Cardioprotective Haemodialysis

FX CorDiax

Designed to Dialyse. Built for Cardioprotection

Cardioprotective Haemodialysis SPOT

FRESENIUS MEDICAL CARE

Protect your Patient

Cardioprotective Haemodialysis

The reduction of risk factors for cardiovascular diseases (CVD) is core to the development of dialysis systems and products at Fresenius Medical Care. Outstanding cardioprotection must be reflected in all levels of product development and application.

Wide-ranging cardioprotection

There have been tremendous improvements in the quality and efficacy of haemodialysis (HD) therapy in recent years. Despite this, cardiovascular diseases (CVD) remain the leading cause of death for patients with end-stage renal disease (ESRD).

Cardioprotective

Services

Over 30 years of experience in dialysis at your service.

- Project Planning and Consulting
- Training and Education
- Technical Services
- Water Quality Service (WQS)
- Medical Information Services

Products

State-of-the-art technologies enable advanced cardioprotective therapies.

- CorDiax product line:
  - 5008 CorDiax and 5008S CorDiax
  - FX CorDiax haemo*dia*filter
  - BCM-Body Composition Monitor
- Classix product line:
  - 4008S classix
  - FX classix dialysers
- Therapy Data Management System (TDMS)
- Online Purification Cascade (OPC)

Moreover, both overall and cardiovascular mortality are markedly greater in ESRD patients than in the general population. This is why we put Cardioprotective Haemodialysis on the SPOT. A comprehensive approach that includes services, products and therapies is needed to achieve the best therapeutic performance – meaning improved clinical outcomes and better quality of life, enhanced control of therapy costs, and simpler, safer handling.

Haemodialysis

Outcomes

Achieving better outcomes with cardioprotective therapies.

- Reduced mortality risk
- Fewer cardiovascular complications
- Optimised use of resources

Therapies

Cardioprotective therapies designed by the world market leader in haemodialysis.

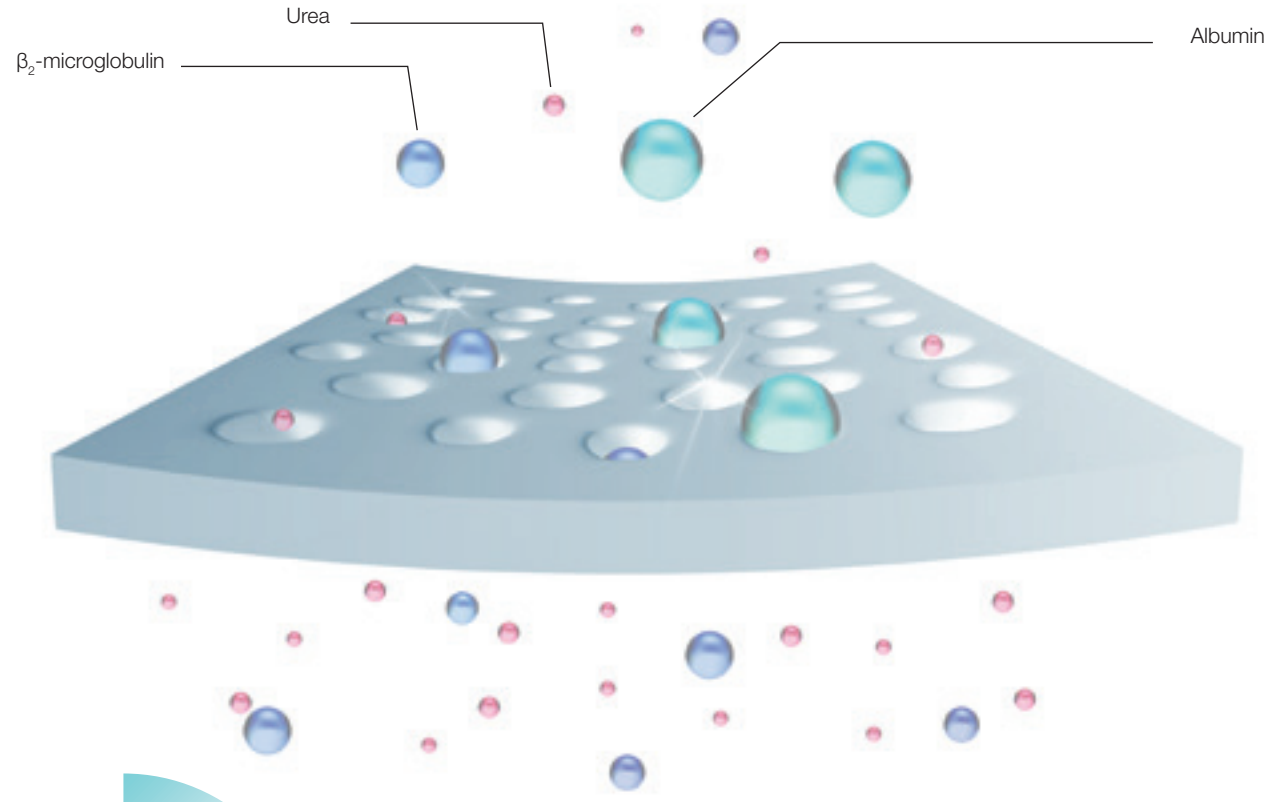
- High-Flux dialysis
- HighVolume**HDF**®
- Advanced Fluid Management

Cardioprotection – at the heart of long-term haemodialysis

The effects of chronic kidney disease (CKD) as well as the effects of dialysis itself can lead to cardiovascular diseases [e.g. atherosclerosis and left ventricular hypertrophy (LVH)], the largest causes of death in haemodialysis patients.[1] Improved middle molecule removal, through enhanced High-Flux membranes for haemodiafiltration, can substantially reduce these risks.[2]

A number of large, multi-centre studies show that the use of High-Flux membranes improves patient survival and quality of life.[3]

Middle molecule removal means the selective filtration of a broad range of uraemic toxins with a molecular weight higher than 500 Dalton (Da). At the same time, the membrane should prevent the loss of substances known to be associated with patient survival, such as serum albumin. This high sieving potential must be accompanied by excellent biocompatibility.
Innovative membranes such as Helixone® provide enhanced filtration, with high sieving of low molecular weight (LMW) and middle molecular weight (MMW) substances as well as volume exchange, while



reducing the induction of inflammatory cascades that are central to many aspects of CVD. State-of-the-art technologies such as Fresenius' Nano Controlled Spinning (NCS™) and INLINE steam sterilisation are the result of continual innovation at Fresenius Medical Care.

Advances in material and production technologies have permitted improvements in the wall structure by opening up the support region of the membrane. The Helixone®*plus* membrane in the new FX CorDiax dialysers improves the clearance of middle molecules while the loss of essential blood components such as albumin is curtailed. The Helixone®*plus* membrane upgrades the FX-class® dialyser into the CorDiax product line, which provides products for superior cardioprotective therapies.

SPOT on:

- CVD are the largest causes of death in dialysis patients.
- High-Flux membranes enhance middle molecule removal and reduce risk factors.
- FX CorDiax for enhanced survival and better outcomes.

The new FX CorDiax

Advances in fibre design allow better removal of uraemic toxins

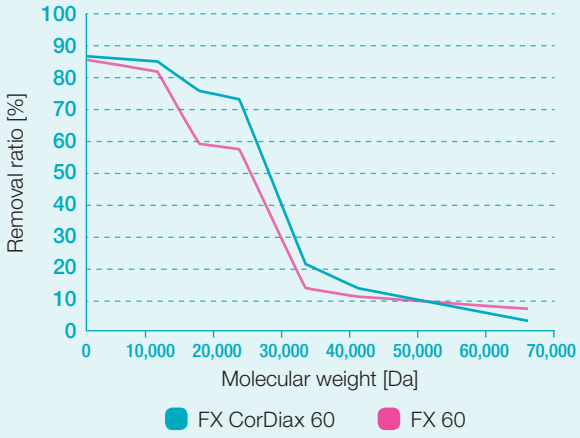
- The fibre support region underneath the inner surface has been “opened up”, optimising porosity and therefore also the convective filtration (“flushing”) of larger uraemic toxins such as β_2-microglobulin (≈ 11,800 Da) or myoglobin (≈ 17,000 Da).
- At the same time the size of the pores of the inner surface area was not increased to avoid flushing of albumin.

