# Towards better care of kidney patients by telemedicine

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International Renal Research Institute
Ospedale San Bortolo - Vicenza

## Four Areas where telemedicine can be useful in Nephrology

- Integrated inter-hospital networks
- Integrated in-hospital networks
- Home hemo- and peritoneal dialysis
- Wearable devices for dialysis and heart failure

## Four Areas where telemedicine can be useful in Nephrology

- Integrated inter-hospital networks

# Il Dipartimento Interaziendale

# Nefrologia Dialisi e Trapianto Renale

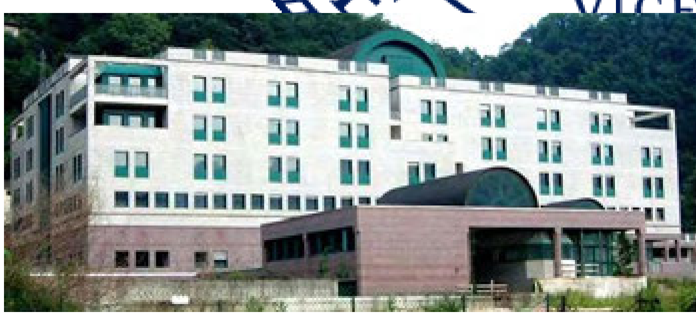
Vicenza

Arzignano

Schio

S. BORTOLAMIUS VICENZA

Asiago



Valdagno

Bassano

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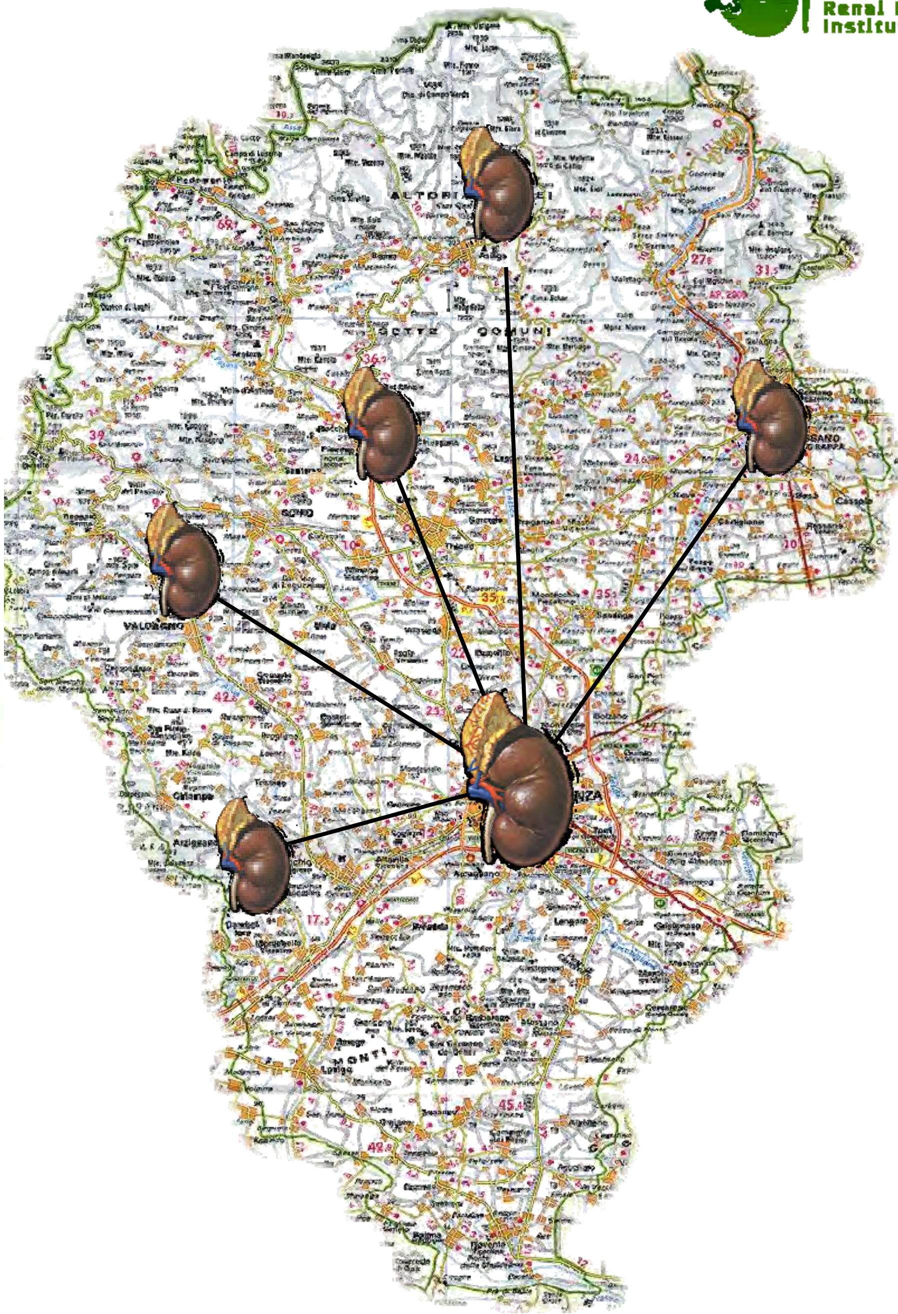
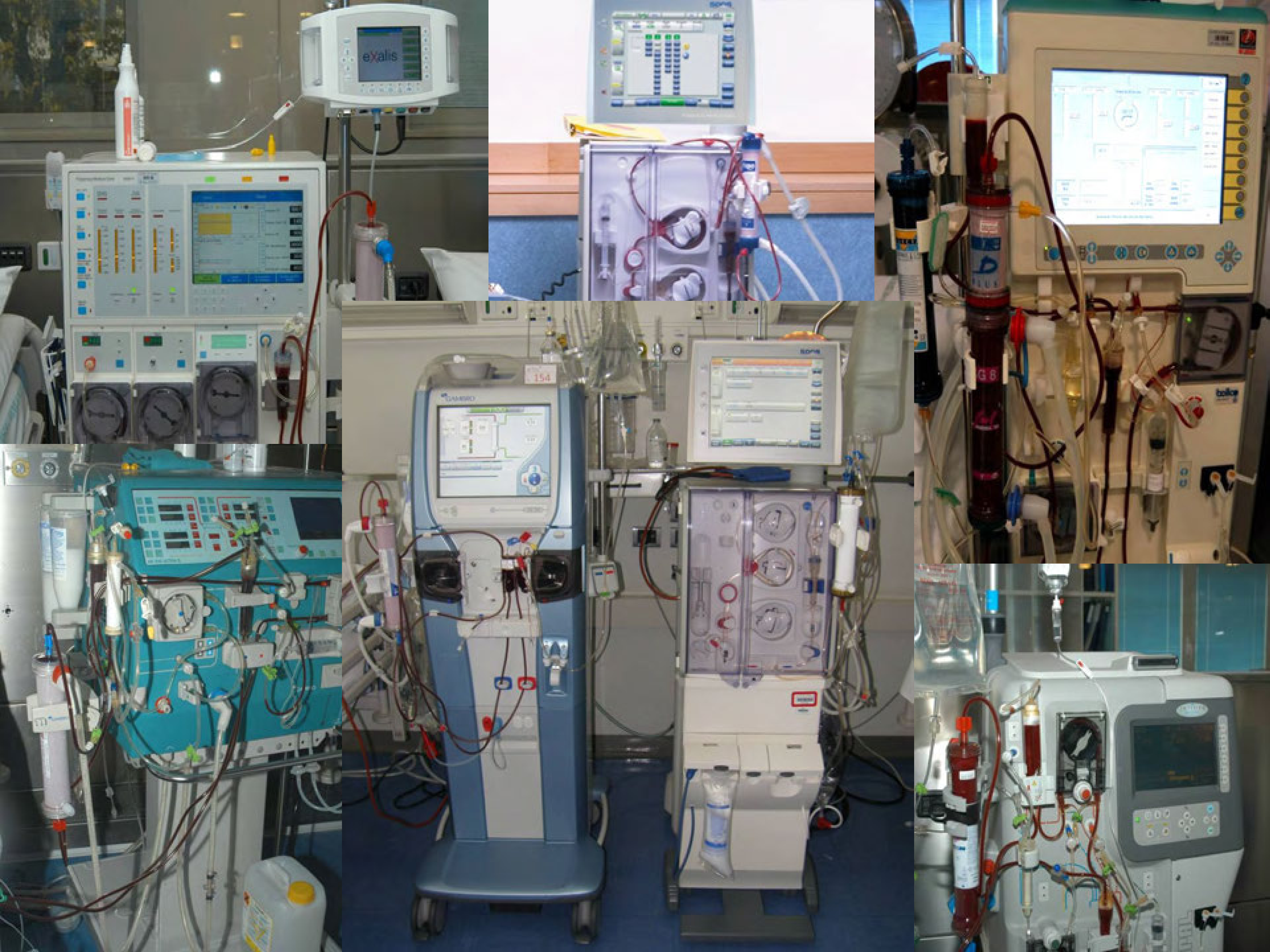
NEFROLOGIA DIALISI E TRAPIANTO RENALE

