Global trends in ESRD epidemiology and impact on Vascular Access

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End Stage Renal Disease (ESRD) and Vascular Access

ESRD – 3 replacement therapy options:
- Kidney transplant (Tx)
- Peritoneal dialysis (PD)
- Hemodialysis (HD)

To perform HD the creation and maintenance of a permanent vascular access (AVF, AVG/shunt or dialysis catheter) is necessary.

2015 ~ 3.572 pat. on RRT

Grassmann, NDT 2005, 2014 estimated

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Worldwide ESRD Treatment Modalities / 2001 – 2015

Almost no change in RRT treatment modality!


HD - the Access relevant Burden!

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Dialysis population by geographical split

(n) in 000


Others = Asia, Latin America, Middle East, Africa

Annual Growth rates

Others ~ 9%
China ~ 15%
Japan ~ 1-2%
EU ~ 2%
USA ~ 3-4%

Data Fresenius Medical Care 2014

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The 15 largest dialysis countries 2013 - HD vs PD

<table>
<thead>
<tr>
<th>Country</th>
<th>HD %</th>
<th>PD %</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>92%</td>
<td>8%</td>
</tr>
<tr>
<td>China</td>
<td>88%</td>
<td>12%</td>
</tr>
<tr>
<td>Japan</td>
<td>97%</td>
<td>3%</td>
</tr>
<tr>
<td>Brazil</td>
<td>94%</td>
<td>6%</td>
</tr>
<tr>
<td>Mexico</td>
<td>40%</td>
<td>60%</td>
</tr>
<tr>
<td>Germany</td>
<td>95%</td>
<td>5%</td>
</tr>
<tr>
<td>India</td>
<td>93%</td>
<td>7%</td>
</tr>
<tr>
<td>Taiwan</td>
<td>90%</td>
<td>10%</td>
</tr>
<tr>
<td>Turkey</td>
<td>92%</td>
<td>8%</td>
</tr>
<tr>
<td>Thailand</td>
<td>75%</td>
<td>25%</td>
</tr>
<tr>
<td>Korea</td>
<td>86%</td>
<td>14%</td>
</tr>
<tr>
<td>Italy</td>
<td>91%</td>
<td>9%</td>
</tr>
<tr>
<td>France</td>
<td>93%</td>
<td>7%</td>
</tr>
<tr>
<td>Egypt</td>
<td>100%</td>
<td>0%</td>
</tr>
<tr>
<td>Malaysia</td>
<td>91%</td>
<td>9%</td>
</tr>
</tbody>
</table>

Data Fresenius Medical Care 2014

4 European countries

HD - the Access relevant Burden!

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SUMMARY
EUROPE
ESRD and RRT in Europe

- Approx. 50 Mill. Patients with chronic kidney disease (10% of the population)
- CKD stages 3–5 prevalence varied from 1.0% to 5.9% (approx. 36 Mill.)
- Approx. 350,000 Patients with ESRD on HD in 2013
  - Approx. 5,400 dialysis centers
- Annual growth rate of Dialysis population approx. 2 %

Data Fresenius Medical Care 2014, ERCPA providers Info Chart
Incidence of RRT in Europe

Prevalence of RRT in Europe

Prevalence (pmp) - Adjusted for age and gender

Distribution of the main pathologies contributing to Chronic Kidney Disease (CKD)

DM – Diabetes Mellitus
HT – Hypertension
GN – Glomerulonephritis
MS – Metabolic Syndrome
UD – Urological Diseases

7 large publications on Global disease trends

1990 vs 2010

Published Dec 15, 2012

Global death ranks with 95% UIs for the top 25 causes in 1990 and 2010, and the percentage change with 95% CIs between 1990 and 2010