FX CorDiax eliminates more middle molecules than FX

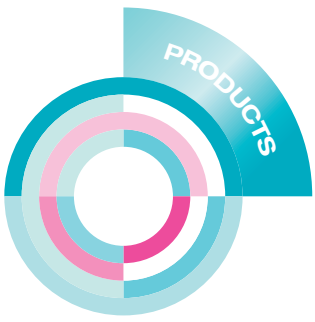
Maduell et al. determined middle molecule removal of FX CorDiax 60 compared to FX 60 in HDF postdilution treatments. Significantly higher removal rates were observed with FX CorDiax for

- Urea (60 Da)
- β_2-microglobulin (11.8 kDa)
- Myoglobin (17.2 kDa)
- Prolactin (22.9 kDa)
- α_1-microglobulin (33 kDa)

The authors concluded that “… treating patients with online haemodiafiltration and FX CorDiax 60 instead of FX 60 dialysers results in significantly increased reduction ratios of middle sized molecules without clinically relevant changes in albumin loss.



Removal ratios of FX 60 and FX CorDiax 60 dialysers in post-dilution HDF[1] (Q_B = 400 mL/min, Q_D = 500 mL/min)

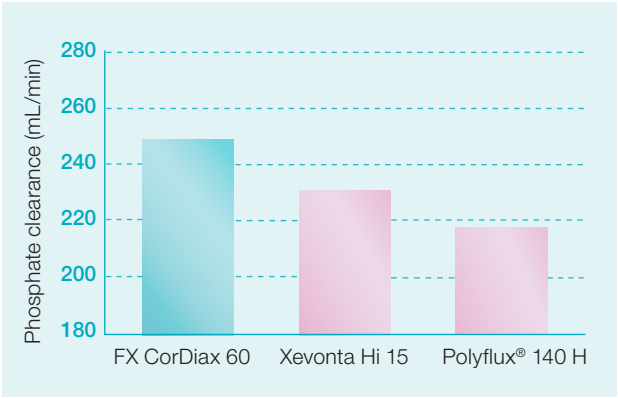


1 Maduell et.al.; ERA-EDTA Congress 2013, May 20, Poster Number MP 390.

- The benefits of the advanced fibre design is not limited to better middle molecule removal. The reduced transmembrane resistance of the FX CorDiax improves the removal of low molecular weight substances, e.g. phosphate.

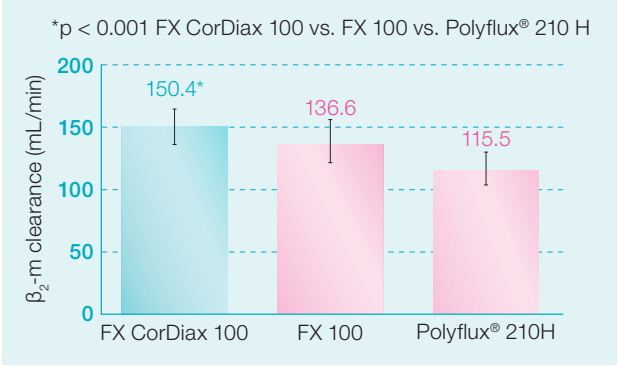
SPOT on:

- High selective permeability for middle molecules
- Improved removal of phosphate



Comparison of aqueous in-vitro clearances of phosphate (Q_B = 300 mL/min, Q_D = 500 mL/min). Investigations carried out by EXcorLab GmbH, an Accredited Calibration and Testing Laboratory.

- In a postdilution HDF treatment the use of FX CorDiax 100 dialysers resulted in a significantly higher clearance of β_2-microglobulin than FX 100 and Polyflux® 210H dialysers. The albumin loss was low and similar for all dialysers.[2]



FX CorDiax offers significantly better β_2-m clearance than FX and Polyflux®[2]

	Albumin loss (g/4h)
FX CorDiax 100	1.74 ± 1.01
FX 100	2.10 ± 1.00
Polyflux® 210H	1. 31 ± 0.12

Comparison of albumin loss in a post-dilution HDF treatment (Q_B = 350 mL/min, Q_D = 800 mL/min, Q_S = 80 mL/min)[2]

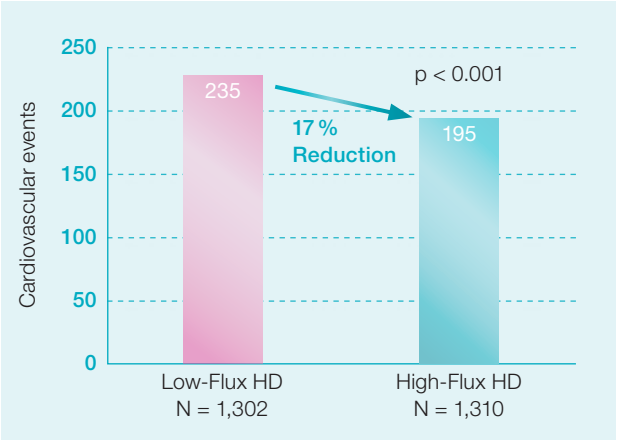
2 Bock A. et al., J Am Soc Nephrol (2013); 24: SA-PO404.

The new FX CorDiax

Clearing middle molecules improves survival rates

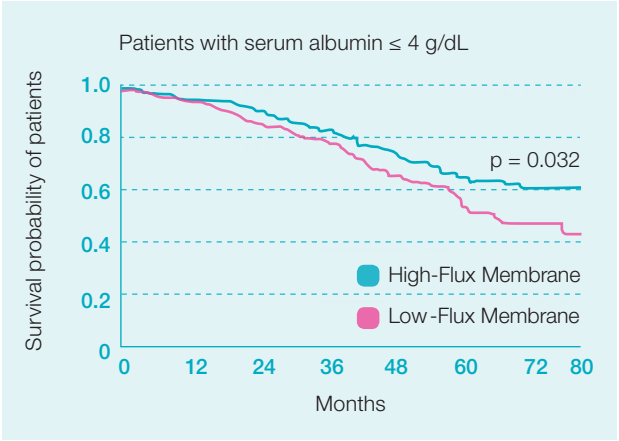
The use of High-Flux membranes instead of Low-Flux membranes improved patient survival rates.

- A meta-analysis of 33 randomised controlled trials and 3,820 patients showed a reduction in cardiovascular mortality of 17 %.[1]
- All-cause mortality in diabetics and patients with albumin ≤ 4 g/dl was significantly improved.[2]



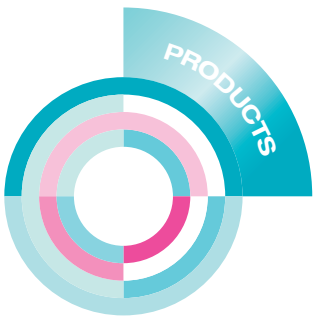
Comparison of cardiovascular mortality when High-Flux instead of Low-Flux dialysers were used[1]

(Graph adapted from original publication)



Comparison of all-cause mortality when High-Flux instead of Low-Flux dialysers were used[2]

(Graph adapted from original publication)



1 Palmer S.C. et al., Cochrane Database of Systematic Reviews (2012); Issue 9.
2 Locatelli F. et al., J Am Soc Nephrol (2009); 20: 645-654.

Cardioprotective Haemodialysis

Innovation at all Levels

FX-class® Design

Cardioprotective Haemodialysis SPOT

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Protect your Patient

Superior by Design

Several state-of-the-art technologies have been combined to create the distinctive, functional features of FX-class® dialysers, which are refined and optimised for performance, safety and handling:

- Design of dialyser housing and fibre bundle for more uniform dialysate flow.
- Refined blood inlet port for improved haemodynamics.

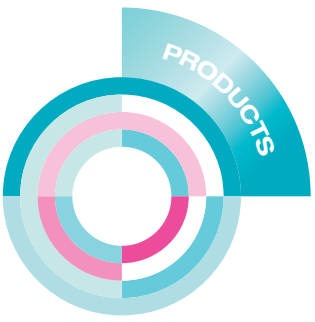
Advances in material and production technologies have permitted improvements in the wall structure of the Helixone®*plus* membrane of the FX CorDiax.

- More porous Helixone®*plus* membrane wall for higher clearance of middle molecules.

Optimised dialysate flow
The 3-dimensional microwave structure of the fibre ensures uniform radial dialysate flow around each fibre within the bundle by preventing fluid channelling, thereby further enhancing clearance values and improving the overall performance of the dialyser.

Better haemodynamics
The lateral blood-inlet port ensures more homogenous blood flow in the dialyser header, preventing stagnation zones. The design essentially eliminates the risk of kinking, contributing to improved safety.

Enhanced convection
The more open structure of the Helixone®*plus* membrane support region serves to reduce diffusion resistance and increases convective filtration. This facilitates clearance of a broad range of uraemic toxins, especially the middle molecules.

