics, Sep 2007* 2007 [cited; Available from: http://www.abs.gov.au/ausstats/abs@.nsf/mf/3101.0/#.
†McDonald, S. and L. Excell, *ANZDATA thirty first annual report - chapter 1: Stock and Flow*. 2008: Adelaide

This figure is quite different from the 79.5 ESKD patients/nephrologist quoted in the submission to the 2005 Productivity Commission [5] and is a consequence of the different number of nephrologists estimated in these two different analyses.

Figure 12: Nephrology Full Time Equivalent Workloads (Australia 2007); referenced against population figures & burden of End Stage Kidney Disease (ESKD)



As in the United Kingdom [23] and USA [24] there is a substantial burden of disease (workload) from Chronic Kidney Disease (CKD) in Australia. [7]

It is recognised that ESKD represents only a small proportion of the kidney disease burden [25,26]and that every patient with ESKD is an indices for a further four patients with Stage 4 CKD and more than 90 suffering with stages 1- 3 CKD[25]. As such, although only 20% of a nephrologists total work time is spent on the management of ESKD, it serves as a marker of a far greater burden of disease and clinical workload.

Any projections of workload also need to incorporate expected changes to patient survival brought about by advances in health care and the impact of an ageing population and changing disease profile (increasing incidence of diabetes mellitus) will have on the prevalence of kidney disease in our community. An estimate of the impact that the increasing incidence of ESKD will have on workforce is described. (see Future Nephrology Requirements) though more extensive projections, however, are beyond the scope of this report.

Hours Worked

Of full time nephrologists working in Australia, **140 (84%) work more than a standard 40 hour week without taking into account further on-call (after hours)** commitments. The average weekly work hour of the full time nephrologist is **52hrs/week**.. This compares similarly, perhaps favourably, with the situation in the UK, USA or Canada

International Comparative Data of Work Hours

Table 11: International Comparison of Nephrologist Work Hours

Country	Weekly Work Hours
Australia	52[1]
% of full time Australian nephrologists exceeding 50hrs/week	35
UK	56
% of UK nephrologists exceeding 48hrs/week	41[2]
USA	57.6[3]

Canada	56.95[4]

1: Full time workers (defined as working ≥35hrs/week). Part time workers excluded
2: Data from 27 English and Welsh units participating in the UK Renal Registry during a five year period from 2002
3: Ad-hoc Committee on nephrology manpower needs 1997. Executive Summary
4: Royal College of Physicians and Surgeons of Canada

Table 12 : Comparative International Workforce Data

	United States Of America [a] 2005	Canada [b] 2004	United Kingdom [c] 2005	Australia 2005	Australia 2007 survey (this research)
Number of pts requiring dialysis (number per million population)	341 319	18 827	20 000	8 528 (420)	9642 [i] (459)
Number of ESKD	485 012	30 924	38 000 (638)	15 067 (741)	16 751 [i] (797)
Annual growth in ESKD (%)	3.9	4.5	5	5.9 [e]	6.5 [j]
Number of practicing nephrologists	4900[g]	366	359	171[f]	278
ESKD/neph	99.0	84.5	105.8	88.1	60.3
Number of Specialist Advanced trainees (Renal)	340[g]	unavailable	301[h]	33[k]	50[k]

[a] US Renal Data System (USRDS) 2007 report
[b] Canadian Organ Replacement Register,1995-2004 (2006 Annual Report)
[c] The UK Renal Registry Eight Annual Report.Bristol,2005
[d] Federation of the Royal College of Physicians of the UK. Census of consultant physicians in the UK, 2005: Data and commentary. London: RCP, 2006
[e] McDonald,S and Excell,L 29th ANZDATA Registry Report (2006)
[f] Faull, R on behalf of ANZSN. 2005 Submission to the Productivity Commission's Health Workforce Study
[g] Osinski, M. and J. Wish (2005) Physician workforce: coming up short. Nephrol News Issues Volume, 58-59,64,67
[h] Royal College of Physicians, The changing face of renal medicine in the UK: the future of the specialty. Report o f a Working Party. 2007, RCP: London.
i McDonald, S, Excell L, ANZDATA thirty first annual report - chapter 1: Stock and Flow. 2008: Adelaide
j McDonald, S, Excell, L ANZDATA thirtieth annual report - chapter 1: Stock and Flow. 2007: Adelaide
k. Royal Australasian College of Physicians (RACP), (Unpublished) Data supplied by the Royal Australasian College of Physicians, Education Department (Sydney). 2007

Work Type

The part time workforce is a highly skilled and valuable asset contributing to the after-hours workload, they are more likely to be engaged in research than the full time cohort, and have the potential to contribute to future workforce productivity. At present they represent around 15% of the workforce. 14% of male nephrologists and 25% of females work part time. Growth in demand for part time work is likely and the nephrology community needs to proactively tailor opportunities to retain this subgroup and capitalise on recruitment opportunities.

FUTURE NEPHROLOGY REQUIREMENTS IN AUSTRALIA

In the USA in 1993, the nephrology community, which was heavily dependent on overseas trained doctors[27] formed the 'ad hoc committee on nephrology manpower needs' with representation from the American Society of Nephrology and four other major nephrology societies (later forming the Council of American Kidney Societies- CAKS). The committee commissioned a workforce study with an aim of determining accurate information predicting future workforce requirements of Nephrologists[21],[28 29].

This study remains the most detailed predictive workforce study in nephrology and our analysis drew heavily on the methodology employed in this earlier research.

As outlined in the results (p30-31), there are 278 FTE nephrologists estimated

to be practicing in Australia in 2007. In this survey, 20% of the ***total working hours*** of the nephrologist were devoted to treating ESKD. i.e. among the 278 FTE nephrologists, 56 are theoretically fully dedicated to the care of ESKD patients.