Regione Veneto

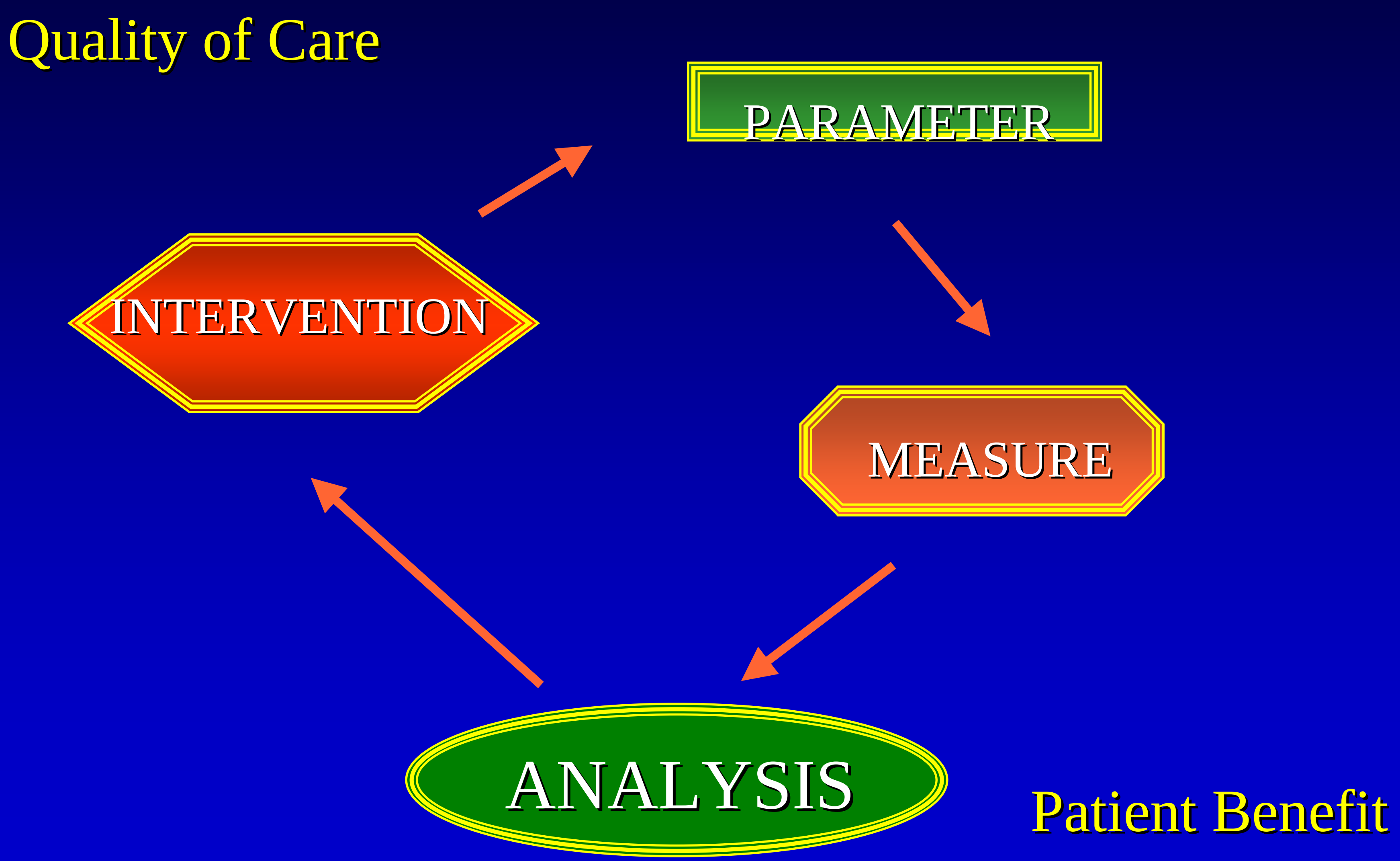
ULSS 3-4-5-6



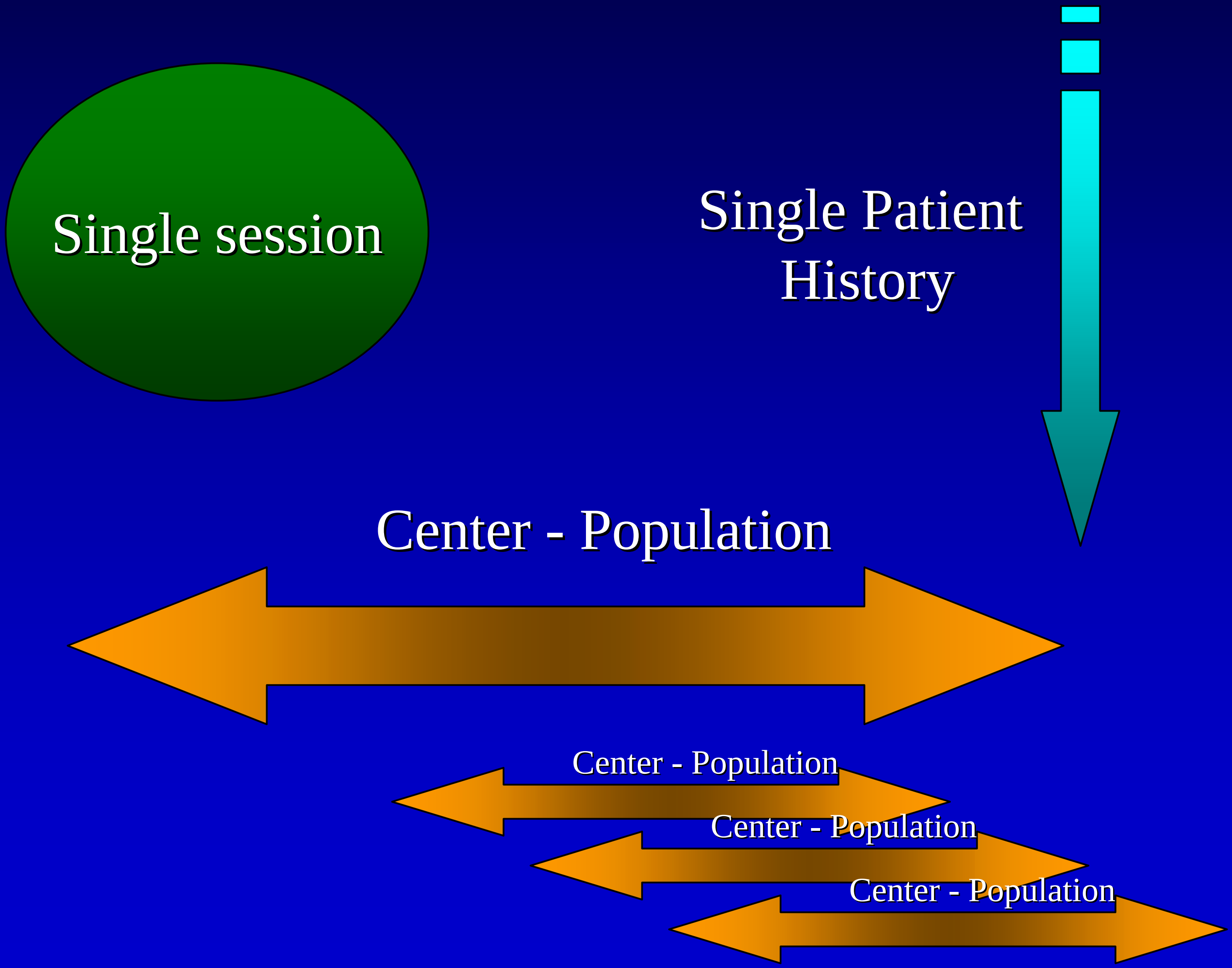

Navigazione
Principale
Sale dialisi
1 2:52
3:21 5
9 2:12
2:04 11
2:27 13


exalis
154
GAMBRO

# The general concept of data collection



# Computer Assisted Data Management



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Continuous Quality Improvement
Quality Assurance Programs