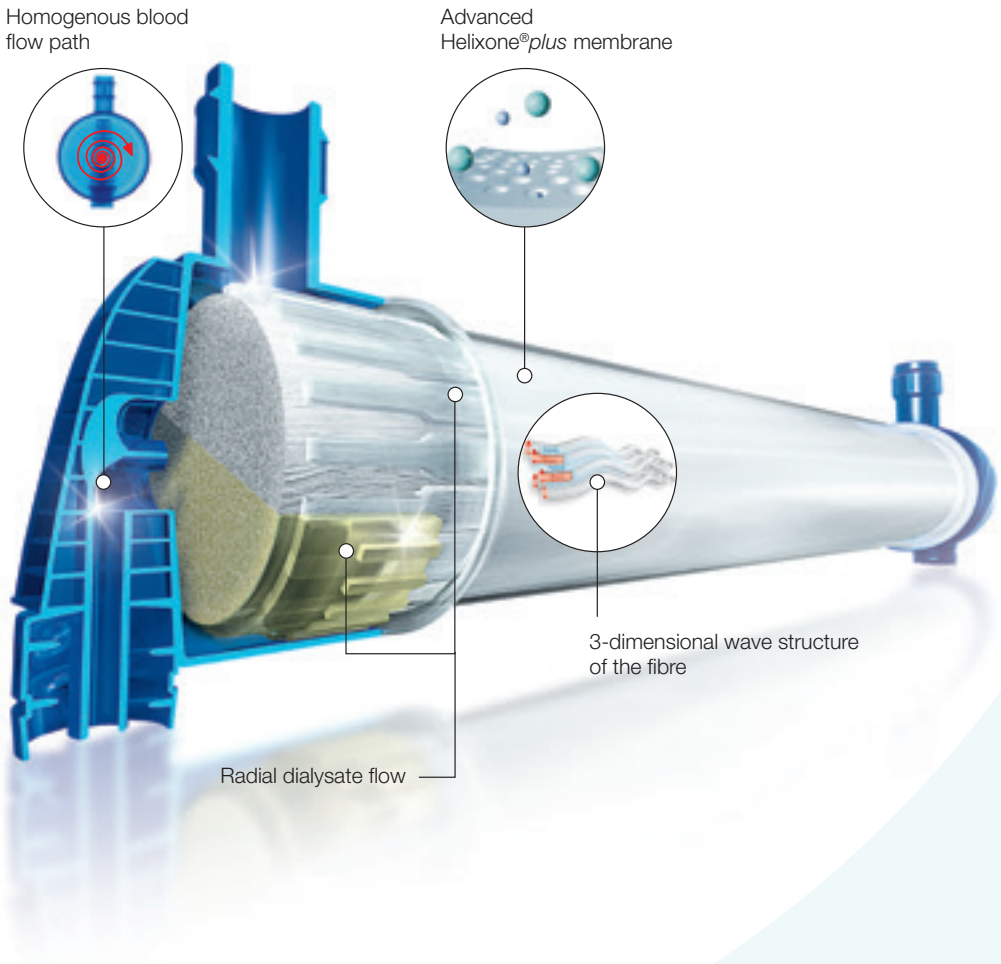


Kind to the environment

Advanced design goes beyond direct functionality, it also has to be easy on the environment. FX-class® dialysers weigh less than half as much as previous dialysers, and at the same time use ecologically friendly plastics. This means a lower carbon-footprint as a result of fewer materials, less packaging, less fuel for transport and cleaner waste management. Due to less priming volume and easy preparation, costs are reduced as well.

SPOT on:

- Optimised performance due to radial dialysate flow.
- Enhanced clearance of middle molecules enabled by a more porous support region of the membrane.



Cardioprotective Haemodialysis

The Pure Difference

INLINE Steam Sterilised Dialysers

INLINE Steam Sterilised Dialysers

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Protect your Patient

Clean and safe

FX-class® dialysers are sterilised using the unique INLINE steam sterilisation process specifically developed by Fresenius Medical Care.

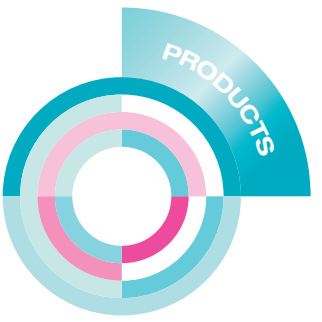
During the INLINE steam sterilisation process, both the blood and the dialysate compartments are rinsed continuously with steam > 121°C. Since no additional chemicals are needed for cleaning or sterilisation, the finished dialysers have extremely low levels of residuals.

Purity ensured – with steam

No chemical residuals with INLINE steam sterilisation
No need for gamma sterilisation – high energy ionising radiation can degrade and alter the material chemistry, producing potential cytotoxic and carcinogenic residuals inside the dialyser.[1]

Low rinsing volumes
Minimal preparation time – since dialysers are clean on arrival, rinsing times prior to use are substantially reduced.

Less rinsing – lower costs
Lower rinsing volumes mean reduced preparation times and costs.



1 Shintani H. et al., Journal of Analytical Toxicology (1989); 13: 354-357.
2 Müller T. F. et al., Nephron (1998); 78: 139-142.

SPOT

SPOT on:

- Reduced risk of blood contact with toxic residuals.[1]
- Activation of the complement system is reduced.[2]

Integrity test: Air pressure is applied to the fibre bundle from one side while the other side contains sterile water. If any leakages were present in the membrane, air would pass the membrane and create bubbles.

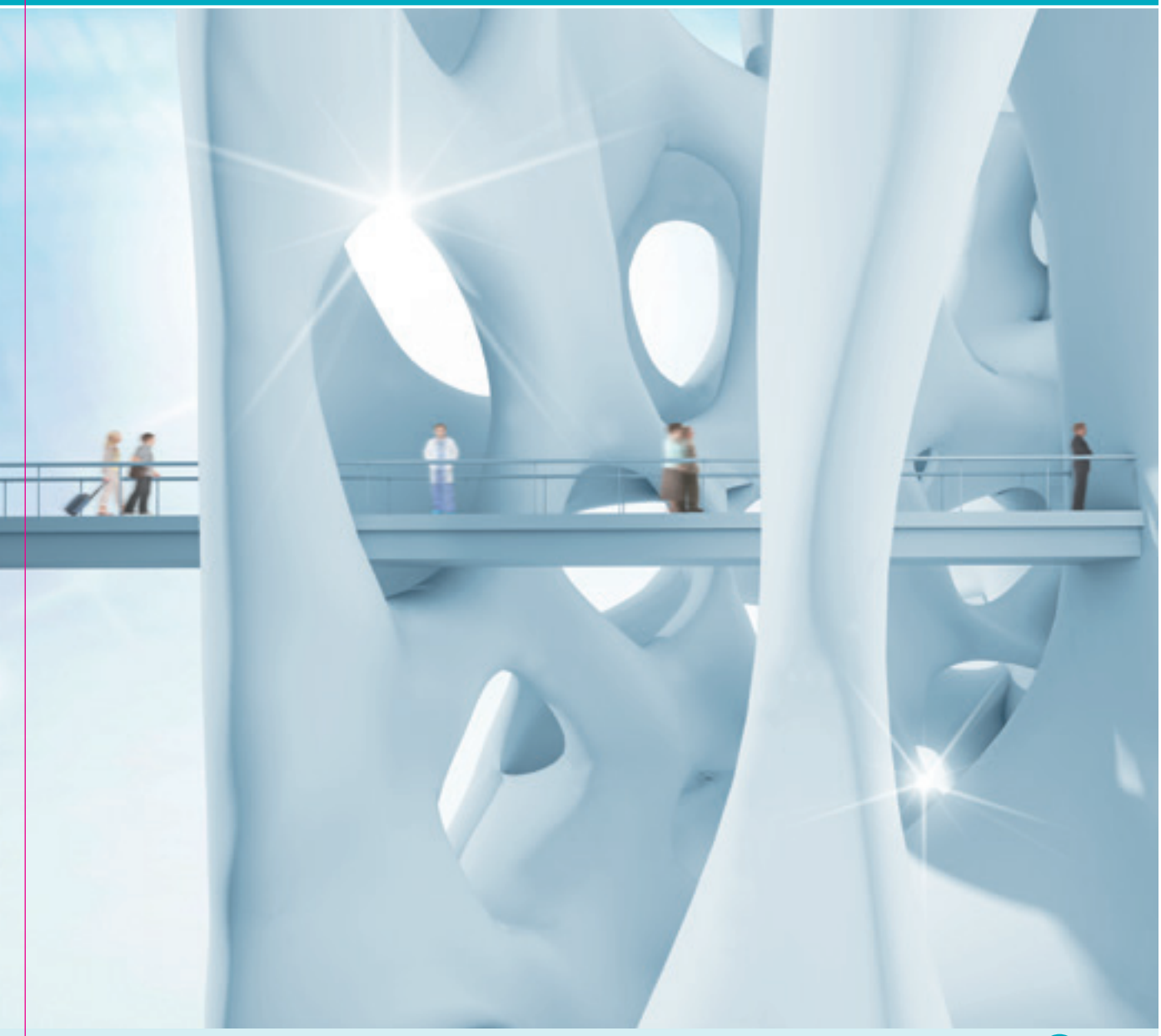
INLINE steam sterilisation process and integrity test

Cardioprotective Haemodialysis

Purity by Design

Superior Endotoxin Retention

Superior Endotoxin Retention



Cardioprotective Haemodialysis SPOT

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Protect your Patient

What are endotoxins?