Taking this as the standard, projections are made to accommodate the future number of ESKD patients for the years of 2010, 2013, 2018 and 2028.

Prediction of future ESKD burden is made in two ways:

1. Using the average yearly growth rate in ESKD
2. Considering the trend in the growth rate over years

From 1983 to 2006 [30]the average annual growth rate of ESKD was 6.5% (prevalence), giving a projected prevalence for 2008 of 18178 patients needing renal replacement therapy. Using this scenario, the projections are furnished in tables 13-15 (for the extended time continuous projections see appendix B).

Advanced Trainee Requirements

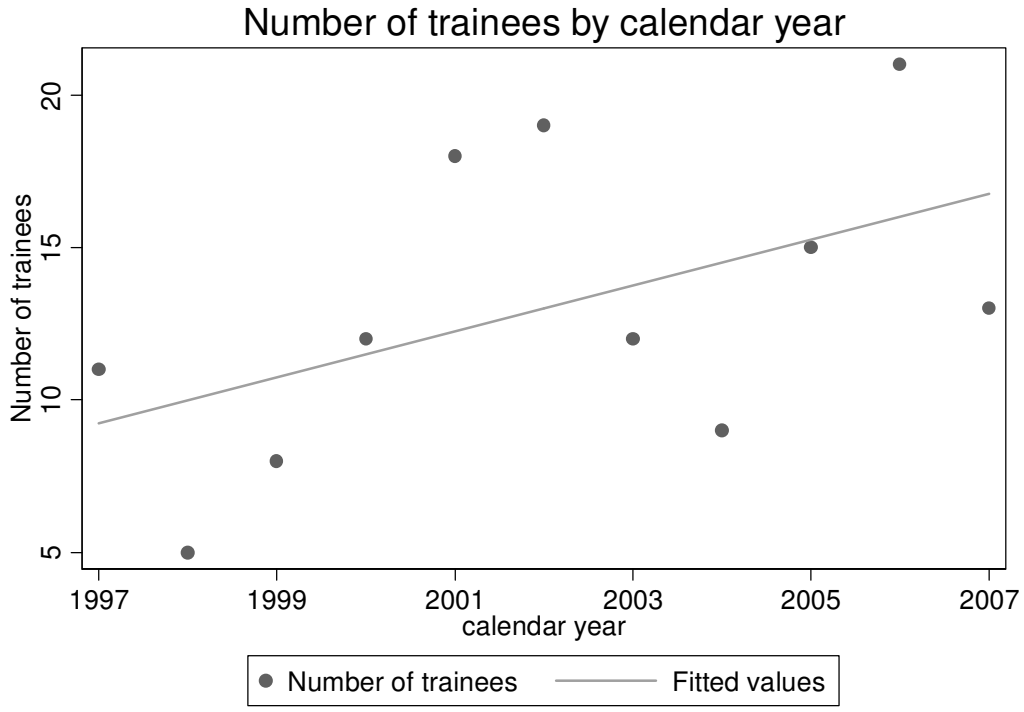
Predictions of future nephrology advanced trainee requirements have been made using three variables:-

1. The anticipated year of retirement of current nephrologists as reported in this research (the 2007 Australian Nephrology Workforce Questionnaire).
2. The anticipated first year nephrology advanced trainee numbers, extrapolated from existing recruitment statistics provided by the Specialist Advisory Committee (nephrology) of the Royal Australasian College of Physicians. (see Workforce Additions: Trainees)

3. The predicted workforce required based on anticipated workload

Over time, as illustrated in figure 13, there is an increasing trend in numbers of first year trainees in nephrology.

Figure 13: Numbers of First Year Nephrology Advanced Trainees from 1997-2007 as listed with the Specialist Advisory Committee (nephrology) of the Royal Australasian College of Physicians



Source: Royal Australasian College of Physicians

Based on this association, by using a simple linear regression, the number of first year trainees expected to have been recruited to nephrology can be predicted.

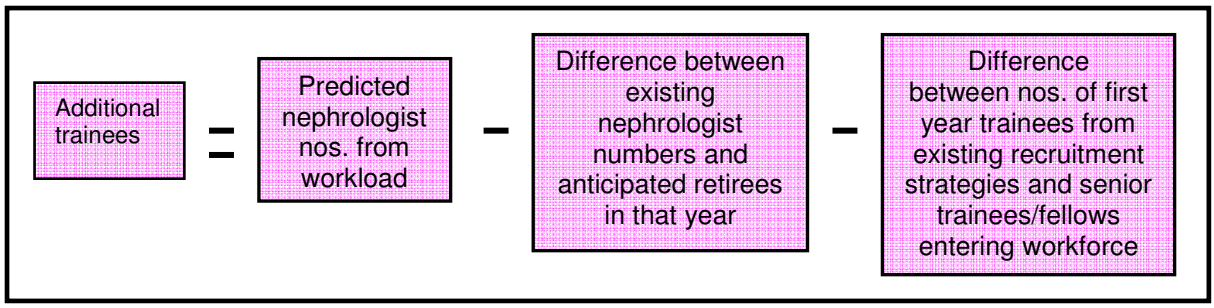
At present there is a widespread recognition within the ANZSN membership of the dependence on Overseas Trained Physicians (trained in nephrology) to meet shortfalls in local physician requirements. If we therefore accept the

current ratio of locally trained nephrologists is insufficient for optimal patient care then ***additional*** trainees will be required above the current rate of intake. A prediction of the future number of required nephrologists is necessary to predict the additional first year trainee requirements.

Predicting Required Numbers of Future Nephrologists (FTE) in Australia.