Hardware Maintenance
Statistical analyses
Dialysis Billing
Accountability
Research

Improvement of blood flow

On line clearance

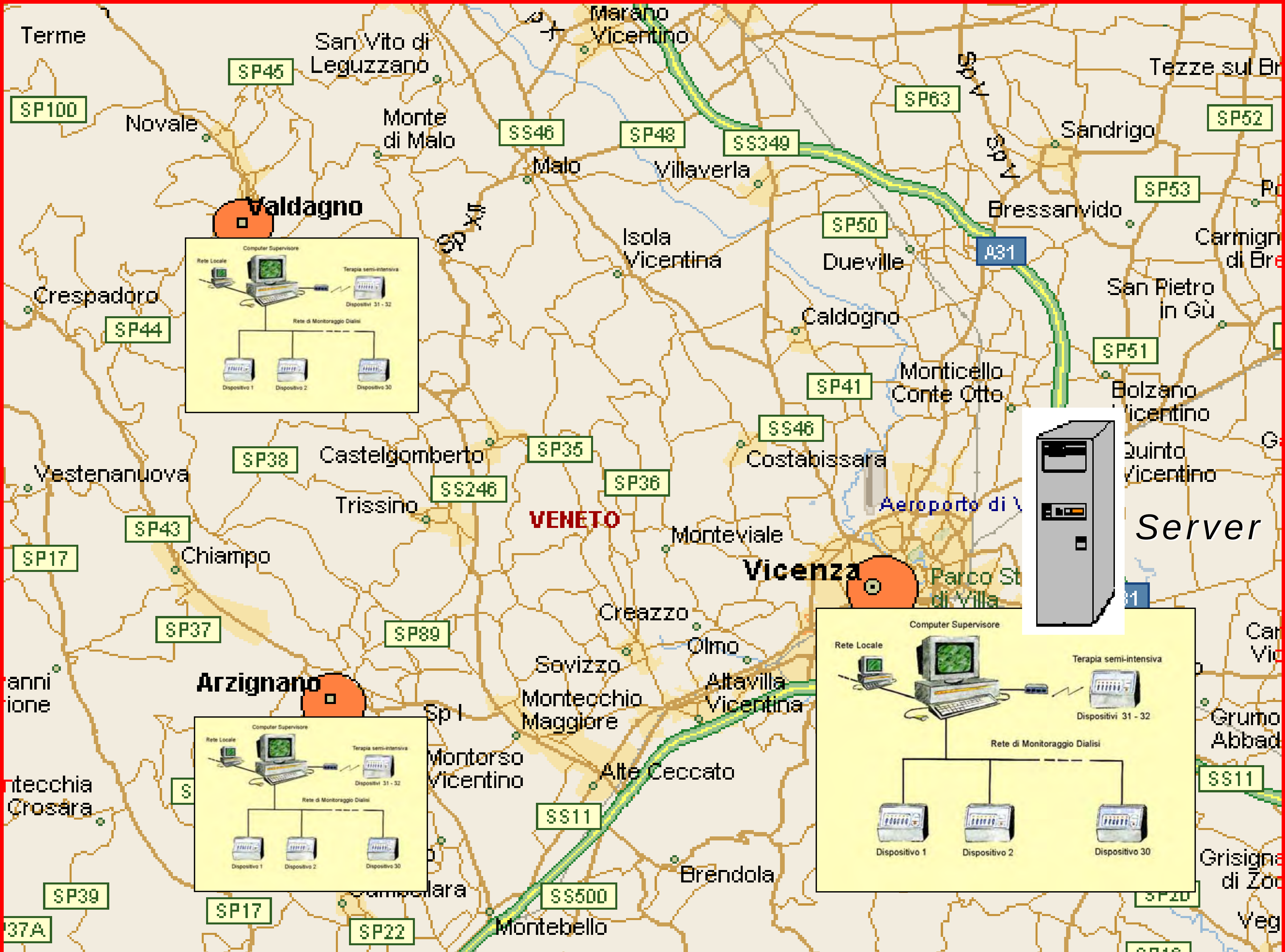
Alarm or failures of electronics and hydraulics (blood flow, dialysate temperature, conductivity)

DRG management and HD reimbursement

Medical Director Acitivit

Number of failures, number of hypotension or saline infusion, Uf off or pump speed