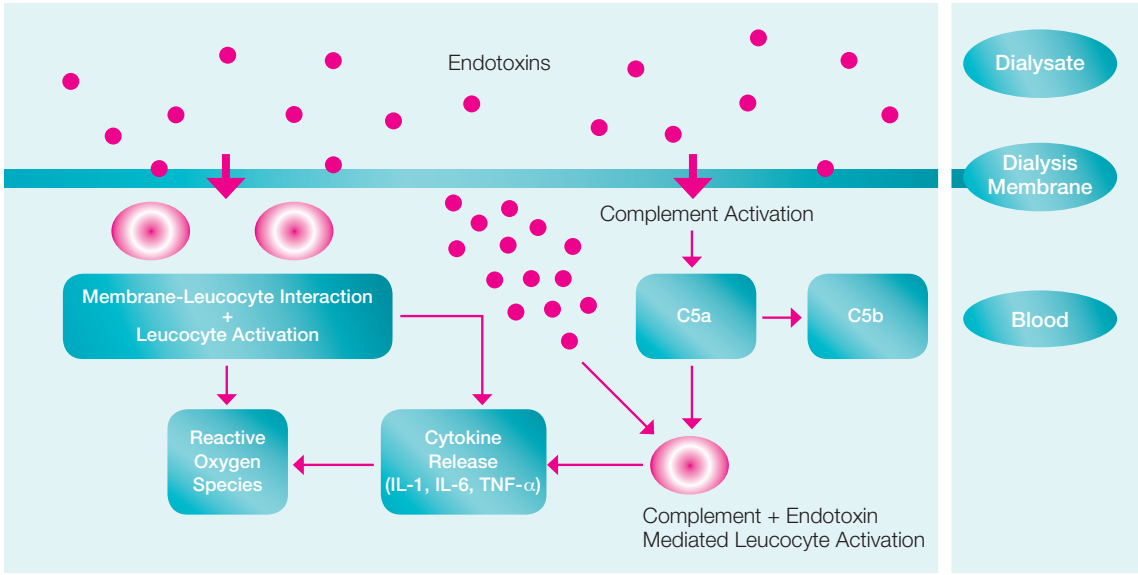
Endotoxins are large molecules from the outer membrane wall of gram-negative bacteria. Chemically, endotoxins are lipopoly-saccharides (LPS), having lipid and poly-saccharide components.

Microbial contamination of water or fluid conduits can therefore lead to the presence of endotoxins in dialysis fluid.

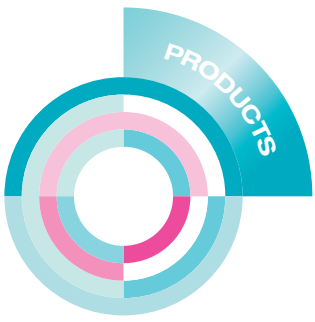
While intact endotoxins are relatively large molecules, their smaller endotoxin fragments may pass across dialysis membranes into the patient's blood via backdiffusion or backfiltration.

Greater protection through active prevention

Once in the patient's blood, endotoxins can induce complement and leucocyte activation, leading to inflammatory responses. Sometimes, these may result in acute reactions such as fever, headaches, convulsions or low blood pressure. In the longer term, they may also contribute to chronic conditions such as amyloidosis, an increased need for EPO, immune disorders or accelerated atherosclerosis. Atherosclerosis and cardiovascular diseases are the most frequent causes of death for dialysis patients.



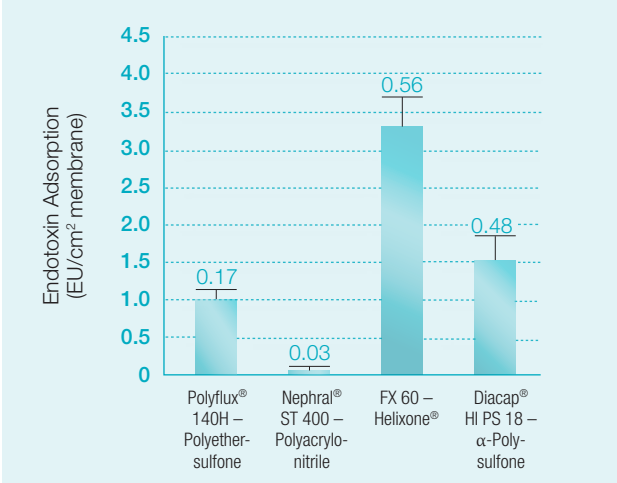
Inflammatory responses simulated by blood-membrane interactions and bacterial dialysate contaminants



Membranes, such as Helixone®, which have a high endotoxin retention capacity, protect the patient from inflammation, particularly when ultrapure dialysate is not available.[1]

SPOT on:

- Absence of endotoxins minimises inflammation.
- Reduced cardiovascular risk factors.



Endotoxin adsorption per cm² membrane surface area after 120 min in-vitro dialysis with contaminated dialysate (endotoxin from bacterial culture filtrates; initial concentration 50 EU/mL).[1]

(Graph adapted from original publication)

How to prevent endotoxins entering dialysis fluids

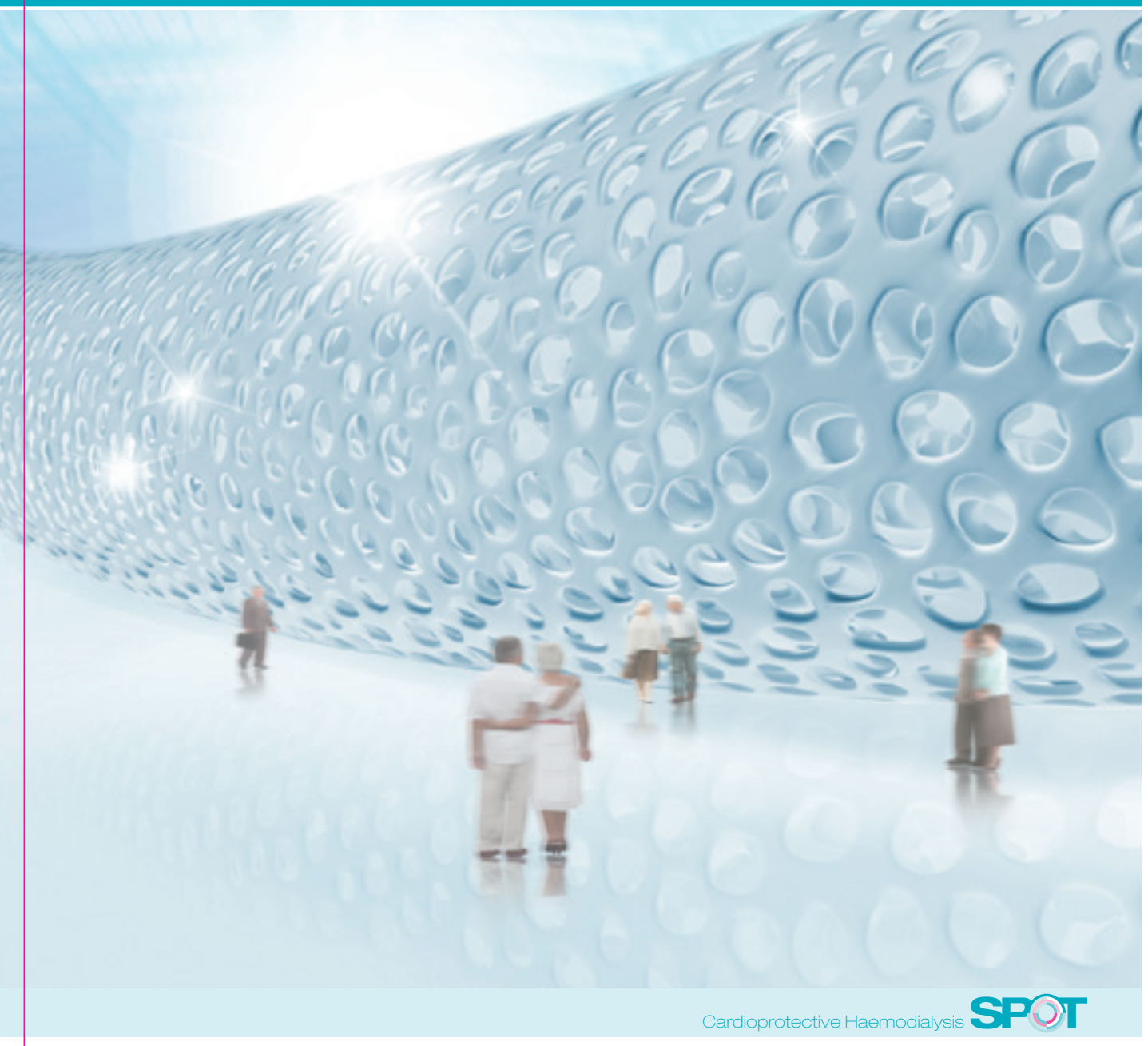
- Improved overall hygiene management.
- Mandatory use of ultrapure dialysis fluid by using dialysis fluid filters such as DIASAFE®*plus* to remove residual endotoxins from dialysis fluid.
- Use of dialysis membranes with high endotoxin retention capacities, particularly when ultrapure dialysate is not available (e.g. Helixone® or Helixone®*plus*).