<table>
<thead>
<tr>
<th>Mean rank (95% UI)</th>
<th>Disorder</th>
<th>1990</th>
<th>Disorder</th>
<th>Mean rank (95% UI)</th>
<th>% change (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (1 to 2)</td>
<td>Ischaemic heart disease</td>
<td>1.0 (1 to 1)</td>
<td>Ischaemic heart disease</td>
<td>1.0 (1 to 1)</td>
<td>35 (29 to 39)</td>
</tr>
<tr>
<td>2 (3 to 7)</td>
<td>Stroke</td>
<td>2.0 (2 to 2)</td>
<td>Stroke</td>
<td>2.0 (2 to 2)</td>
<td>26 (16 to 33)</td>
</tr>
<tr>
<td>3 (3 to 4)</td>
<td>COPD</td>
<td>3.4 (3 to 4)</td>
<td>COPD</td>
<td>3.4 (3 to 4)</td>
<td>-7 (-12 to 0)</td>
</tr>
<tr>
<td>4 (3 to 4)</td>
<td>Lower respiratory infections</td>
<td>3.6 (3 to 4)</td>
<td>Lower respiratory infections</td>
<td>3.6 (3 to 4)</td>
<td>-18 (-24 to -13)</td>
</tr>
<tr>
<td>5 (5 to 5)</td>
<td>Diabetes</td>
<td>5.8 (3 to 10)</td>
<td>Diabetes</td>
<td>5.8 (3 to 10)</td>
<td>48 (24 to 64)</td>
</tr>
<tr>
<td>6 (6 to 7)</td>
<td>Tuberculosis</td>
<td>6.4 (5 to 8)</td>
<td>Tuberculosis</td>
<td>6.4 (5 to 8)</td>
<td>106 (223 to 465)</td>
</tr>
<tr>
<td>7 (7 to 9)</td>
<td>Premature birth complications</td>
<td>6.7 (5 to 9)</td>
<td>Premature birth complications</td>
<td>6.7 (5 to 9)</td>
<td>-42 (-49 to -35)</td>
</tr>
<tr>
<td>8 (7 to 12)</td>
<td>Lungs cancer</td>
<td>8.4 (5 to 11)</td>
<td>Lungs cancer</td>
<td>8.4 (5 to 11)</td>
<td>42 (18 to 66)</td>
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<tr>
<td>9 (4 to 15)</td>
<td>Malaria</td>
<td>9.0 (7 to 13)</td>
<td>Malaria</td>
<td>9.0 (7 to 13)</td>
<td>93 (68 to 102)</td>
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<tr>
<td>10 (3 to 14)</td>
<td>Road injury</td>
<td>10.1 (8 to 13)</td>
<td>Road injury</td>
<td>10.1 (8 to 13)</td>
<td>-38 (-55 to -23)</td>
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<tr>
<td>11 (8 to 14)</td>
<td>Protein-energy malnutrition</td>
<td>11.0 (6 to 13)</td>
<td>Protein-energy malnutrition</td>
<td>11.0 (6 to 13)</td>
<td>21 (-9 to 56)</td>
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<tr>
<td>12 (11 to 16)</td>
<td>Cirrhosis</td>
<td>12.1 (8 to 14)</td>
<td>Cirrhosis</td>
<td>12.1 (8 to 14)</td>
<td>33 (25 to 41)</td>
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<tr>
<td>13 (9 to 18)</td>
<td>Stomach cancer</td>
<td>13.0 (7 to 22)</td>
<td>Stomach cancer</td>
<td>13.0 (7 to 22)</td>
<td>-2 (-10 to 5)</td>
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<tr>
<td>14 (6 to 20)</td>
<td>Self harm</td>
<td>14.1 (11 to 20)</td>
<td>Self harm</td>
<td>14.1 (11 to 20)</td>
<td>32 (8 to 49)</td>
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<tr>
<td>15 (8 to 19)</td>
<td>Diabetes</td>
<td>14.2 (12 to 18)</td>
<td>Diabetes</td>
<td>14.2 (12 to 18)</td>
<td>48 (39 to 56)</td>
</tr>
<tr>
<td>16 (12 to 20)</td>
<td>Congenital anomalies</td>
<td>14.3 (12 to 18)</td>
<td>Congenital anomalies</td>