Clinical trials
Correlations
Data Statistics



Terme
San Vito di Leguzzano
Marano Vicentino
Tezze sul Br
SP45
SP100
Novale
Monte di Malo
SS46
SP48
SS349
SP63
Sandrigo
SP52
Malo
Villaverla
Valdagno
SP53
Bressanvido
SP50
A31
Carmign di Bre
Isola Vicentina
Dueville
San Pietro in Gù
Crespadoro
SP44
Caldogno
SP51
SP41
Monticello Conte Otto
Bolzano Vicentino
SS46
Quinto Vicentino
Castelgomberto
SP35
SP38
Costabissara
Vestenanuova
SS246
SP36
Trissino
Aeroporto di V
VENETO
Server
SP43
Monteviale
SP17
Chiampo
Vicenza
Parco St di Villa
Creazzo
SP37
SP89
Olmo
Sovizzo
Arzignano
Altavilla Vicentina
Montecchio Maggiore
Grumo Abbad
Montorso Vicentino
Alte Ceccato
SS11
tecchia Crosara
SS11
SP39
Brendola
Grisign di Zoc
SP17
SS500
SP22
Montebello
Veg
Computer Supervisore
Rete Locale
Terapia semi-intensiva
Dispositivi 31 - 32
Rete di Monitoraggio Dialisi
Dispositivo 1
Dispositivo 2
Dispositivo 30

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Institute Vicenza

# Clinical Data for a Kidney Transplant in real time

# Clinical Data for acute dialysis in real time

Four Areas where telemedicine can be useful in Nephrology

- Integrated inter-hospital networks

- Integrated in-hospital networks

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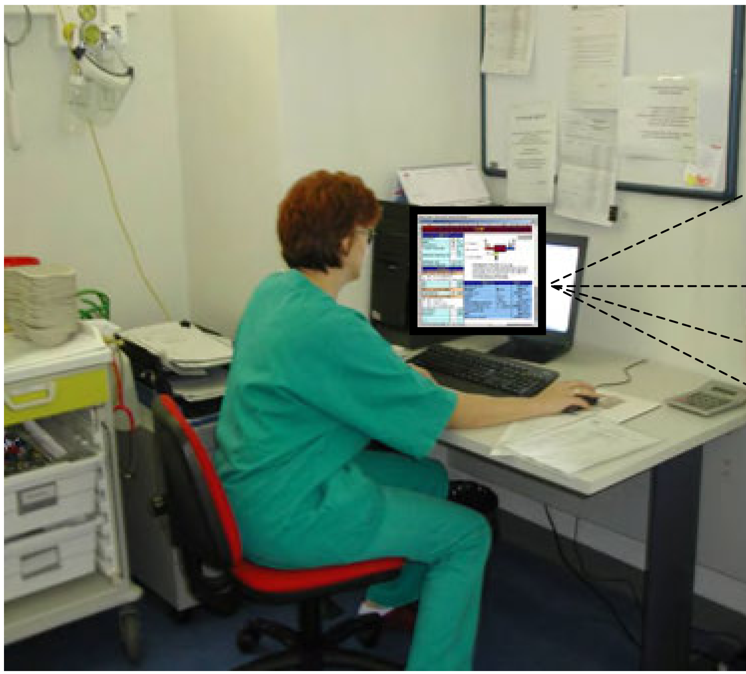
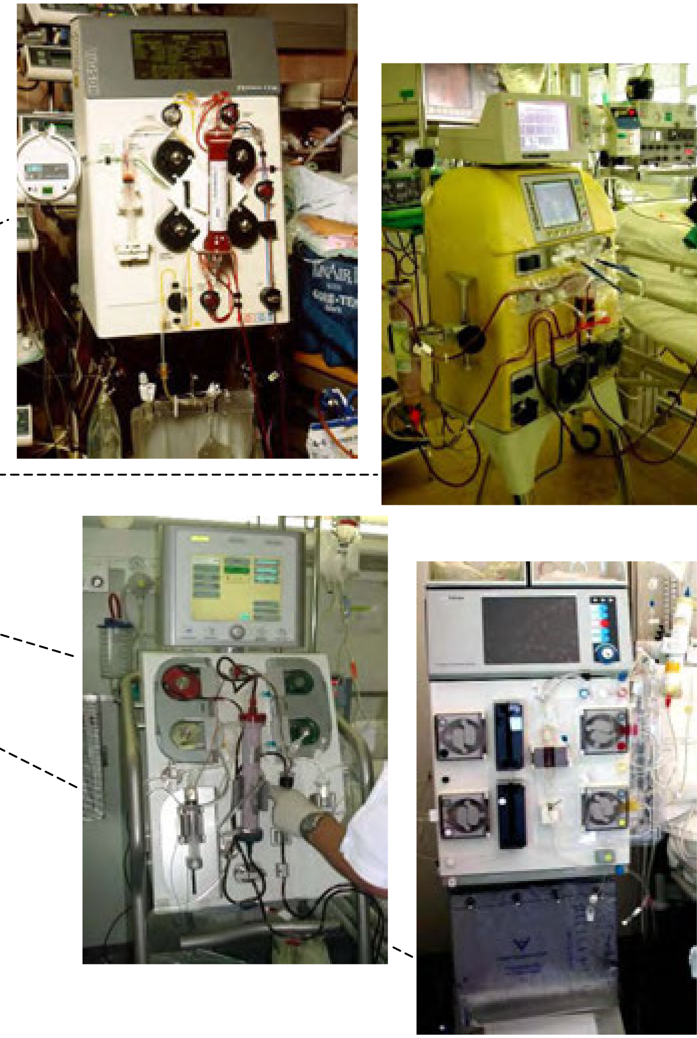
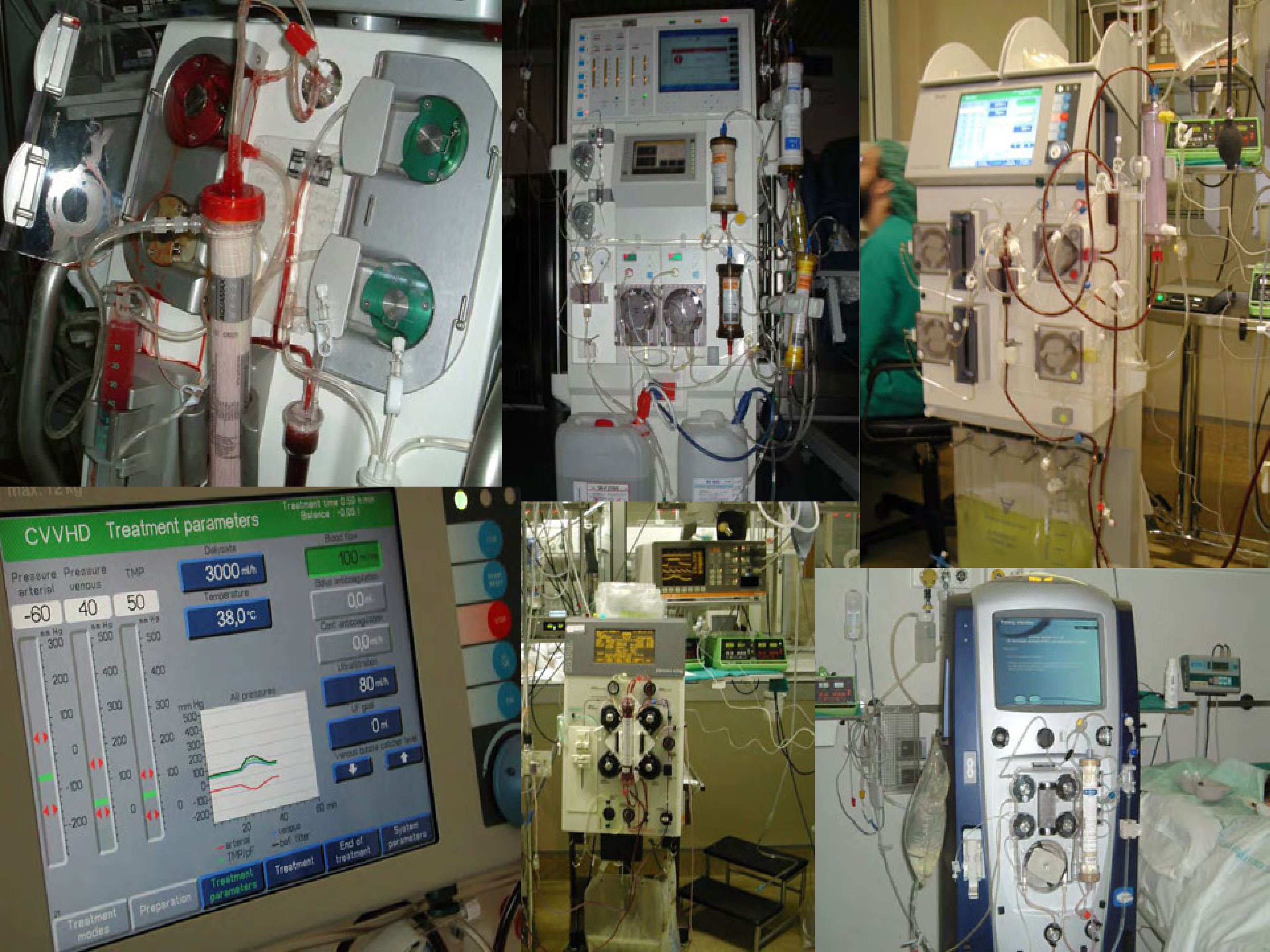
# Intensive Care