1 Weber V. et al., Blood Purif (2003); 21: 365.

Cardioprotective Haemodialysis

Open up to Porosity

Enhanced Middle Molecule Removal



Cardioprotective Haemodialysis SPOT

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Protect your Patient

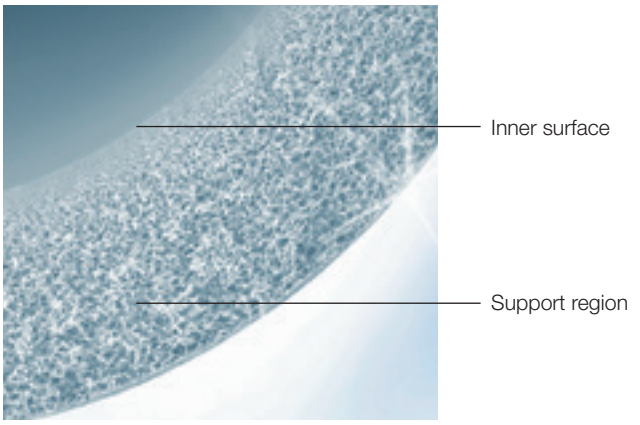
Key to optimal middle molecule removal

Solutes encounter resistance while traversing the membrane wall. Resistance to solute transport is affected, in part, by pore size at the inner surface and the porosity of the membrane wall.

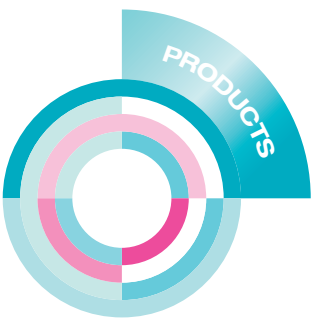
Furthermore, wall structure and thickness as well as inner fibre dimensions and 3-dimensional microwave structure play important roles in transmembrane flux.

The new membrane structure of Helixone®*plus* allows the easy passage of middle molecules across the more porous support region of the membrane.

- The structure of the support region is crucial to overall performance.
- Membrane porosity, together with the pore size, regulates the transport of middle molecules.



Close-up of the inner surface and the support region of the Helixone®*plus* membrane



Refined membrane architecture

New production technology combined with INLINE steam sterilisation allows crucial enhancements of membrane porosity, reducing flow resistance and improving transport across the membrane.

- Significantly improved removal of middle molecules while preventing the loss of useful substances, such as serum albumin.

SPOT

SPOT on:

- Optimised membrane porosity for enhanced removal of middle molecules.

Cardioprotective Haemodialysis

Improved Survival – Better Outcomes

High-Flux Dialysis

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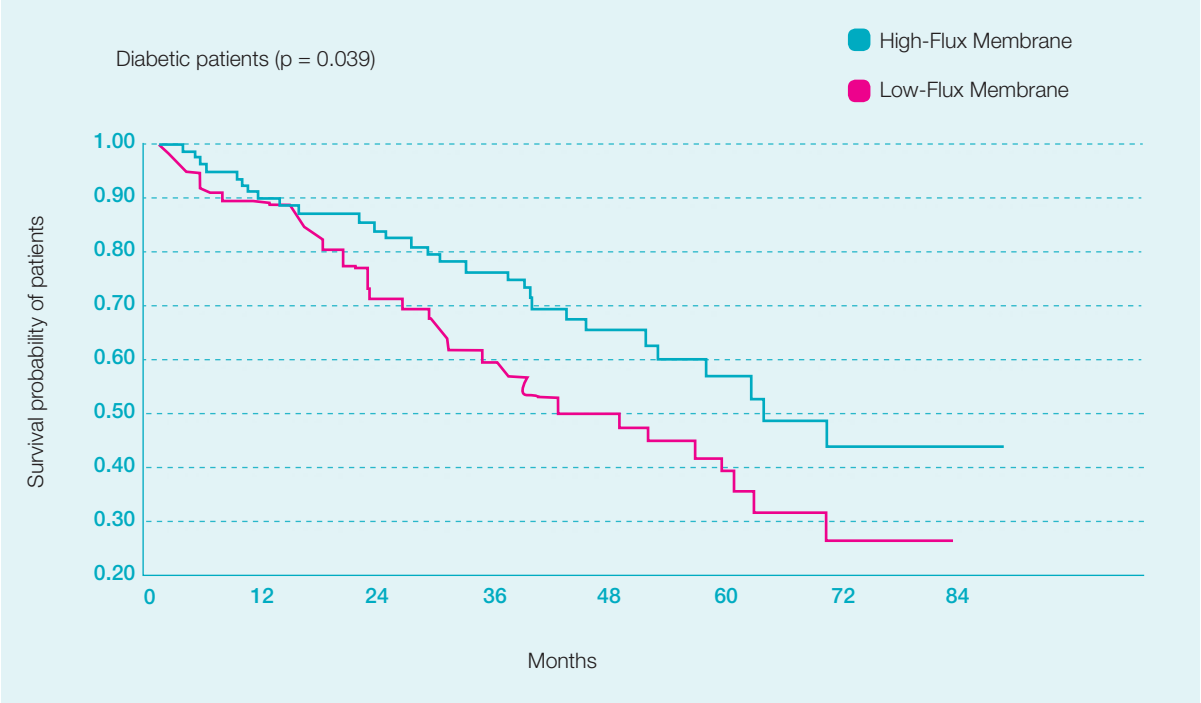
Extended survival

Use of High-Flux membranes enhances the removal of uraemic toxins, particularly middle molecules such as β_2-microglobulin.

A growing body of evidence has emerged in recent years demonstrating that use of High-Flux dialysis membranes as well as advanced treatment modalities such as HighVolume**HDF**® may contribute towards reduced risk of death.

The results of the MPO study indicate the beneficial effect of High-Flux membranes in terms of reduced mortality for patients with serum albumin levels ≤ 4.0 g/dL or diabetes.[1]



Kaplan-Meier survival curves for the subpopulation of patients with diabetes (log-rank test p = 0.039)[1]

(Graph adapted from original publication)

Reduced complications

Enhanced middle molecule removal contributes towards reducing the complications of haemodialysis as well as improving long-term patient outcomes by affecting:[2]

- **Inflammation** – lower CRP levels.[3]
- **Anaemia** – haemoglobin levels improve at lower EPO doses.[4]
- **Amyloidosis** – efficient removal of β_2-microglobulin and other middle molecules can reduce the relative risk of developing amyloidosis by up to 50 %.[5, 6]
- **Immune dysfunction** – aberrant suppression of IFN-γ may be corrected.[7]

The clinical benefits of High-Flux HDF are described in more detail in the chapter “Clinical Benefits of the Removal of Middle Molecules”.