Based on 2006 number of ESKD patients reported in table 1.10 of the 30th ANZADATA Registry 2007 report [30] and an average annual growth rate of ESKD patients of 6.5%, the projected number in 2008 was 18178. Under this scenario the projections of nephrologists and additional trainee requirements are furnished in table 13 and more fully in appendix B

The number of **additional trainees** can be calculated using the following formula:



For ease of calculation it is assumed the number of trainees entering the workforce following training/research will be similar to the number entering the workforce as first year trainees in the preceding year ie overlook the lag in training time.

For instance, in 2007, there were 278 nephrologists and from RACP records, 13 first year trainees; we anticipate one retirement by the end of the year (based on survey data adjusted for response rate). In 2008, 291 nephrologists would be anticipated to be required from workload estimates. Seventeen trainees would be anticipated from existing recruitment strategies and we know that there will be a number of graduating trainees entering the workforce, estimated to be 13, leaving a shortfall of ten additional nephrologists needing to be trained (or imported)

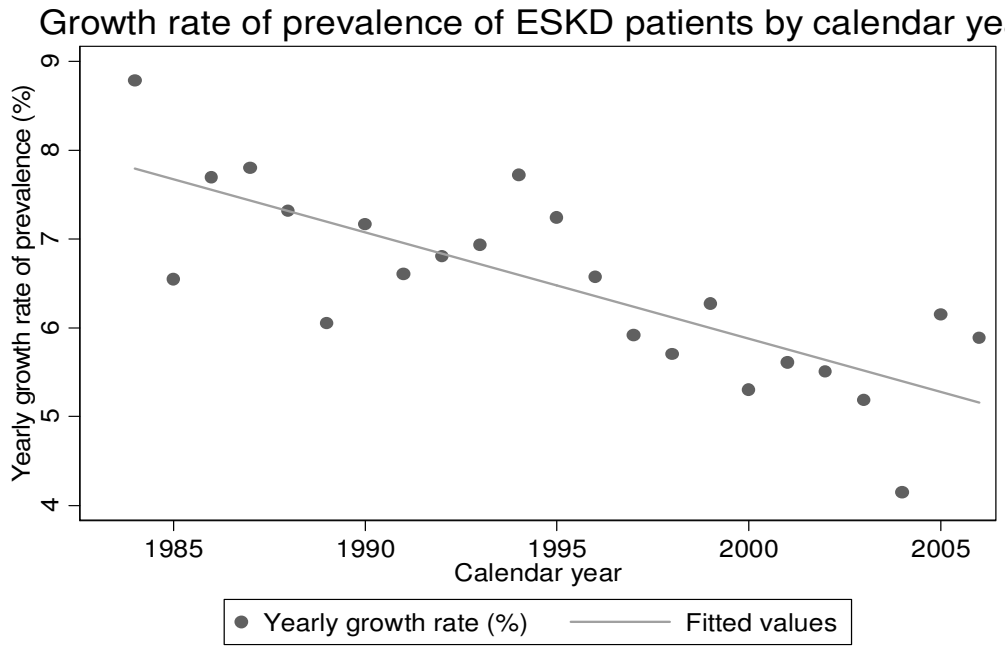
i.e. [291-(278-1)- (17-13)] = 13 additional trainees.

Table 13: Estimated Requirements of Full Time Equivalent Nephrologists and Trainees* Based on the Current Growth Rate of ESKD patients (6.5%)

Year	Total no. of nephrologists required	Total Retirements	Anticipated Trainee nos.	Additional trainees
2010	318	5	19	26
2013	383	9	21	32
2018	525	10	25	39
2028	987	14	33	67

From the same report (table 1.10) [30] the growth rate of ESKD for each year has a decreasing trend with increasing calendar year. This relation is being demonstrated in figure 14.

Figure 14: Growth Rate of Prevalence of End Stage Kidney Disease in Australia *



*Source: McDonald, S. and L. Excell, ANZDATA thirtieth annual report - chapter 1: Stock and Flow. 2007: Adelaide.

If a simple linear regression model of calendar year on the yearly growth rate is fitted; the slope is -0.1197, that is, for each calendar year the percentage growth rate will decrease by 0.1197. (intercept of the equation was 245.32 ; R^2 of 0.60).

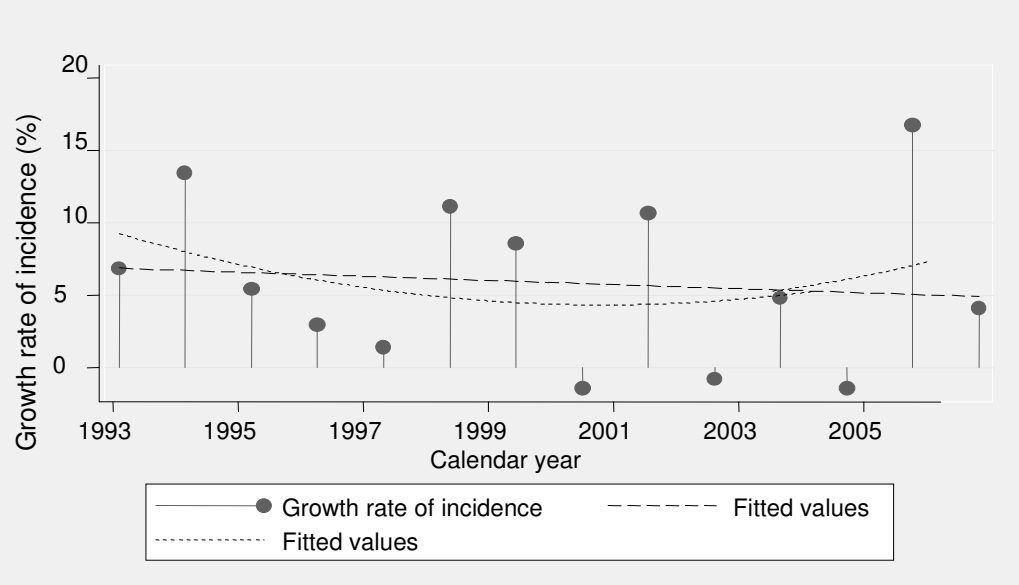
Based on this equation, growth rates for all years up to 2028 have been predicted. The predicted rates were used to extrapolate the number of ESKD patients which were then used to make projection for the requirement of nephrologists. ***Based on previous ANZDATA registry results*** [30]***, decreasing growth rate would appear to be the most likely predicted scenario***. Table 14 documents isolated results from a continuos projection – see appendix B, table 14