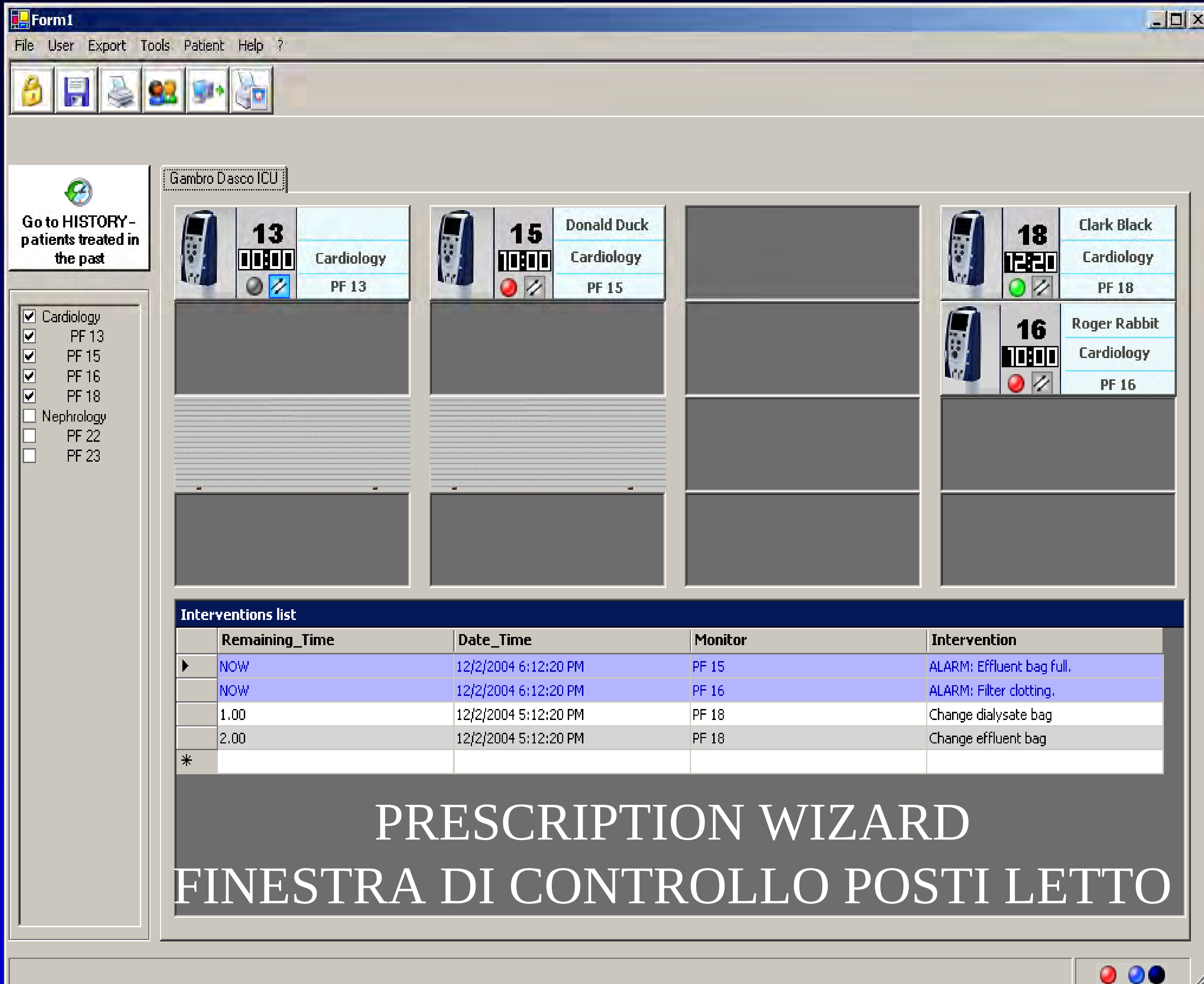
## Nefrologia





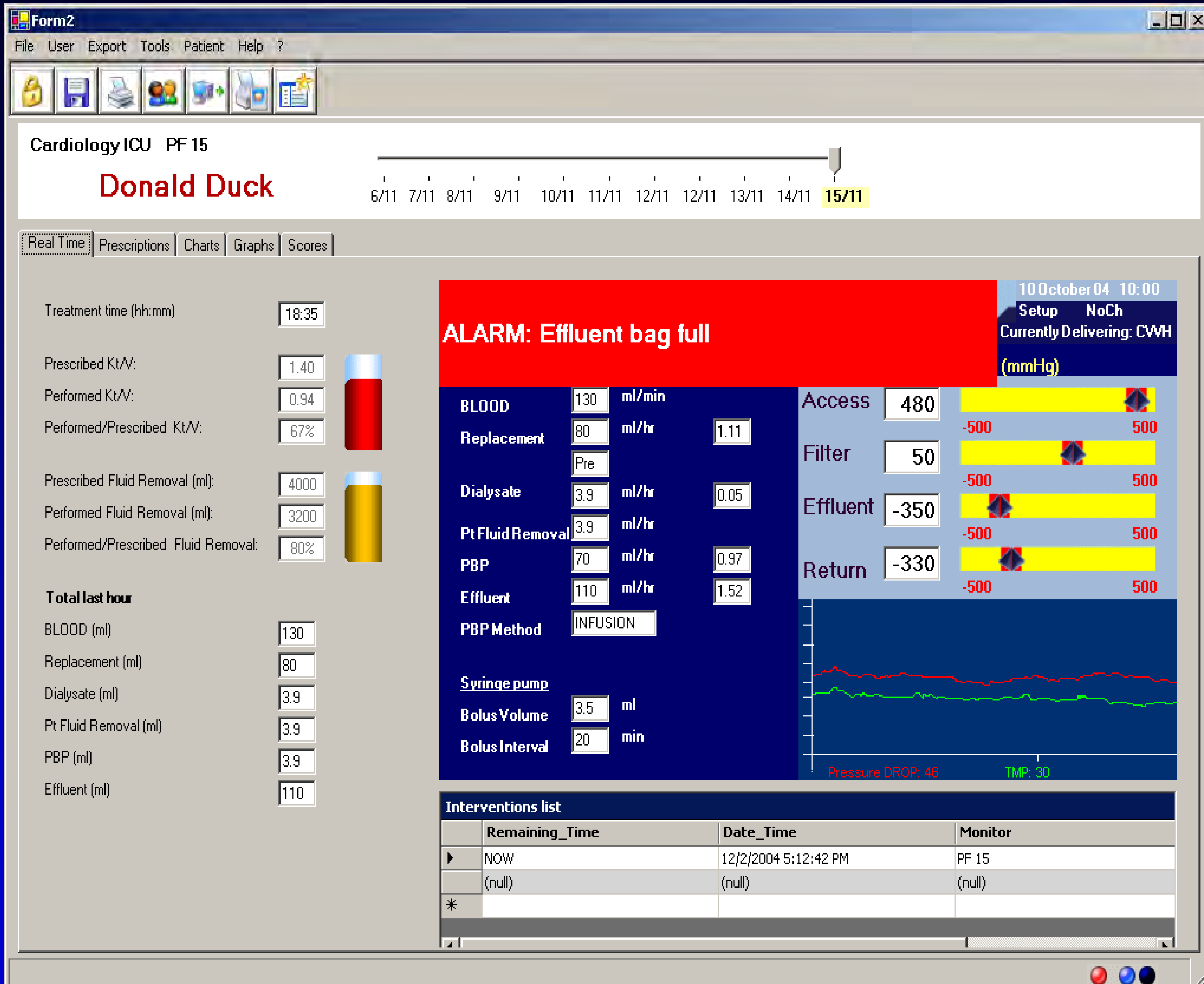

2-2-17
TERAPIA
SEMI-INTENSIVA
Letti A-B

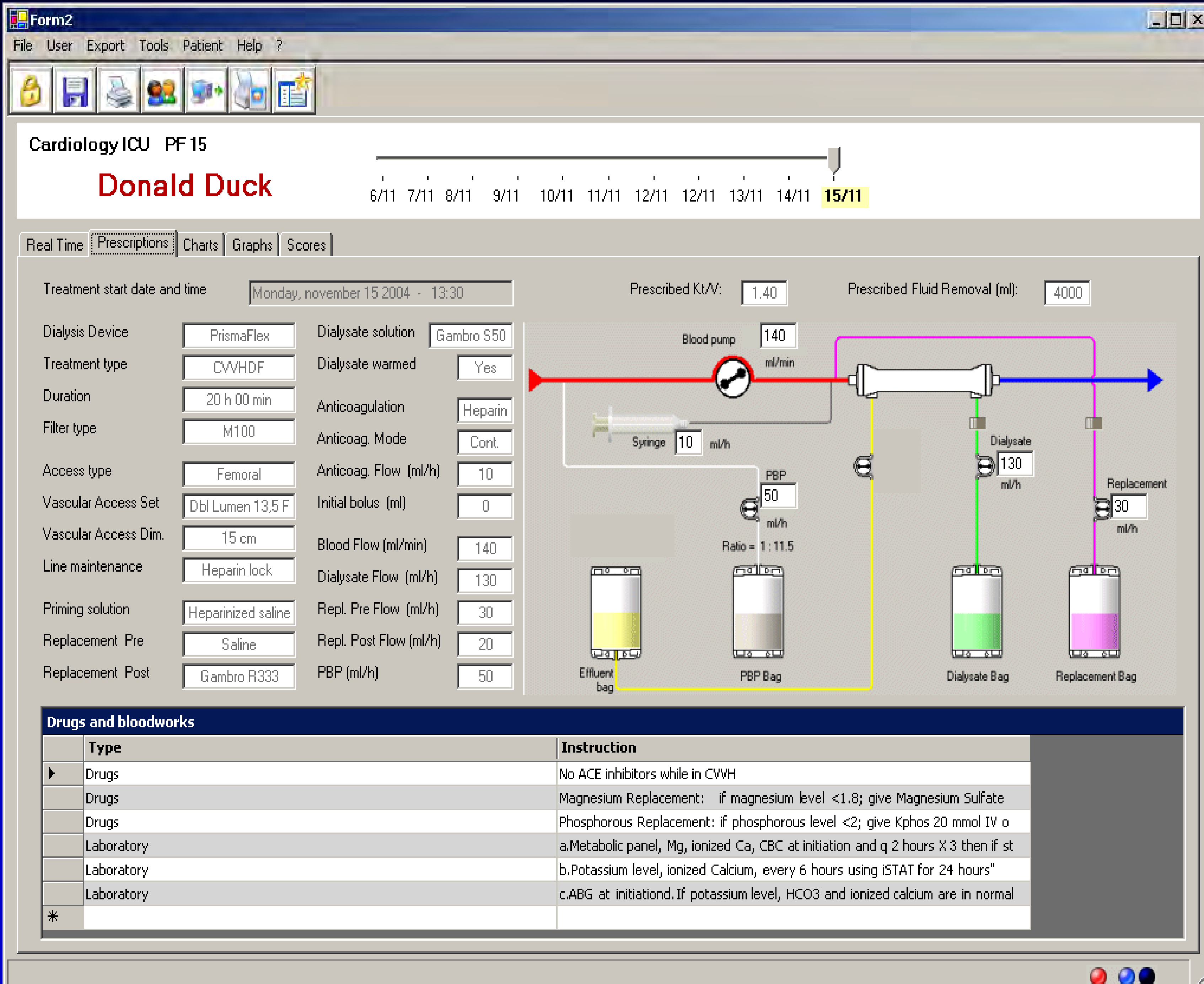

CVVHD Treatment parameters
Dialysate
3000 ml/h
Blood flow
Temperature
38,0 °C
Pressure arterial
Pressure venous
TMP
-60
40
50
Ultrafiltration
80 ml/h
UF goal
0 ml
All pressures
arterial
venous
Treatment modes
Preparation
Treatment parameters
Treatment
End of treatment
System parameters




# PRESCRIPTION WIZARD

# FINESTRA DI CONTROLLO POSTI LETTO


Form2
File User Export Tools Patient Help ?
Cardiology ICU PF 15
Donald Duck
6/11 7/11 8/11 9/11 10/11 11/11 12/11 12/11 13/11 14/11 15/11
Real Time
Prescriptions
Charts
Graphs
Scores
Treatment time (hh:mm) 18:35
Prescribed Kt/V: 1.40
Performed Kt/V: 0.94
Performed/Prescribed Kt/V: 67%
Prescribed Fluid Removal (ml): 4000
Performed Fluid Removal (ml): 3200
Performed/Prescribed Fluid Removal: 80%
Total last hour
BLOOD (ml) 130
Replacement (ml) 80
Dialysate (ml) 3.9
Pt Fluid Removal (ml) 3.9
PBP (ml) 3.9
Effluent (ml) 110
ALARM: Effluent bag full
10 October 04 10:00
Setup NoCh
Currently Delivering: CVVH
(mmHg)
BLOOD 130 ml/min
Replacement 80 ml/hr 1.11
Pre
Dialysate 3.9 ml/hr 0.05
Pt Fluid Removal 3.9 ml/hr
PBP 70 ml/hr 0.97
Effluent 110 ml/hr 1.52
PBP Method INFUSION
Syringe pump
Bolus Volume 3.5 ml
Bolus Interval 20 min
Access 480 -500 500
Filter 50 -500 500
Effluent -350 -500 500
Return -330 -500 500
Pressure DROP: 46
TMP: 30
Interventions list
Remaining_Time Date_Time Monitor
NOW 12/2/2004 5:12:42 PM PF 15
(null) (null) (null)