<td>14.3 (12 to 18)</td>
<td>-28 (-39 to -17)</td>
</tr>
<tr>
<td>17 (13 to 20)</td>
<td>Neonatal asphyxia*</td>
<td>14.4 (12 to 20)</td>
<td>Neonatal asphyxia*</td>
<td>14.4 (12 to 20)</td>
<td>83 (49 to 78)</td>
</tr>
<tr>
<td>18 (24 to 22)</td>
<td>Hypertensive heart disease</td>
<td>16.0 (13 to 22)</td>
<td>Hypertensive heart disease</td>
<td>16.0 (13 to 22)</td>
<td>-10 (-30 to 10)</td>
</tr>
<tr>
<td>19 (5 to 16)</td>
<td>Measles</td>
<td>16.1 (15 to 21)</td>
<td>Measles</td>
<td>16.1 (15 to 21)</td>
<td>46 (36 to 61)</td>
</tr>
<tr>
<td>20 (12 to 36)</td>
<td>Neonatal sepsis</td>
<td>17.0 (12 to 32)</td>
<td>Neonatal sepsis</td>
<td>17.0 (12 to 32)</td>
<td>20 (40 to 55)</td>
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<tr>
<td>21 (29 to 36)</td>
<td>Colorectal cancer</td>
<td>17.1 (13 to 30)</td>
<td>Colorectal cancer</td>
<td>17.1 (13 to 30)</td>
<td>-2 (-10 to 5)</td>
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<tr>
<td>22 (18 to 26)</td>
<td>Meningitis</td>
<td>17.2 (12 to 32)</td>
<td>Meningitis</td>
<td>17.2 (12 to 32)</td>
<td>-2 (-10 to 5)</td>
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<tr>
<td>23 (21 to 26)</td>
<td>Other cardiovascular and circulatory</td>
<td>18.7 (15 to 21)</td>
<td>Other cardiovascular and circulatory</td>
<td>18.7 (15 to 21)</td>
<td>86 (65 to 105)</td>
</tr>
<tr>
<td>24 (7 to 28)</td>
<td>Liver cancer</td>
<td>18.9 (14 to 20)</td>
<td>Liver cancer</td>
<td>18.9 (14 to 20)</td>
<td>83 (49 to 78)</td>
</tr>
<tr>
<td>25 (20 to 27)</td>
<td>Rheumatic heart disease</td>
<td>19.0 (13 to 33)</td>
<td>Rheumatic heart disease</td>
<td>19.0 (13 to 33)</td>
<td>86 (65 to 105)</td>
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<td>30 (5 to 33)</td>
<td>Falls</td>
<td>19.1 (15 to 25)</td>
<td>Falls</td>
<td>19.1 (15 to 25)</td>
<td>-32 (-42 to -23)</td>
</tr>
<tr>
<td>31 (5 to 33)</td>
<td>HIV/AIDS</td>
<td>19.2 (15 to 25)</td>
<td>HIV/AIDS</td>
<td>19.2 (15 to 25)</td>
<td>-32 (-42 to -23)</td>
</tr>
<tr>
<td>32 (5 to 33)</td>
<td>Meningitis</td>
<td>19.3 (15 to 25)</td>
<td>Meningitis</td>
<td>19.3 (15 to 25)</td>
<td>-32 (-42 to -23)</td>
</tr>
<tr>
<td>33 (5 to 33)</td>
<td>Chronic kidney disease</td>
<td>19.4 (16 to 25)</td>
<td>Chronic kidney disease</td>
<td>19.4 (16 to 25)</td>
<td>-32 (-42 to -23)</td>
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<tr>
<td>34 (5 to 33)</td>
<td>Measles</td>
<td>19.5 (16 to 25)</td>
<td>Measles</td>
<td>19.5 (16 to 25)</td>
<td>-32 (-42 to -23)</td>
</tr>
<tr>
<td>35 (5 to 33)</td>
<td>Communicable, maternal, neonatal, and nutritional disorders</td>
<td></td>
<td></td>
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<tr>
<td>36 (5 to 33)</td>
<td>Non-communicable diseases</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>37 (5 to 33)</td>
<td>Injuries</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