Table 14: Estimated Number of Full Time Equivalent Nephrologists Based on Predicted ESKD Growth Rates (Australia). Table is discontinuous and each year is independent of the other. Please see appendix B for continuos data. Assumption is made that workforce will

Year	Predicted ESKD Growth Rate	Predicted no. of patients with ESKD	Total no. nephrologists required	Total Retirements	Anticipated Trainee nos.	Additional trainee nos.
2010	4.73	19306	320	5	19	21
2013	4.37	22023	365	9	21	23
2018	3.77	26805	444	10	25	23
2028	2.57	36409	603	14	33	22

As seen in figure 14; the ***prevalence growth rate*** is decreasing. This is because the ***growth rate of incidence*** (number of new patients) is not increasing, and on average, has a relatively flat pattern. Figure 15 illustrates the growth rate of incidence against calendar year.

Figure 15: Growth Rate of End Stage Kidney Disease Incidence (Australia)



The broken straight line on the above graph shows linear fit of the growth rate

across years, which is almost flat. A better fit is achieved with a quadratic model (dotted line), indicating a quadratic relation between calendar year and growth rate, though none of these coefficients were statistically significant. The dotted line in figure 15 depicts an increasing trend in the incident growth rate after 2003; the cause of this has not been examined but may reflect the growth in diabetes and the ageing population with increasing incidence of End Stage Kidney Disease in the over 65 year old cohort.

If this observation persists, using the quadratic model, incidence rates and workforce requirements can be predicted as before. These predictions seem unrealistic and in practice incident growth rates would be expected to flatten at a certain time in the future. Nevertheless from these estimates it can be seen that small changes in incident growth rates have a dramatic impact on workload and workforce requirements and highlight the importance and likely cost effectiveness of preventive health measures.

Table 15: Estimated Numbers of Nephrologists (FTE) & Trainees Based on Quadratic Growth Rate in End Stage Kidney Disease Incidence (Australia)

Year	Predicted growth rate of ESKD	Extrapolated patients nos. with ESKD	Total no of nephrologists required	Retirement Nos.	Predicted Training	Additional training
2010	21.8	20954	347	5	19	33
2013	28.0	28045	464	9	21	56
2018	42.0	67075	110	10	25	238

CONCLUSION AND RECOMMENDATIONS

The above discussion has focussed on unavoidably imprecise manpower predictions. Unforseen and poorly predictable variables inevitably mean such predictions can only seek to estimate future workforce requirements. This should not distract from those elements which have been established from this study, namely:-

1. The solution to the current nephrology workforce 'crisis' must incorporate a focus toward recruitment - more young doctors need to be attracted into a career in nephrology. Using the ***conservative*** model of decreasing growth rate– see table 13 and appendix B ; it is necessary to attract approximately ***20 additional first year advanced trainees*** (ie approximately 40 first year trainees) into nephrology ***per year*** to simply ***maintain a workforce status quo***. This does not consider ongoing losses due to decreasing participation rates. Our previous research has clearly and statistically shown that to attract more trainees into nephrology we must not only expose them to renal medicine early in their postgraduate career but also ensure this exposure is enjoyable and interesting and that trainees feel incorporated into the department. The influence of a strong mentor and role model can not be understated.

2. Some areas have a full complement of trainees but this may still be insufficient for service needs. Regardless of modelling techniques employed it is clear that the growth in End Stage Renal Failure is increasing at a

greater rate than our current recruitment. Additional training posts are required and such posts require funding. Increases in training posts need to be undertaken in areas with established service needs and in areas with high proportions of patients with End Stage Renal Failure and Chronic Kidney Disease. A national approach to facilitating such training posts may be more efficient and easier to coordinate than individual state based endeavours given the recognised funding difficulties within the various state & territory based health services. Funding of posts needs to incorporate the increased supervisory requirements which must accompany increased trainee numbers if the training is to be educationally successful and meet educational credentialing criteria.

3. Although part time training and specialist positions appear to reduce the available workforce in the short term the long term benefits of such workpractices should not be overlooked as they feed positively into recruitment of trainees (particularly given the changing demographics and greater demands for maternity/paternity leave) . From this research part time workers report greater control of their workhours (?satisfaction) and a willingness to reenter the workforce. Opportunities must be proactively tailored to attract and retain this valuable workforce subgroup.

4. Improving remuneration, particularly for those nephrologists providing renal services to rural and remote Australia may assist in improving equity of renal health service delivery, qualitative results from this questionnaire describe a

perception that current compensation is insufficient for the additional 'after-care' work required in these rural/remote sites. Remuneration associated with dialysis was identified as a separate issue, particularly surrounding the Medicare billing system for dialysis patients and the perceived lack of adequate funding for dialysis supervision. Recent changes in Medicare billing around this issue may have provided some level of relief to this problem.