Form2
File User Export Tools Patient Help ?
Cardiology ICU PF 15
Donald Duck
6/11 7/11 8/11 9/11 10/11 11/11 12/11 12/11 13/11 14/11 15/11
Real Time
Prescriptions
Charts
Graphs
Scores
Treatment start date and time
Monday, november 15 2004 - 13:30
Prescribed Kt/V:
1.40
Prescribed Fluid Removal (ml):
4000
Dialysis Device
PrismaFlex
Treatment type
CVVHDF
Duration
20 h 00 min
Filter type
M100
Access type
Femoral
Vascular Access Set
Dbl Lumen 13,5 F
Vascular Access Dim.
15 cm
Line maintenance
Heparin lock
Priming solution
Heparinized saline
Replacement Pre
Saline
Replacement Post
Gambro R333
Dialysate solution
Gambro S50
Dialysate warmed
Yes
Anticoagulation
Heparin
Anticoag. Mode
Cont.
Anticoag. Flow (ml/h)
10
Initial bolus (ml)
0
Blood Flow (ml/min)
140
Dialysate Flow (ml/h)
130
Repl. Pre Flow (ml/h)
30
Repl. Post Flow (ml/h)
20
PBP (ml/h)
50
Blood pump
140
ml/min
Syringe
10
ml/h
PBP
50
ml/h
Ratio = 1 : 11.5
Dialysate
130
ml/h
Replacement
30
ml/h
Effluent bag
PBP Bag
Dialysate Bag
Replacement Bag
Drugs and bloodworks
Type
Instruction
Drugs
No ACE inhibitors while in CVVH
Drugs
Magnesium Replacement: if magnesium level <1.8; give Magnesium Sulfate
Drugs
Phosphorous Replacement: if phosphorous level <2; give Kphos 20 mmol IV o
Laboratory
a.Metabolic panel, Mg, ionized Ca, CBC at initiation and q 2 hours X 3 then if st
Laboratory
b.Potassium level, ionized Calcium, every 6 hours using iSTAT for 24 hours"
Laboratory
c.ABG at initiationd. If potassium level, HCO3 and ionized calcium are in normal

PrescriptionWizard_5

Cardiology ICU PF 15

# Donald Duck

## Performed treatment evaluation

Treatment time within last 24 hours: 18:35

Blood flow rate (ml/min) 180

Prediluition replacement rate (ml/hr) 4000

Postdiluition replacement rate (ml/hr) 4000

Fluid removal rate (ml/hr) 4000

Anticoagulant rate (ml/hr) 20

Calculated urea clearence (ml/min) 3

○ K ◉ Kt/V ○ ml/Kg/hr

Prescribed: 1.40

Delivered: 0.94

Delivered/Prescribed: 67%

**Fluid Removal (ml)**

Prescribed: 4000

Performed: 3200

Performed/Prescribed: 80%

<<

## New prescription - Step 5/5

| Parameter | Value | Uom | Parameter_ | Value_ | Uom_ |
|---|---|---|---|---|---|
| Time | 21 | hh:mm | CRRT Fluid | 46,2 | l/day |
| Urea clearan | 2200 | ml/h | Total Fluid Ba | 2000 | l/day |
| Kt/V | 1,2 | | Blood Filtratio | (null) | % |
| Dose | 31,43 | ml/Kg/h | Plasma Filtrat | (null) | % |

| | | | | | |
|---|---|---|---|---|---|
| Dialysis Device | PrismaFlex | Priming solution | Heparinized saline | Blood Flow (ml/min) | 82 |
| Treatment type | CVVHDF | Dialysate solution | Gambro S50 | Dialysate Flow (ml/h) | 2000 |
| Duration | 20 h 00 min | Dialysate warmed | Yes | Repl. Pre Flow (ml/h) | 1098 |
| Filter type | M100 | Replacement Pre | Saline | Repl. Post Flow (ml/h) | 1098 |
| | | Replacement Post | Gambro R333 | PBP (ml/h) | 50 ? serve ? |
| Access type | Femoral | Anticoagulation | Heparin | N. Dialysate bags | 5 |
| Vascular Access Set | Dbl Lumen 13,5 F | Anticoag. Mode | Continuous | N. PBP bags | 5 |
| Vascular Access Dim. | 15 cm | Anticoag. Flow (ml/h) | 10 | N. Replacement bags | 9 |
| Line maintenance | Heparin lock | Initial bolus (ml) | 0 | Heparin ml | 552 |