SPOT

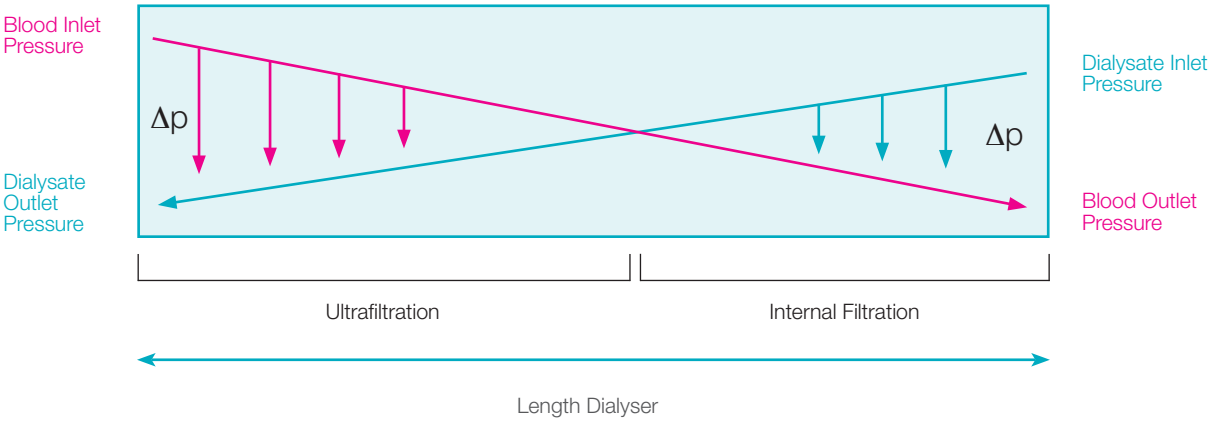
SPOT on :

- High-Flux dialysis can reduce secondary diseases.
- Prolonging patients’ lives.[1]
- Control of anaemia and amyloidosis.

Protect your Patient

Evolution of fibre design

Reducing the inner fibre diameter from 200 µm to 185 µm acts to increase internal filtration, thereby increasing the pressure gradient along the length of the fibre. This results in a greater pressure difference between the blood and dialysate compartments. Together with structural refinements to the support region of the fibre, this enables improvements in both diffusive and convective transport, which is of particular importance when performing High-Flux haemodialysis.



1 Locatelli F. et al., Journal of American Society of Nephrology (2009); 20: 645-654.
2 Tattersall J. et al., Nephrol Dial (2007); 22(Suppl.2); ii5-ii21.
3 Pedrini L. A. et al., Nephrol Dial Transplant (2011); doi: 10.1093/ndt/gfq761.
4 Merello Godino J. I. et al., Int J Artif Organs (2002); 25(11): 1049-1060.

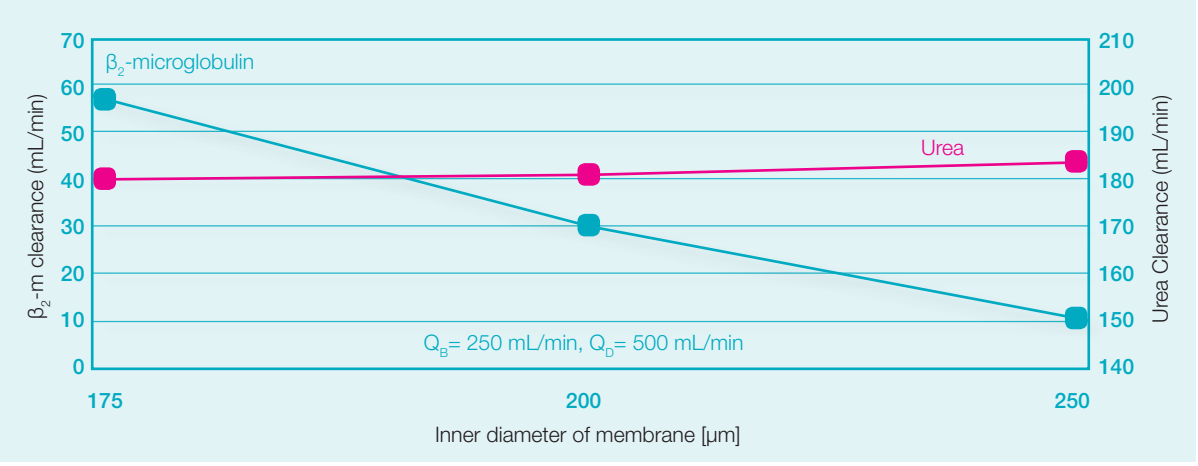
- Modification of the inner diameter increases the pressure gradient between blood and dialysate compartments.

- The result is improved clearance of middle molecules such as vitamin B_{12}, inulin, β_2-microglobulin and myoglobin.[8]

- The increased pressure gradient combined with structural refinements to the membrane (support region) enhances diffusive as well as convective filtration, especially when performing High-Flux haemodialysis with FX CorDiax.

SPOT on:

- Specific fibre design leads to increased removal of middle molecules.



Reduced inner diameter improves middle molecule elimination[8]

(Graph adapted from original publication)

5 Koda Y. et al., Kidney Int (1997); 52: 1096-1101.
6 Locatelli F. et al., Kidney Int (1999); 55: 286-293.
7 Lonnemann G. et al., Blood Purif (2003); 21(3): 225-231.
8 Dellanna F. et al., (1996); NDT 11 (Suppl 2): 83-86.

Protect your Patient

Guidelines recommend High-Flux dialysers

Clinical practice guidelines in Europe recommend the use of High-Flux haemodialysers:

European Renal Best Practice Advisory Board; Guideline 2.1:

"Synthetic High-Flux membranes should be used to delay long-term complications of haemodialysis therapy … even in low-risk patients..."[1]

The Renal Association (UK):

"Suggest that high-flux dialysers should be used instead of low-flux dialysers to provide haemodialysis. Evidence of improved patient survival with the use of high-flux membranes is restricted to incident patients, who have lower serum albumin concentrations (< 4 g/L) or have diabetes mellitus, and prevalent patients who have been on haemodialysis > 3.7 years"[2]

1 Tattersall J., Nephrol Dial Transplant (2010); 25: 1230–1232.

2 Mactier R. et al., Renal Association 2009, Renal Association Clinical Practice Guidelines. Haemodialysis membranes (Guidelines 4.1 to 4.5). http://www.renal.org/clinical/GuidelinesSection/Haemodialysis.aspx. Accessed 2 Dec. 2012.

Cardioprotective Haemodialysis

Advance the Experience
HighVolume**HDF**®

Cardioprotective Haemodialysis SPOT

FRESENIUS MEDICAL CARE

Protect your Patient

Better filtration

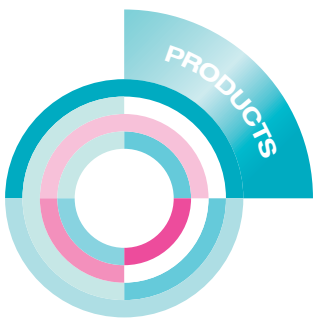
In recent years, there has been increased interest in more efficient haemodialysis treatment modalities. The main emphasis today is on the efficient removal of a wide range of uraemic toxins, particularly larger middle molecules such as β_2-microglobulin, a surrogate of middle molecules. However, excessive loss of useful substances such as albumin needs to be curtailed.

The high removal of larger solutes during HighVolume**HDF**® is achieved through a combination of two principles: diffusion and convection at high substitution volumes. Solute removal by convection occurs along a pressure gradient facilitated by the ultrafiltration of fluid across a highly permeable membrane.

HighVolume**HDF**® improves patient outcomes and exerts beneficial effects on the main cardiovascular risk factors:

- Intradialytic haemodynamic stability[1]
- Anaemia[2]
- Inflammation[3]
- Serum β_2-m and phosphate levels[4,5,6]

HighVolume**HDF**® is currently considered as the most efficient renal replacement therapy.



Improved survival

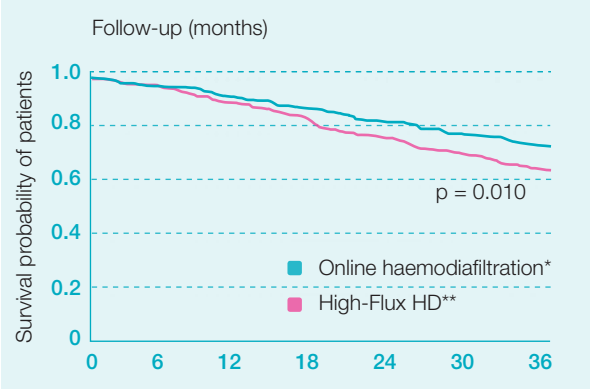
SPOT

SPOT on:

- High convective transport enhances the removal of uraemic toxins, especially in the middle molecular range.

The Catalonian high-volume HDF study,[7] on behalf of the Estudio de Supervivencia de Hemodiafiltración On-Line (ESHOL) study group, is a multi-centre, prospective randomised controlled trial, which showed a wide range of benefits for patients being treated with high-efficiency post-dilution HDF (HighVolume**HDF**®). Achieving a mean delivered total substitution volume of 21 L/session should therefore be the target for every HDF treatment.