18 Chronic Kidney Disease
27 diabetes
14 HT
Trends for major underlying diseases/factors

- Hypertension
- Obesity
- ESRD
- Age
- Diabetes
Trends for major underlying diseases

Diabetes
Trends in **Diabetic disease** worldwide
2010 to 2030

439 Mill. diabetics in 2030

- **285 Mill. diabetics in 2010**
- **+154 Mill.**
- **+54% (ann. 2.2%)**

7.7% of the adult population

6.4% of the adult population

*Shaw JE, Diab Res Clin Pract (2010); 87:4-14*

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Diabetes: A global emergency

Estimated number of people with diabetes worldwide and per region in 2015 and 2040 (20-79 years)

- **North America and Caribbean**
  - 2015: 44.3 million
  - 2040: 60.5 million

- **Europe**
  - 2015: 59.8 million
  - 2040: 71.1 million

- **Middle East and North Africa**
  - 2015: 35.4 million
  - 2040: 72.1 million

- **South and Central America**
  - 2015: 29.6 million
  - 2040: 48.8 million

- **Africa**
  - 2015: 14.2 million
  - 2040: 34.2 million

- **South East Asia**
  - 2015: 78.3 million
  - 2040: 140.2 million

- **Western Pacific**
  - 2015: 153.2 million
  - 2040: 214.8 million

**World Diabetes Prev. (Mill.)**

- 2015: 415
- 2040: 642

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Diabetes prevalence estimates in European Region 2010 – 2030

Europe 2010
pop 646,4 Mill.

Europe 2030
pop 659,3 Mill.

http://www.idf.org/diabetesatlas/
Diabetes prevalence Europe / country - 2010 - 2030

Only in age groups 20-79 years

National - 2010
National - 2030

http://www.idf.org/diabetesatlas/
Trends for major underlying factors

Age
The global ageing of the population up to 2050 and its impact on ESRD

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The Global ageing and population 2002 - 2050

- The elderly population is projected to grow most rapidly!

Source: U.S. Census Bureau, An aging world – International population Reports, Nov 2001
Population age structure
EU-27 1990 - 2060

(1) Excluding French overseas departments in 1990; 2010, provisional; 2020-2060 data are projections (EUROPOP2010 convergence scenario).

Source: Eurostat (online data codes: demo_pjanind and proj_10c2150p)
Incidence of ESRD RRT per million age related population (pmarp) at Day 1 in 2009

by age group (pmarp)

Median Age incident & prevalent ESRD population Europe - 2012

Prevalent pat. - Median

Germany - prev.: 1996: 59 years, 2006: 66 years, 2014: 71 years

Average 62.3 y

Incident pat. - Median

Germany - incid.: 1996: 63 years, 2006: 70 years, 2014: 72 years

Average 67.7 y

Average 67.1 y

61.3 y

Age structure + ESRD

- **Significant increase of the older population** over the next 35 years – Life longer

- **Increase in age specific diseases** (mainly non communicable diseases) many of them also causing ESRD
  - Diabetes
  - Hypertension
  - Cardiovascular Diseases

- **ESRD / HD population is getting older**
Trends for major underlying diseases

Hypertension
Trends in hypertensive (HT) disease worldwide - 2000 to 2025

26% of the adult population in 2000

29% of the adult population in 2017

+60% increase

972 Mill. HT adults in 2000

+ 588 Mill.

1,560 Bill. HT adults in 2025

Prevalence of high Blood pressure by sex (%) - 2015

Central and Eastern Europe
High Income Western
Sub-Saharan Africa
Others

Men more likely have high BP
Women more likely have high BP

Global prevalence of Hypertension (2000 and 2025)

Prevalence of HT and Overweight/Obesity

HYDRA Study – n = 38,873; http://www.hydra-studie.de

Bramlage P. Hypertension in Overweight and Obese Primary Care Patients Is Highly Prevalent and Poorly Controlled. Am J Hypertens 2004;17:904–910
Trends for major underlying factors

Obesity
Facts on Worldwide Obesity - 2014

2014

% Obese BMI ≥ 30

< 2%
2% - 5%
5% - 10%
10% - 15%
15% - 20%
20% - 25%
25% - 30%
> 30%

www.metrocosm.com
Age-adjusted Prevalence of Obesity and Diagnosed Diabetes Among US Adults