5. Improving the efficiency of the existing nephrologists. Inadequate secretarial and administrative support, along with issues such as restricted access (or the requirement of time consuming paperwork) to required pharmaceuticals under the Pharmaceutical Benefits Scheme (PBS)/Authority Scheme limits the efficiency of the current workforce. Insufficient renal donors, forcing dialysis as a modality over transplantation further exacerbate the workload and costs associated with renal health care

.

6. Although not specific to nephrology, there is some evidence [31] that specialty practice location is related to training exposure. This raises the possibility of providing rural practice exposure within the nephrology training program as one possible method of encourageing future rural/ remote nephrology service delivery. Such an option is not without short term barriers. At present insufficient supervisory capacity exists in these sites and would require remote supervision or an increase in remuneration to attract supervisors to these areas. Another barrier is the relative unattractiveness of these

rotations when compared with metropolitan sites in both renal and other subspecialties. This has particular import for nephrology, already experiencing recruitment difficulties. Such an option would only be palatable for nephrology if all subspecialties agreed to implement this component to training

7. Consideration needs to be given to restructuring the way renal health services are delivered. At present there is still a heavy reliance on hospital based, rather than a chronic disease management model with a focus on community based health care delivery. Institution based health care is likely to be more costly and far more inefficient compared to a community based model.

8. Trainees need to be exposed to research yet whether their final year should be non-clinical based is questionable from both an educational and workforce perspective. Increasing clinical exposure and enhancing clinical service delivery with research undertaken post fellowship may be a more effective strategy and would have the additional benefit of increasing effective trainee numbers and providing some relaxation of the clinical demands on consultants, enabling better supervision of these clinically active trainees. A research focus should not be lost and should be delivered utilising the current project requirements.

9. Re evaluation of the curriculum is timely and emphasis should be given to

areas reflected by the vocational needs of the nephrologist. Areas such as clinical nephrology particularly dialysis and chronic kidney disease and research are areas currently consuming a large amount of a nephrologists' time. The curriculum must reflect these needs along with training in administration/managerial issues and basic principles of how to teach efficiently eg teaching on the run courses

10. Opportunities exist for workforce redesign with the development of supportive roles such as the 'Career Medical Officer' or 'Hospitalist' position in nephrology. Such doctors can become trained alongside nephrology advanced trainees but remain in hospital based practice covering areas such as dialysis units and outpatient clinics.

11. Policy need to be developed at a Commonwealth level to ensure:-
    a. The workforce and workload predictions in this report are more formally developed and reassessed on a biannual basis, thereafter in consultation with ANZSN
    b. Funding is planned now for the additional nephrologist positions and for the additional first year advanced trainees required by 2018.
    c. Discussion and decision around the ethics of recruiting overseas trained nephrologists from countries less affluent than Australia.

The results from this survey and analysis provide new insights into the current state of the nephrology workforce in Australia. It is hoped this report will be of

assistance to the ANZSN and feedback is welcome.

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APPENDIX A

Two versions of the Australian Nephrology Workforce Survey exist; the electronic version.

notes1-med.med.unsw.edu.au/surveys/renal.nsf/RecordPrefs?OpenForm

and hardcopy version appendix page II

Nephrology is currently suffering a widespread workforce shortage that is likely to be exacerbated by demands from an increasing patient burden (aging population with increasing incidence of diseases with known renal associations such as diabetes and obesity) and a current undersupply of physicians who are not driven to pursue nephrology. As increasing levels of undergraduates emerge from new medical schools it is likely there will be a competitive recruitment drive amongst subspecialties. Successful government lobbying to increase training numbers and sites (private practice) will depend on the provision of accurate figures regarding workloads. The key performance indicator of waiting time is unlikely to be regarded as reliable in the future and has previously been shown to be open to manipulation. Please assist by providing the most accurate and reliable information you can. Your comments will be incorporated into the final analysis and report. In piloting, this questionnaire has only taken 9 minutes to complete. For your convenience, it is also available on-line at http://www.med.unsw.edu.au/surveys/renal.nsf/RecordPrefs **PLEASE ONLY COMPLETE ONE SURVEY**

Cathie Lane. On behalf of New South Wales Renal Services Network (Workforce, Education and

DEMOGRAPHICS

1. Are you

☐ Male
☐ Female

---

2. What is your year of birth? _ _ _ _

---

3. Are you married or in a permanent long term relationship?

☐ No
☐ Yes → If Yes: 3b. Does your spouse/partner work?

☐ Yes, works in full time paid employment
☐ Yes, works in part time paid employment
☐ No does not work in paid employment

---

4. Do you have children?

☐ No
☐ Yes → If Yes: 4b. Do they live with you?

☐ Yes
☐ No

---

5. Do any of your children require day care?

☐ Yes
☐ No

---

6. Are any of your children attending school?

☐ Yes
☐ No

---

7. If you have children do day-care or school commitments reduce the hours you are able to work?

☐ Yes
☐ No

---

8. At what age do you intend to completely retire from nephrology practice? _____ years

---

TRAINING

9. Did you complete your undergraduate medical degree in Australia?

☐ No ☐ Yes

---

10. Do you have another undergraduate degree/qualification?

☐ Yes. Please specify _____
☐ No.

11. Do you have a postgraduate degree/qualification?

☐ Yes. Please specify _____
☐ Currently completing
☐ No.

12. Did you undertake nephrology specialty training in Australia?

☐ No ☐ Yes

13. Do you have specialty training in another field (excluding general medicine) recognised by the Royal Australasian College of Physicians?

☐ No ☐ Yes

SITE OF PRACTICE

14. In which Australian state do you undertake the majority of your work?
Please select only one category

☐ QLD ☐ NT ☐ NSW ☐ VIC ☐ TAS ☐ ACT ☐ SA ☐ WA

15. What are the main locations where you have worked in the last 4 weeks? Please indicate the postcode (or name of the town/suburb & **state**) and the hours worked.