The primary outcome all-cause mortality was significantly reduced for the patients being treated with HighVolume**HDF**®.



Results from the Catalonian high-volume HDF study[7]
*median delivered convective volume ranged from 23 to 24 L/session
**92% on High-Flux HD

Improved survival

30% **risk reduction in all-cause mortality (p = 0.01)**

55% risk reduction in mortality from infection (p = 0.03)

61% risk reduction in mortality from stroke (p = 0.03)

Reduced treatment costs

22% risk reduction in all-cause hospitalisation (p = 0.001)

Better patient well-being

28% risk reduction in incidence of hypotensive episodes (p < 0.001)

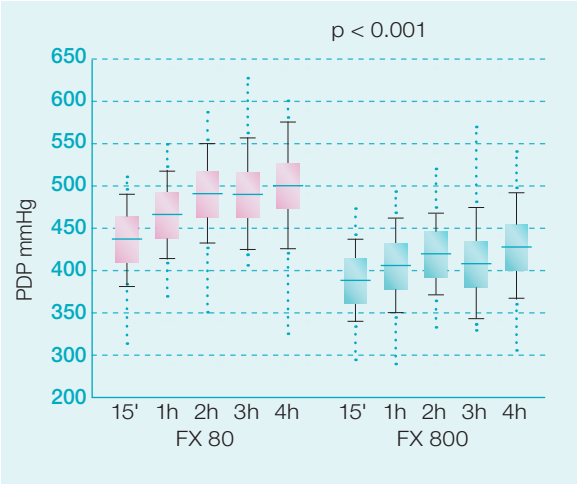
1 Locatelli F. et al., J Am Soc Nephrol (2010); 21: 1798–1807.
2 Bonforte G. et al., Blood Purif (2002); 20: 357–363.
3 Pedrini L. et al., Nephrol Dial Transplant, advanced access published Jan 18, 2011.
4 Canaud B., Contrib Nephrol (2007); 158: 216–224.
5 Penne L. et al., Clin J Am Soc Nephrol (2010); 5: 80–86.
6 Davenport A., Nephrol Dial Transplant (2010); 25: 897–901.
7 Maduell F. et al., J Am Soc Nephrol (2013); 24: 487–497.

Protect your Patient

FX CorDiax haemo*dia*filter – Superior by design

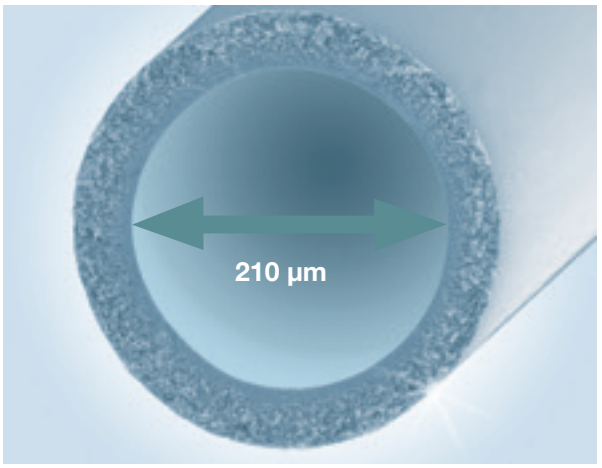
HighVolume**HDF**® therapy requires specially designed filters. Stepping up to this challenge, we developed the FX CorDiax haemo*dia*filter for HighVolume**HDF**® with the most efficient removal of middle molecules while minimising albumin loss.

- **Increased fibre lumen for better flow conditions**
  An increase of its inner diameter results in a substantially reduced pressure drop within a hollow fibre according to the Hagen Poiseuille law. Differences in the capillary diameter of a dialyser can therefore affect its performance and the quality of the treatment provided to a patient. The inner diameter of FX-class® haemo-*dia*filters is 210 µm compared to 185 µm of FX-class® HD filters. The larger inner diameter facilitates improved flow conditions which allowed for a significantly higher convective volume in a HDF treatment.[1]

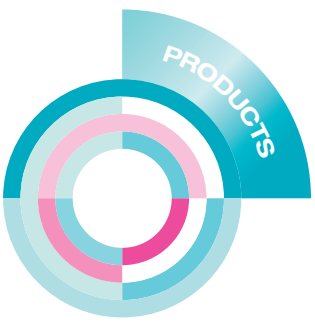


Reduced dialyser inlet pressure of FX 800 (210 µm) vs. FX 80 (185 µm)[1]

(Graph adapted from original publication)



The 210 µm fibre lumen of FX CorDiax haemo*dia*filters optimises blood flow conditions within the dialyser for maximal HighVolume**HDF**® performance.



1 Vega Vega O. et.al.; ERA-EDTA Congress 2012, Poster 457—FP.

Cardioprotective Haemodialysis

When Performance is Priority

Clinical Benefits of the Removal of Middle Molecules

Clinical Benefits of the Removal of Middle Molecules

Cardioprotective Haemodialysis SPOT

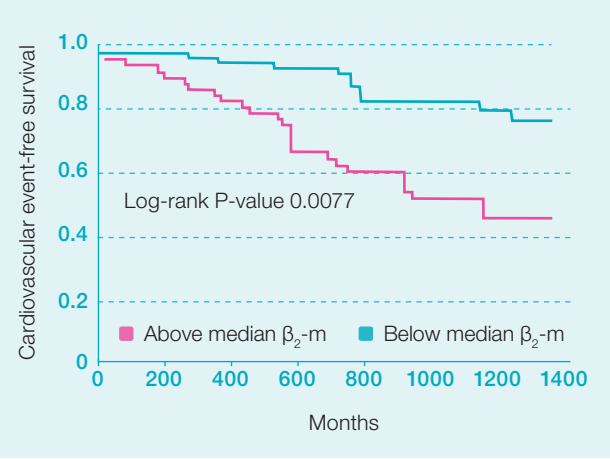
FRESENIUS MEDICAL CARE

Protect your Patient

Improved survival with High-Flux membranes

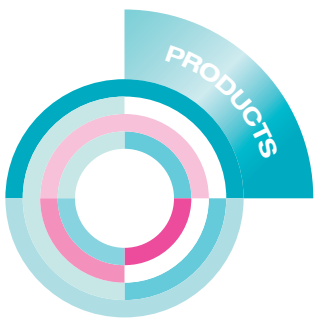
On top of traditional cardiovascular risk factors, increased middle molecule levels such as β_2-microglobulin (β_2-m) pose an additional risk for the development of cardiovascular diseases (CVD) in end stage renal disease (ESRD) patients. The European Uremic Toxin Work Group (EUTox) confimed the power of β_2-m to predict overall and cardiovascular mortality and cardiovascular events in patients at different stages of CKD.[1]

Thus, enhanced middle molecule removal contributes towards improving long-term patient outcomes and reducing dialysis related complications.



Kaplan-Meier estimates of the probability of cardiovascular event-free survival of predialysis patients, as a function of median plasma β_2-m level[1]

(Graph adapted from original publication)

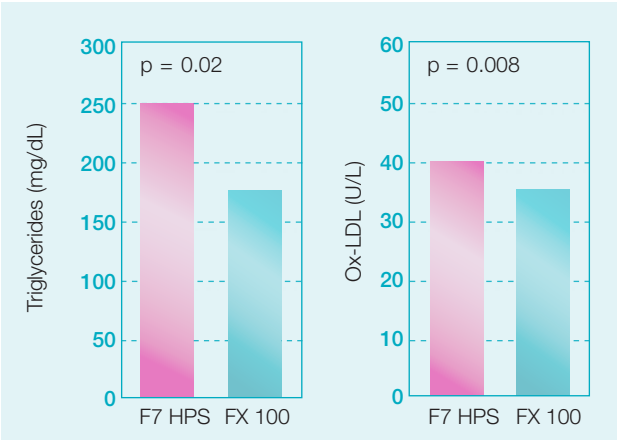


Cardioprotective Haemodialysis

- **Dyslipidaemia** – the use of High-Flux Helixone® membranes improves plasma lipid profiles,[2] reducing levels of LDL (low-density lipoprotein) and VLDL (very low-density lipoprotein) and increasing those of protective HDL (high-density lipoprotein). The levels of triglycerides and oxidised LDL, an indicator of oxidative stress and a specific risk factor for atherosclerosis, are also significantly reduced using Helixone® membranes.[3]

SPOT on:

- Improved patient survival.[1]
- Reduced risk factors of atherosclerosis.[3]