Obesity (BMI > 30 kg / m²)

Diabetes

NOTE: Survey method changes in 2011 may impact trends. [CDC website link]

CDC’s Division of Diabetes Translation. United States Diabetes Surveillance System available at [CDC diabetes data link]
In the WHO/European Region

over 50% of people are overweight or obese

over 20% of people are obese

1 in 3 11-year-olds is overweight or obese

Overweight  BMI ≥ 25 kg/m²

Obese  BMI ≥ 30 kg/m²

Several direct and indirect effects on the kidney

www.euro.who.int/obesity

http://www.euro.who.int/en/health-topics/noncommunicable-diseases/obesity
Europe Obesity - 2014

Data from WHO "World health statistics 2015"
Association between obesity and KD based on cohort studies in the general populations (Metaanalysis)

Overweight (BMI 25 ≥–BMI ≤ 30) vs normal weight

Obese (BMI ≥ 30) vs normal weight

Test for heterogeneity: $Q=37.11$, $P=0.003$;  
Pooled RR (95% CI): 1.40 (1.30 –1.50).

Test for heterogeneity: $Q=40.96$, $P=0.001$;  
Pooled RR (95% CI): 1.83 (1.57–2.13).

Strong correlation with Kidney Diseases

Alice RZ, Advances in Chronic Kidney Disease (2013)20:121-127
Higher BMI was a risk factor for ESRD in adjusted multivariable models.

320,252 adult members of Kaiser Permanente who volunteered for screening health checkups between 1964 and 1985 and who had height and weight measured.

Hsu C. Ann Intern Med. 2006;144:21-28
CO-MORBIDITY

- Diabetes
- CHD
- Cardiac
- pAOD
- Cerebrovascular
- Maglignoma
- Infections
- COPD
- Other chronic diseases
HD - Dialysis patients and Comorbidity

Dialysis population (HD) prevalent comorbidities

- 30% diabetes mellitus needing treatment
- 27% CHD
- 54% other cardiac diseases,
- 13% peripheral arterial occlusion disease (pAOD),
- 11% cerebrovascular diseases,
- 9% malignoma,
- 4% chronic infections,
- 2% demecia, 3% Polyneuropthia, 3% depression
- 46% had other chronic diseases

Only 14% of the dialysis patients had no additional diseases
Komorbiditativa sjukdomar vid inklusion i CKD-registret 2014-2015

SVENSKT NJURREGISTER - ÅRSRAPPORT 2016
Co-morbidities / Multimorbidity

- Elderly nephrologic / ESRD patients
  - Difficult vessel situation
  - Multimorbidity
  - Malnutrition
  - More complications
  - Compliance issues
  - Often no transplant candidates
  - Social and psychological issues

- Vascular access challenges
- More complex access revisions

Picture: courtesy M.K. Widmer, Bern
The 4 bad guys for the kidney will grow further

Hypertension

Obesity

Age

ESRD

Diabetes
Only 11 out of these 25 countries provide RRT above the 2013 world average of 450 pmp.
Dialysis Patients 2013 & 2030 (Millions)

In the next 13 years → PLUS 4 Million dialysis patients

6% growth est.

Asia-Pacific: +2.300.000
North America: +632.000
Europe: +319.000
Latin America: +308.000
Middle East: +210.000
Africa: +156.000
Conclusion – Epidemiologic Aspects

- Further increase prevalent HD population
- High prevalence of Diabetes, HT and Obesity
- Increasing Age of the incident and prevalent patients

*Elderly multimorbid nephrologic patient with ESRD*

- More complex cases / challenges in Vascular Access

- Interdisciplinary Challenge

- Adequate training and education – IMPORTANT role
Future Vascular Access Challenges

The access challenge is
individual and locally different in the various regions or countries in the world.

The biggest challenge is however
how can we provide adequate and high standard vascular access for all HD patients worldwide!
Thank you very much for your attention

Acknowledgement:
All people around the world who run and contribute to the various ESRD registries