	Postcode				Total Hours Worked	Location
First Location						
Second Location						
Third Location						
Fourth Location						

WORK HOURS

16. 'Part time' work is defined as less than 36hrs/week. Would you describe your usual working week as

- ☐ Full Time
- ☐ Part Time (<36 hours/week)
- ☐ Temporarily Not Working
- ☐ Permanently Left Workforce

---

17. On average, please indicate how many hours a week you work as a nephrologist (EXCLUDE ON-CALL).

- ☐ 4-10
- ☐ 11-35
- ☐ 36-40
- ☐ 41-50
- ☐ 51-60
- ☐ 61-80
- ☐ 81-100
- ☐ >100

---

18. Do you have on-call duties during your usual working week?

- ☐ No
- ☐ Yes → If Yes 18b:

How many hours are worked on-call/week
(please average rosters out to a weekly quota)

- ☐ <5
- ☐ 5-10
- ☐ 11-
- ☐ 31-40
- ☐ 41- 50
- ☐ 51- 70
- ☐ 71-100
- ☐ >100
- ☐ Unable to calculate

TYPE OF PRACTICE

19. Please indicate the practice mix that best describes your usual working week

- ☐ Full time salaried university/research appointment with no clinical nephrology
- ☐ Full time salaried university/research appointment involving clinical nephrology
- ☐ Full time salaried public hospital appointment involving clinical nephrology
- ☐ Part time Public hospital and part time research
- ☐ Part time private practice and part time research
- ☐ Full time private practice with a public/private hospital VMO position
- ☐ Full time private practice without a hospital appointment.
- ☐ Other. Please specify _____

---

20. Do you intend to permanently **reduce** the hours you work by > 20%?

- ☐ Unsure
- ☐ No
- ☐ Yes → If Yes 20b. When do you plan to do this?

  - ☐ Now
  - ☐ In 2-5 years
  - ☐ In 6 -10
  - ☐ In 11-15 years
  - ☐ >15 years from now

21. Do you intend to permanently **increase** the hours you work by > than 20%?

☐ Unsure
☐ No
☐ Yes ⟶ If Yes 21b. When do you plan to do this?

☐ Now
☐ In 2-5
☐ In 6-10 years
☐ In 11-15 years
☐ >15 years from now

22. Do you feel able to control your work hours?

☐ Yes
☐ No ⟶ If No PLEASE indicate the reason(s) for this

_____

_____

_____

_____

23. Please indicate the percentage of your work dedicated to the following categories

	Proportion of weekly work time (%)
Administration	
Teaching	
Continuing Medical Education	
Clinical Nephrology	
Other Clinical Specialty Work eg General Medicine, Nuclear Med	
Research	
Other professional duties	
Medicolegal	
Other (please specify)	
TOTAL	100

24. Do you personally perform central vascular access procedures?

☐ No ☐ Yes

---

25. Do you personally perform renal biopsy procedures?

☐ No ☐ Yes

CLINICAL NEPHROLOGY

If you do not provide a clinical service please go to question 28.

26. If you undertake clinical nephrology. Please indicate the percentage of your clinical workload spent with each patient group.

	Proportion of Clinical Workload %
Dialysis (both HD and PD)	
Hypertension	
Chronic Kidney Disease (CKD)	
Acute Renal Transplantation	
Long Term Follow-Up of Renal Transplant	
Renal Donor Suitability	
Obstetric Medicine	
General Medicine in the non-nephrology patient	
OTHER - Please Specify	
TOTAL	**100**

27. If you undertake clinical nephrology are you personally involved in providing clinical care to rural or remote areas?

☐ No
☐ Yes

28. What do you see as the greatest issues impacting on nephrology service provision?

29. Do any current regulations impact negatively on the care you are able to provide to your patients?

☐ No
☐ Yes. Please indicate what these are.

THANK YOU FOR YOUR TIME IN FILLING IN THIS SURVEY

APPENDIX B

Equation 1: Formula used for end stage kidney disease population predictions employed in the following prediction tables

Formula for population growth rate and prediction:

$\mathbf{P_n = P_0 (1+r)^n}$

Where,

P_n = Population in Nth year

P_0 = Population in the starting year

r = growth rate

n = number of years

Simplification of the equation for r is

$$r = \exp\left\{\frac{1}{n} Ln\left(\frac{P_n}{P_0}\right)\right\} - 1$$

Table 13: Continuous Data Explanatory Notes
Predictions if End Stage Kidney Disease growth rate fixed at 6.5%pa

The first row of figures is based on direct report from the survey results (eg anticipated retirement) or from figures from the 2008 ANZSN yearly report. These figures are used as the baseline in the subsequent calculations.

Predicted rate (%) = the growth rate of ESKD patients predicted by using the simple linear regression model graphically presented in Figure 14 of the report. The equation is: growth rate= 245.3233-0.1197x (calendar year)
Predicted ESKD population =No of ESKD patients predicted from the previously predicted growth rate according to the equation: ESKD population in the year=ESKD population in the previous year(1+ growth rate); where 16027 is the ESKD population in 2006 as reported in table 1.10 of chapter 1: Stock and Flow. 2007
N_ESKD_Req = Number of nephrologists required only for ESKD patients, calculated according to the equation: N_ESKD_Req=56/17678.36x(ESKD population in that year); where 17678.36 is the predicted ESKD population in 2008 for which there are 56 nephrologists.
N_Tot_Req. = Total number of nephrologists required, calculated assuming that 20% time of the total time of the nephrologists is spent on ESKD patients.
Predicted Trainees = number of nephrologists requiring training predicted from the simple linear regression model graphically presented in Figure 13 of the report. The equation is : training= -1497.6+0.7545455x(calendar year)
Additional trainees required = training required on top of the predicted training, calculated from the equation: additional training=Total nephrologists required -Total nephrologists required in the previous year-adjusted number of anticipated retirement in the previous year_ first year trainees in previous year-predicted number of first year trainees

