

SECTION E SCOTTISH MORTALITY AUDIT RENAL REPLACEMENT THERAPY (SMARRT)

Data on all deaths in adult patients receiving RRT in Scotland are submitted to the SRR via the Scottish Mortality Audit of Renal Replacement Therapy (SMARRT). Cause and contributors to death as well as location of death are recorded. In addition, the clinicians responsible for a patient's care are asked to comment on the presence or absence of areas of clinical concern in patient management prior to death.

A five point scale is used:

1. **There were no areas of concern or for consideration in the management of this patient**
2. **There were areas for consideration but they made no difference to the eventual outcome**
3. **There were areas of concern but they made no difference to the eventual outcome**
4. **There were areas of concern which may have contributed to this patient's death**
5. **There were areas of concern which CAUSED the death of this patient who would have been expected to survive**

Those deaths classed as category 4 or 5 are further assessed through a process which may include a review of case note records, discussion at local morbidity and mortality meetings, critical incident review reports or procurator fiscal reports. From analysis of this additional information several recurring themes have emerged.

These themes are:

- **Hyperkalaemia**

Death due to hyperkalaemic arrest. Patient non-concordance with treatment is noted to contribute in >50% of cases.

- **Prescribing**

Death attributed to adverse drug effects - inappropriate drug choices, combinations or monitoring. Most cases involve the use of common drugs including antiplatelet agents/ anticoagulants, opioid analgesics or immunosuppressant medication.

- **Systems of care**

Deaths attributed to failures of communication, inadequate out of hours cover, delays in specialist renal input or inadequate staff training.

- **Infection**

Deaths attributed to severe infection due to delays in its recognition or management, sepsis in the context of immunosuppressive drugs or due to vascular access related infection.

- **Vascular Access**

Deaths attributed to complications of vascular access. Examples include fatal blood loss (intentional and accidental), inadequate dialysis following failure to address poor vascular access or cardiovascular compromise from AVF formation.

● Interventions

Deaths attributed as a direct consequence of an operation or procedure. Examples include recognised bleeding complications of angiography and viscus perforation during endoscopic procedures.

● Other

Deaths following a fall-related fracture, unexpected deterioration during dialysis or noncompliance.

E1 Categories of deaths by year 2008-2016												
Year	Cat 1		Cat 2		Cat 3		Cat 4		Cat 5		Missing	
	n	%	n	%	n	%	n	%	n	%	n	%
2008-2011*	1486	84.0	176	10.0	31	1.8	58	3.3	10	0.6	7	0.4
2012	318	79.9	52	13.1	7	1.8	13	3.3	2	0.5	6	1.5
2013	349	77.9	56	12.5	20	4.5	15	3.3	6	1.3	2	0.4
2014	336	77.8	42	9.7	21	4.9	23	5.3	6	1.4	4	0.9
2015	353	76.6	61	13.2	25	5.4	15	3.3	3	0.7	4	0.9
2016	363	77.2	61	13.0	22	4.7	12	2.6	1	0.2	11	2.3
Total	3205	80.6	448	11.3	126	3.2	136	3.4	28	0.7	34	0.9

* Number and percentage over four year period 2008-2011

E2 Themes of category 4 and 5 deaths by year 2008-2016															
Year	Hyper-kalaemia		Prescribing		Systems of Care		Infection		Vascular Access		Intervention		Other		Total
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	
2008-2011*	2	2.9	12	17.6	15	22.1	25	36.8	7	10.3	5	7.4	2	2.9	68
2012	2	13.3	1	6.7	4	26.7	3	20.0	3	20.0	2	13.3	0	0.0	15
2013	2	9.5	0	0.0	9	42.9	3	14.3	1	4.8	4	19.0	2	9.5	21
2014	0	0.0	0	0.0	7	24.1	11	37.9	5	17.2	2	6.9	4	13.8	29
2015	0	0.0	4	22.2	6	33.3	5	27.8	0	0.0	1	5.6	2	11.1	18
2016	1	7.7	1	7.7	3	23.1	6	46.2	0	0.0	0	0	2	15.4	13
Total	7	4.3	18	11.0	44	26.8	53	32.3	16	9.8	14	8.5	12	7.3	164

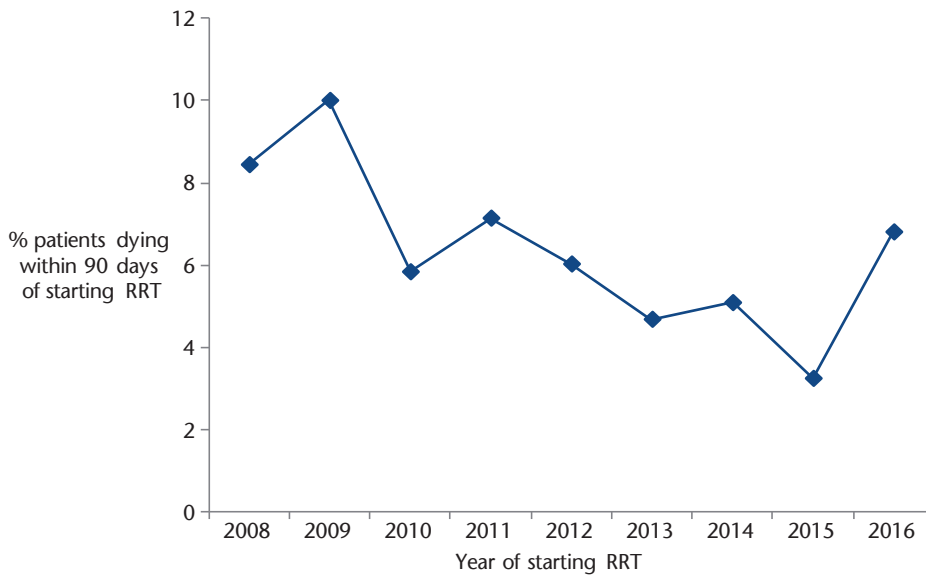
* Number and percentage over four year period 2008-2011