Improving plasma lipid profiles: reduction of ox-LDL and triglycerides with FX 100 dialysers[3]

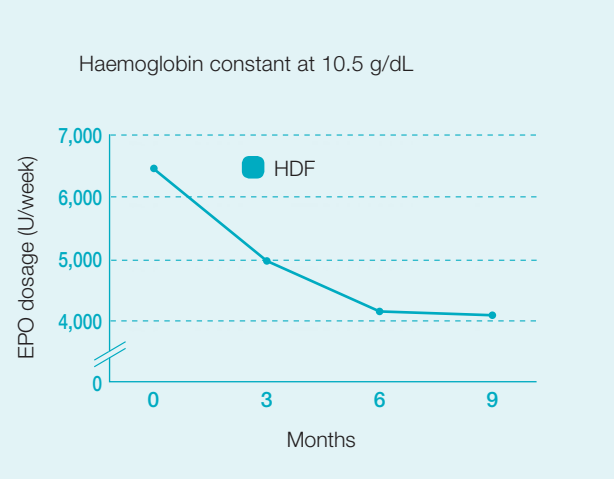
(Graph adapted from original publication)

Protect your Patient

Cardioprotective Haemodialysis

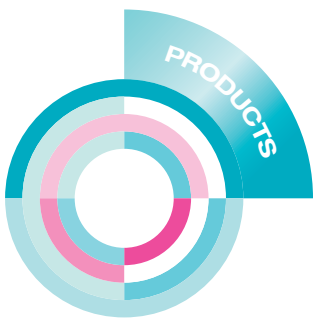
- **Amyloidosis** – a debilitating complication of longterm haemodialysis, amyloidosis involves the build-up of β_2-microglobulin. FX-class® High-Flux dialysers efficiently remove β_2-microglobulin and other middle molecules, reducing the risk of carpal tunnel syndrome.[4,5]

- **Inflammation** – specialised production processes such as INLINE steam sterilisation as well as the high endotoxin retention properties of FX-class® dialysers contribute to reducing the levels of endotoxin exposure during haemodialysis. This results in the reduced induction of inflammatory responses.[2]



With High-Flux membranes, it was possible to progressively reduce the EPO dose while maintaining Hb control[6]

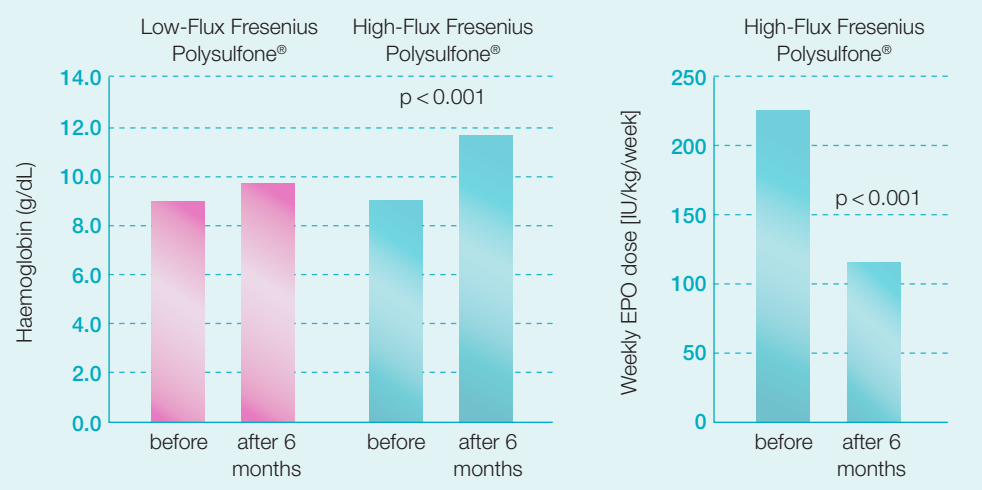
(Graph adapted from original publication)



- **Anaemia management** – it was shown that High-Flux membranes improved control of anaemia in EPO hypo-responsive patients while allowing a progressive reduction in the exogenous EPO dose by 25 to 45 %.[7] Hence, High-Flux membranes offer the potential to reduce EPO costs.

SPOT on:

- Improved anaemia control.[6,7]
- Reduced inflammation.[2]
- Reduced risk of CVD due to minimising the risk factors.



Recovery of haemoglobin (Hb) levels was significantly better after 6 months for patients treated with High-Flux vs Low-Flux membranes. Further, in this patient group the mean EPO dose was significantly lower.[7]

(Graph adapted from original publication)

The FX CorDiax allows the enhanced removal of middle molecules which, together with other factors, contributes towards improved survival.

1 Liabeuf S. et al., Kidney International (2012) 82, 1297.
2 Merello Godino J. I. et al., Int J Artif Organs (2002); 25(11): 1049-1060.
3 Wanner C. et al., JASN (2002); 13 (SU-P0645): 600A.
4 Ahrenholz P. G. et al., Clinical Nephrology (2004); 62: 21-28.
5 Koda Y. et al., Kidney Int (1997); 52: 1096-1101.
6 Bonforte G. et al., Blood Purif (2002); 20: 357-363.
7 Ayli D. et al., J Nephrol (2004); 17: 701-706.

Performance Data

Sieving coefficients of FX CorDiax High-Flux Dialysers and Haemo*dia*filters	Molecular weight (Dalton)	
Albumin	66,500	< 0.001
Myoglobin	17,053	0.5
β_2-microglobulin	11,731	0.9
Inulin	5,200	1

Membrane material		Helixone®*plus*
Sterilisation method		INLINE steam
Housing material		Polypropylene
Potting compound		Polyurethane
Units per box		24

FX CorDiax High-Flux Dialysers		FX CorDiax 40	FX CorDiax 50	FX CorDiax 60	FX CorDiax 80	FX CorDiax 100	FX CorDiax 120
Clearance (Q_B = 300 mL/min)							
Cytochrome c	12,230	48 *	76	96	111	125	136
Inulin	5,200	56 *	88	116	127	144	149
Vitamin B_{12}	1,355	96 *	144	175	190	207	213
Phosphate	132	142 *	215	237	248	258	262
Creatinine	113	155 *	229	252	261	272	274
Urea	60	175 *	255	271	280	283	284
Clearance (Q_B = 400 mL/min)							
Cytochrome c	12,230	–	–	100	117	133	145
Inulin	5,200	–	–	122	135	154	160
Vitamin B_{12}	1,355	–	–	191	209	229	237
Phosphate	132	–	–	270	285	299	305
Creatinine	113	–	–	290	303	321	325
Urea	60	–	–	319	336	341	343
**Clearance (Q_B = 200 mL/min)*							
Ultrafiltration coeff. (mL/h x mmHg)		21	33	47	64	74	87
In vitro performance: Q_D = 500 mL/min, Q_F = 0 mL/min, T = 37 °C (EN 1283). Sieving coefficients: human plasma, $Q_B$max, Q_F = 0.2 x $Q_B$max (EN1283). Ultrafiltration coefficients: human blood (Hct 32 %, protein content 6 %).							
Effective surface (m²)		0.6	1.0	1.4	1.8	2.2	2.5
K_oA Urea		547	886	1,164	1,429	1,545	1,584
Priming volume (mL)		32	53	74	95	116	132
Article number		**F00001588**	**F00001589**	**F00001590**	**F00001591**	**F00001592**	**F00002384**

FX CorDiax Haemo*dia*filters		FX CorDiax 600	FX CorDiax 800	FX CorDiax 1000
Clearance (Q_B = 300 mL/min, Q_F = 75 mL/min)				
Cytochrome c	12,230	131	141	151
Inulin	5,200	144	156	166
Vitamin B_{12}	1,355	204	217	225
Phosphate	132	257	267	271
Creatinine	113	271	277	280
Urea	60	285	291	292
Clearance (Q_B = 400 mL/min, Q_F = 100 mL/min)				
Cytochrome c	12,230	149	160	172
Inulin	5,200	166	178	190
Vitamin B_{12}	1,355	235	251	262
Phosphate	132	307	321	328
Creatinine	113	327	339	343
Urea	60	354	365	367
Ultrafiltration coeff. (mL/h x mmHg)		46	62	76
In vitro performance: Q_D = 500 mL/min, T = 37 °C (EN 1283). Sieving coefficients: human plasma, $Q_B$max, Q_F = 0.2 x $Q_B$max (EN1283). Ultrafiltration coefficients: human blood (Hct 32 %, protein content 6 %).				
Effective surface (m²)		1.6	2.0	2.3
K_oA Urea		1,148	1,365	1,421
Priming volume (mL)		95	115	136
Article number		**F00001593**	**F00001594**	**F00001595**

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