Continuous Data for Table 13. Fixed growth Rate of ESKD population

Predicted ESKD population	ESKD population in 2008	Rate	No. of years	Year	N_ESKD_Req	N_Tot_Req	Adjusted retiree	Reported Retiree	Predicted trainees	Additional trainees required
19359.57	18178	0.065	1	2009	59.64	298.2	7.594936709	6	18	
20617.94205	18178	0.065	2	2010	63.52	317.583	5.063291139	4	19	25.97793671
23385.38532	18178	0.065	4	2012	72.04	360.2105782	8.860759494	7	21	45.69086931
24905.43537	18178	0.065	5	2013	76.72	383.6242658	8.860759494	7	21	32.27444708
32040.00455	18178	0.065	9	2017	98.70	493.5197092	7.594936709	6	24	115.7562029
34122.60484	18178	0.065	10	2018	105.12	525.5984903	10.12658228	8	25	38.67371781
60143.49292	18178	0.065	19	2027	185.28	926.4043359	7.594936709	6	32	403.932428
64052.81996	18178	0.065	20	2028	197.32	986.6206178	13.92405063	11	33	66.81121855

Explanatory Legend for Table 14 continuous data Predictions if End Stage Kidney Disease prevalent growth rates continue to decrease in a stable manner. (based on established prevalent growth rates from 1983

The first row of figures are based on direct report from the survey results(eg anticipated retirement) or from figures from the 2008 ANZSN yearly report. These figures are used as the baseline in the subsequent calculations.

Predicted rate (%) = the growth rate of ESKD patients predicted by using the simple linear regression model graphically presented in Figure 14 of the report. The equation is: growth rate= 245.3233-0.1197x(calendar year)

Predicted ESKD population =No of ESKD patients predicted from the previously predicted growth rate according to the equation: ESKD population in the year=ESKD population in the previous year(1+ growth rate); where 16027 is the ESKD population in 2006 as reported in table 1.10 of chapter 1: Stock and Flow. 2007

N_ESKD_Req= Number of nephrologists required only for ESKD patients, calculated according to the equation

N_ESKD_Req= 56/17678.36x(ESKD population in that year); where 17678.36 is the predicted ESKD population in 2008 for which there are 56 nephrologists.

N_Tot_Req= Total number of nephrologists required, calculated assuming that 20% time of the total time of the nephrologists is spent on ESKD patients.

Predicted Trainees = number of nephrologists requiring training predicted from the simple linear regression model graphically presented in Figure 13 of the report. The equation is : trainees= -1497.6+0.7545455x(calendar year)

Additional trainees required = training required on top of the predicted training, calculated from the equation: additional training=Total nephrologists required - Total nephrologists required in the previous year-adjusted number of anticipated retirement in the lprevious year+first year trainees in previous year-predicted number of first year trainees.

Adjusted Retiree Nos.= Retiree numbers anticipated for the given year based upon stated retirement plans from survey and adjusted for response rate.

Continuous Data for Table 14. Decreasing Growth Rate of ESKD

Predicted rate (%)	Year	Predicted ESKD population	growth rate	N_ESKD_Req	N_Tot_Req	Adjusted retiree	Reported retiree	Predicted Trainees	Additional trainees
5.0854	2007	16751		56	278	1.26582278	1	13	
4.9657	2008	17582.80441	0.04966	64.029077	291.0412591	8.86075949	7	17.527364	9.779717876
4.846	2009	18434.86711	0.04846	67.13192607	305.1451185	7.59493671	6	18.2819095	22.21007341
4.7263	2010	19306.15423	0.04726	70.30478229	319.5671922	5.06329114	4	19.036455	21.26246494
4.6066	2011	20195.51153	0.04607	73.54344239	334.2883745	5.06329114	4	19.7910005	19.02992792
4.4869	2012	21101.66394	0.04487	76.84326311	349.2875596	8.86075949	7	20.545546	19.30793072
4.3672	2013	22023.21581	0.04367	80.1991621	364.5416459	8.86075949	7	21.3000915	23.3603003
4.2475	2014	22958.6519	0.04247	83.60562151	380.0255523	8.86075949	7	22.054637	23.5901204
4.1278	2015	23906.33913	0.04128	87.05669435	395.7122471	11.3924051	9	22.8091825	23.79290874
4.0081	2016	24864.52911	0.04008	90.54601372	411.5727896	11.3924051	9	23.563728	26.49840214
3.8884	2017	25831.36146	0.03888	94.06680492	427.576386	7.59493671	6	24.3182735	26.64145592
3.7687	2018	26804.86798	0.03769	97.61190059	443.6904572	10.1265823	8	25.072819	22.95446247
3.649	2019	27782.97761	0.03649	101.1737588	459.880722	2.53164557	2	25.8273645	25.56230156
3.5293	2020	28763.52224	0.03529	104.7444843	476.1112923	6.32911392	5	26.58191	18.00767039
3.4096	2021	29744.2433	0.0341	108.3158523	492.344783	7.59493671	6	27.3364555	21.80805905
3.2899	2022	30722.79916	0.0329	111.8793355	508.542434	10.1265823	8	28.091001	23.03804222
3.1702	2023	31696.77334	0.0317	115.4261342	524.6642462	13.9240506	11	28.8455465	25.49384902
3.0505	2024	32663.68341	0.03051	118.9472084	540.6691291	13.9240506	11	29.600092	29.17438796
2.9308	2025	33620.99064	0.02931	122.4333132	556.5150599	7.59493671	6	30.3546375	29.01543597
2.8111	2026	34566.11031	0.02811	125.875036	572.1592547	6.32911392	5	31.109183	22.48458606
2.6914	2027	35496.4226	0.02691	129.2628368	587.5583489	7.59493671	6	31.8637285	20.97366261
2.5717	2028	36409.2841	0.02572	132.5870891	602.668587	13.9240506	11	32.618274	21.95062927

Legend for Table 15

Predictions if End Stage Kidney Disease incident growth rates were to continue to increase as they have since 2003 see page 61 of report.
The first row of figures is based on direct report from the survey results (eg anticipated retirement) or from figures from the 2008 ANZSN yearly report. These figures are used as the baseline in the subsequent calculations.