E3 Location of death by year 2008-2016														
Year	Usual Residence		Hospital		Hospice		Community Hospital		Other		Unknown		Missing	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
2008-2011*	375	21.2	1218	68.9	33	1.9	43	2.4	27	1.5	19	1.1	53	3.0
2012	93	23.4	270	67.8	12	3.0	6	1.5	8	2.0	0	0.0	9	2.3
2013	98	21.9	317	70.8	11	2.5	13	2.9	5	1.1	2	0.4	2	0.4
2014	85	19.7	303	70.1	17	3.9	10	2.3	3	0.7	0	0.0	14	3.2
2015	105	22.8	300	65.1	17	3.7	16	3.5	3	0.7	1	0.2	19	4.1
2016	99	21.1	308	65.5	21	4.5	11	2.3	4	0.9	1	0.2	26	5.5
Total	855	21.5	2716	68.3	111	2.8	99	2.5	50	1.3	23	0.6	123	3.1

* Number and percentage over four year period 2008-2011

E4 Factors contributing to death 2008-2016																		
Year	With-drawal		Access failure/ infection		Dialysis complications		Non-compliance		Peritoneal Infection		Trans-plant Complication		Health-care Associated Infection		Malignancy		Missing	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
2008-2011*	548	31.0	161	9.1	96	5.4	65	3.7	52	2.9	98	5.5	148	8.4	287	16.2	25	1.4
2012	127	31.9	30	7.5	21	5.3	23	5.8	7	1.8	28	7.0	21	5.3	61	15.3	11	2.8
2013	161	35.9	24	5.4	23	5.1	21	4.7	13	2.9	32	7.1	30	6.7	77	17.2	5	1.1
2014	147	34.0	32	7.4	19	4.4	24	5.6	11	2.5	35	8.1	28	6.5	80	18.5	10	2.3
2015	171	37.1	37	8.0	18	3.9	10	2.2	9	2.0	40	8.7	26	5.6	88	19.1	9	2.0
2016	159	33.8	20	4.3	23	4.9	21	4.5	8	1.7	22	4.7	20	4.3	80	17.0	11	2.3
Total	1313	33.0	304	7.6	200	5.0	164	4.1	100	2.5	255	6.4	273	6.9	673	16.9	71	1.8

* Number and percentage over four year period 2008-2011

E5 Proportion of patients who died within 90 days of starting RRT 2008-2016

The percentage of patients who die at ≤ 90 days after commencing RRT is decreasing.

Comparing each era 2008-2011 and 2012-2016 demonstrates a significant decline over time, $p=0.001$.

Hyperkalaemia related deaths 2008-2015 – ‘Are we doing enough?’

We analysed all data relating to all death 2008-2015 where hyperkalaemia was the primary cause of death, or felt to be a significant contributor to death from clinician comments contributed to SMARRT.

Patient demographics were compared between groups, including analyses of last available serum potassium results. A directed case note analysis was performed by SMARRT representatives to investigate efforts taken to reduce hyperkalaemia prior to death.

In the 8 years 2008-2015 there were 3,501 deaths; 79% HD, 6.3% PD and 14.7% in patients with a renal transplant.

In 28 deaths (0.8%) hyperkalaemia was either a primary cause ($n=16$) or significant contributor to death. Those who died from hyperkalaemia were younger when starting RRT (median age 44.4 vs 66.5 years, $p<0.001$), more likely to have non-concordance identified in SMARRT as a contributor to death (50 vs 3.7%, $p<0.001$) and a shorter than average duration of final hospital admission (median 1 vs 5 days, $p=0.002$). Serum phosphate was significantly higher in those who died from hyperkalaemia (1.66 vs 1.28mmol/L, $p=0.002$), possibly acting as a further surrogate marker of poor concordance with treatment goals.

Case note review was possible in 26 of 28 cases (93%). In 16 cases, hyperkalaemia was a recognised issue prior to death, with the remaining cases being unexpected or a complication of other illness.

In all 16 cases attempts were made to reduce serum potassium; dietician input in 81.3%, review of dialysis access in 62.5% and alteration of dialysis prescription in 25%.

At case note review, patient non-concordance was described in 11 (68.8%) cases. Of these 11, 4 were referred to psychiatric services and a further 3 were known to psychiatric services for other reasons. Only 1 unit had access to renal-specific psychiatric liaison during the study period. No unit has access to a renal-specific psychologist.

Our review has confirmed that hyperkalaemia related deaths are rare in people with end-stage renal disease on RRT when recognised measures are taken to reduce serum potassium. However those patients at risk are often young and have recognised poor concordance with treatment.

Strategies to support such patients and minimise this risk must be prioritised.

Data on hyperkalaemia related deaths between 01 January 2008 and 31 December 2015 using SMARRT data were presented to the European Renal Association meeting in Madrid, June 2017.

Reference: HYPERKALAEMIA ASSOCIATED DEATHS IN RRT - ARE WE DOING ENOUGH? Nephrology Dialysis Transplantation, Volume 32, Issue supplement 3, May 2017, Pages ii34, <https://doi.org/10.1093/ndt/gfx111.S0060>