Predicted incidence rate= the incidence rate of ESKD patients predicted by using the quadratic equation graphically presented in Figure 15 of the report. the equation is :
rate= 3666.739 +(calendar year)x(-3.666104)+(calendar year)2x0.0009164

Predicted incidence= the incidence (number) of ESKD patients calculated from the previously predicted rate according to the equation: incidence =incidence in the previous year(1+ growth rate); here 2378 is the incidence of ESKD patient in 2006 as reported in table 1.9 of chapter 1: Stock and Flow. 2007.

Predicted existing rate = the growth rate of existing ESKD population (total ESKD population - the new cases developed in the year). It was calculated by using the equation: = 2.257167 +(Calendar year)x-0.0010991, this equation was obtained for the existing ESKD population (not shown in the report)

Predicted existing population = Existing population predicted from the previously calculated growth rate. The equation: existing population= existing population in the previous year (1+growth rate); here the existing population for year 2006 was used as 13649 which was obtained by subtracting the figures for 2006 in table 1.9 from that in table 1.10 of chapter 1: Stock and Flow. 2007.
NB: other variables defined previously

Continuous Data for Table 31. Workforce Predictions Based on Increasing Incident Growth Rate of End Stage Kidney Disease

Year	Predicted incidence rate	Predicted incidence	Predicted ESKD population	Adjusted retiree	Reported Retiree	N_ESKD_Req	N_Tot_Req	Predicted trainees	Additional training required	Predicted existing rate	Predicted existing population
2007	0.1723756	2787.9091	16751	1.2658227	1	56	278	13			13963.090
2008	0.1856176	3305.3941	17969.07192	8.8607594	7	60.07211675	300.3605837	17.527364	19.09	0.0501742	14663.677
2009	0.2006924	3968.7616	19352.06087	7.594936	6	64.69556495	323.4778247	18.2819095	31.22	0.0490751	15383.299
2010	**0.2176**	**4832.3642**	**20953.69257**	**5.0632911**	**4**	**70.04995426**	**350.2497713**	**19.036455**	**33.61**	**0.047976**	**16121.328**
2011	0.2363404	5974.4471	22851.49336	5.0632911	4	76.39446171	381.9723085	19.7910005	36.03	0.0468769	16877.046
2012	0.2569136	7509.3638	25159.00412	8.8607594	7	84.10866401	420.5433201	20.545546	42.87	0.0457778	17649.640
2013	**0.2793196**	**9606.8763**	**28045.07961**	**8.8607594**	**7**	**93.75705677**	**468.7852839**	**21.3000915**	**56.34**	**0.0446787**	**18438.203**
2014	0.3035584	12523.1243	31764.85714	8.8607594	7	106.1925855	530.9629275	22.054637	70.28	0.0435796	19241.732
2015	0.32963	16651.1218	36710.25305	11.392405	9	122.7254594	613.627297	22.8091825	90.77	0.0424805	20059.131
2016	0.3575344	22604.4706	43493.67683	11.392405	9	145.4030149	727.0150744	23.563728	124.02	0.0413814	20889.206
2017	0.3872716	31358.5401	53089.21162	7.5949367	6	177.4816937	887.4084683	24.3182735	171.03	0.0402823	21730.671
2018	**0.4188416**	**44492.8013**	**67074.95001**	**10.126582**	**8**	**224.2371918**	**1121.185959**	**25.072819**	**240.61**	**0.0391832**	**22582.148**
2019	0.4522444	64614.4215	88056.59106	2.5316455	2	294.3805802	1471.902901	25.8273645	360.08	0.0380841	23442.169
2020	0.48748	96112.6598	120421.8379	6.3291139	5	402.580319	2012.901595	26.58191	542.77	0.036985	24309.178
2021	0.5245484	146528.4017	171709.9366	7.5949367	6	574.0407407	2870.203704	27.3364555	862.87	0.0358859	25181.534
2022	0.5634496	229089.771	255147.2909	10.126582	8	852.9788246	4264.894123	28.091001	1401.53	0.0347868	26057.519
2023	0.6041836	367502.0536	394437.3914	13.924050	11	1318.63733	6593.186652	28.8455465	2337.66	0.0336877	26935.337
2024	0.6467504	605184.1538	632997.2766	13.924050	11	2116.163064	10580.81532	29.600092	4000.79	0.0325886	27813.122
2025	0.69115	1023457.182	1052146.126	7.5949367	6	3517.412874	17587.06437	30.3546375	7019.41	0.0314895	28688.944
2026	0.7373824	1778136.495	1807697.307	6.3291139	5	6043.283936	30216.41968	31.109183	12636.19	0.0303904	29560.812
2027	0.7854476	3174769.537	3205196.224	7.5949367	6	10715.2402	53576.20099	31.8637285	23365.35	0.0292913	30426.687
2028	**0.8353456**	**5826799.301**	**5858083.783**	**13.924050**	**11**	**19584.06614**	**89018.48244**	**32.618274**	**35449.12**	**0.0281922**	**31284.482**