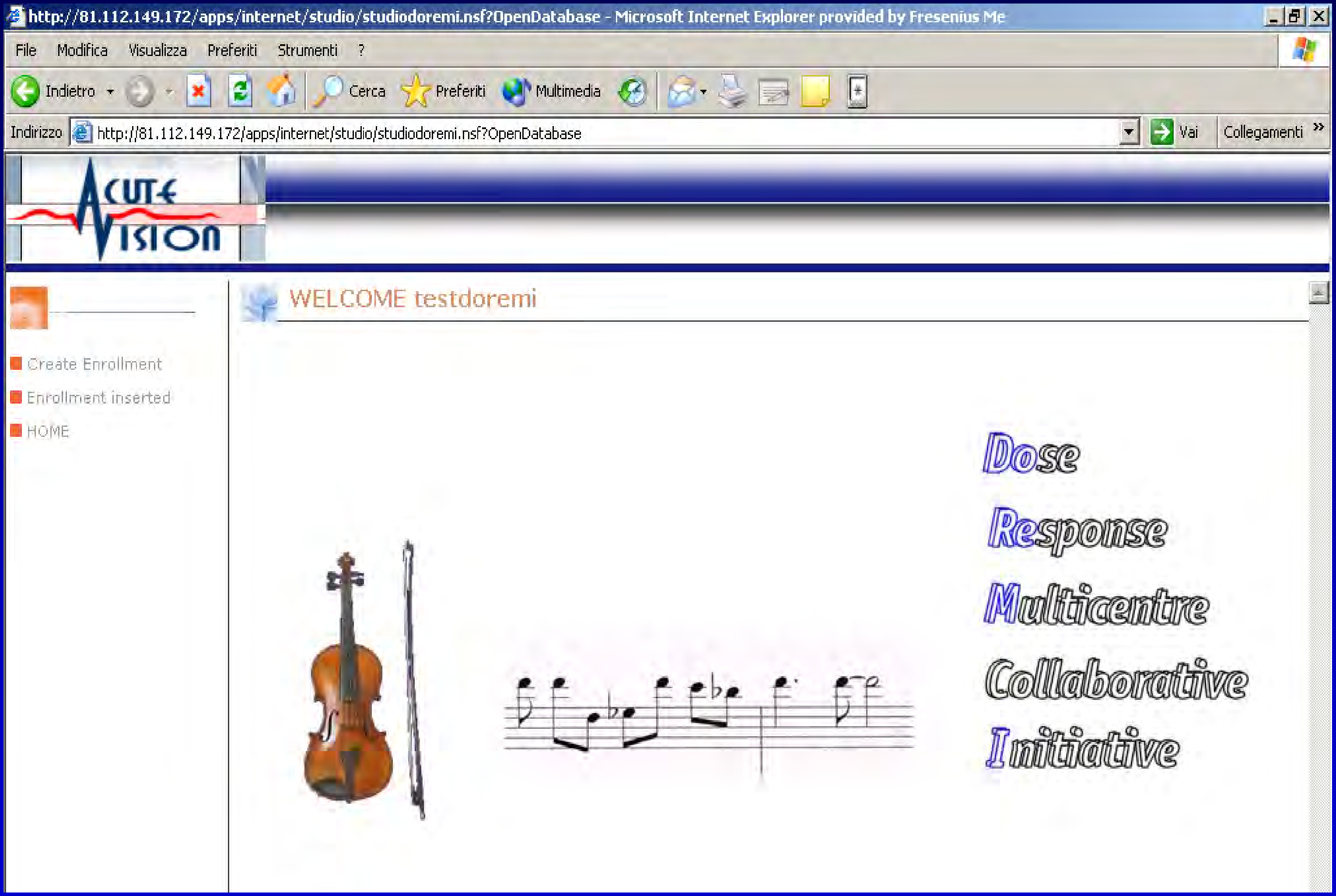
**Drugs and bloodworks**

- [x] Magnesium Replacement: if magnesium level <1.8; give Magnesium Sulfate 2 grams IV over 4 hours.
- [ ] Phosphorous Replacement: if phosphorous level <2; give Kphos 20 mmol IV over 6 hours.
- [ ] a. Metabolic panel, Mg, ionized Ca, CBC at initiation and q 2 hours X 3 then if stable q 6 hours."
- [ ] b. Potassium level, ionized Calcium, every 6 hours using iSTAT for 24 hours""""
- [ ] c. ABG at initiationd. If potassium level, HCO3 and ionized calcium are in normal ranges for 24 hours change to daily labs"

Cancel | << Back | Save

# INFORMATION TECNOLOGY FOR OBSERVATIONAL STUDIES

## Web – Based data collection



Research

**Open Access**

# Delivered dose of renal replacement therapy and mortality in critically ill patients with acute kidney injury

Sergio Vesconi[1*], Dinna N Cruz[2*], Roberto Fumagalli[3], Detlef Kindgen-Milles[4], Gianpaola Monti[1], Anibal Marinho[5], Filippo Mariano[6], Marco Formica[7], Mariano Marchesi[8], Robert René[9], Sergio Livigni[10], Claudio Ronco[2] for the DOse REsponse Multicentre International collaborative Initiative (DO-RE-MI Study Group)

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[6]Nephrology and Dialysis Unit, CTO Hospital, Via Gianfranco Zuretti 29, 10126 Turin, Italy
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[8]Department of Anaesthesiology and Intensive Care, Riuniti di Bergamo Hospital, Via Tito Livio 2, 24123 Bergamo, Italy
[9]Intensive Care Unit, University of Poitiers, 2, rue de la Miletrie, 86021, Poitiers, France
[10]Department of Intensive Care, Giovanni Bosco Hospital, Piazza Del Donatore di Sangue 3, 10154 Torino, Italy
* Contributed equally

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# Four Areas where telemedicine can be useful in Nephrology

- Integrated inter-hospital networks
- Integrated in-hospital networks
- Home hemo- and peritoneal dialysis

# Emodialisi

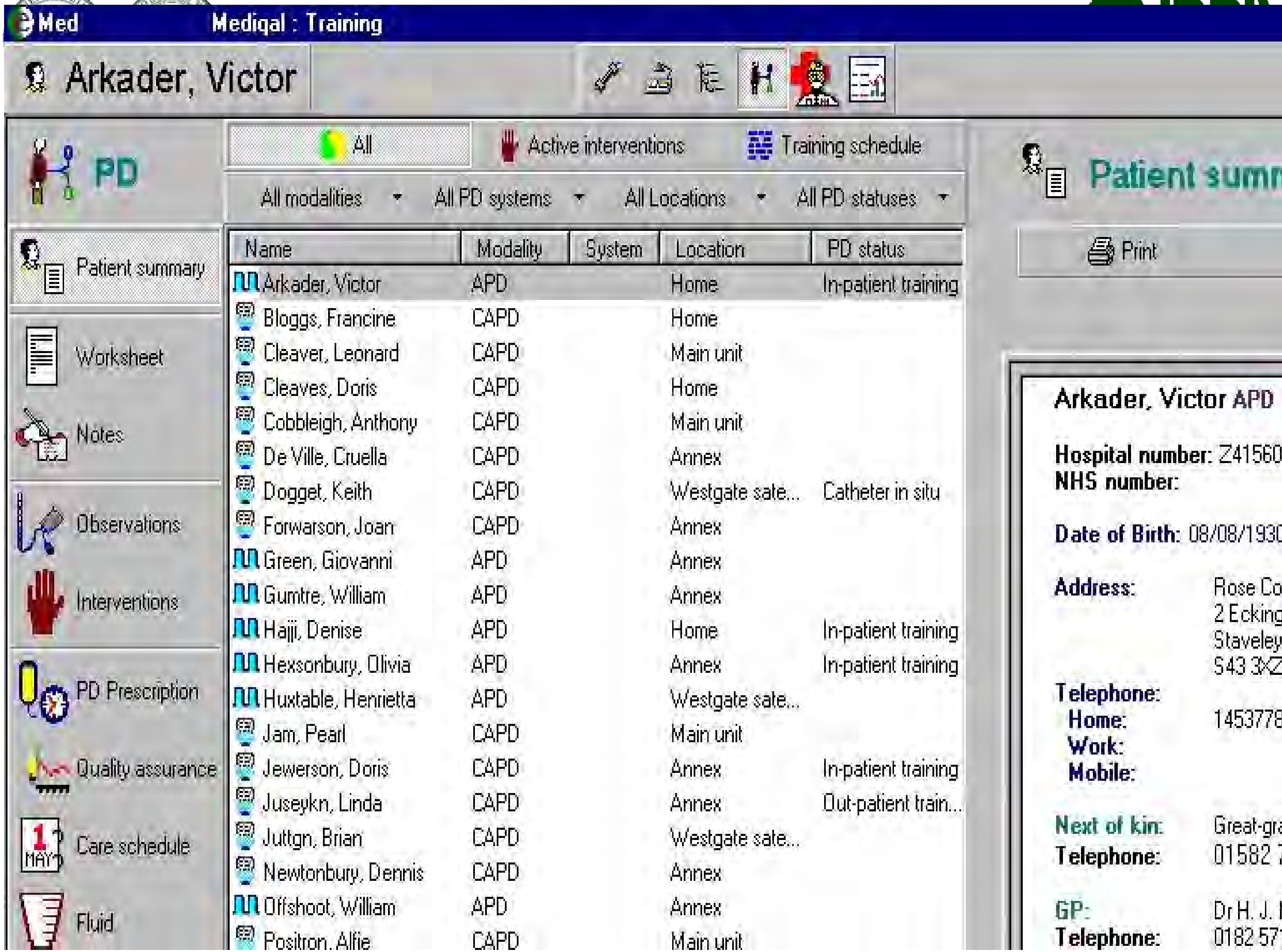
In spite of modern technology…….

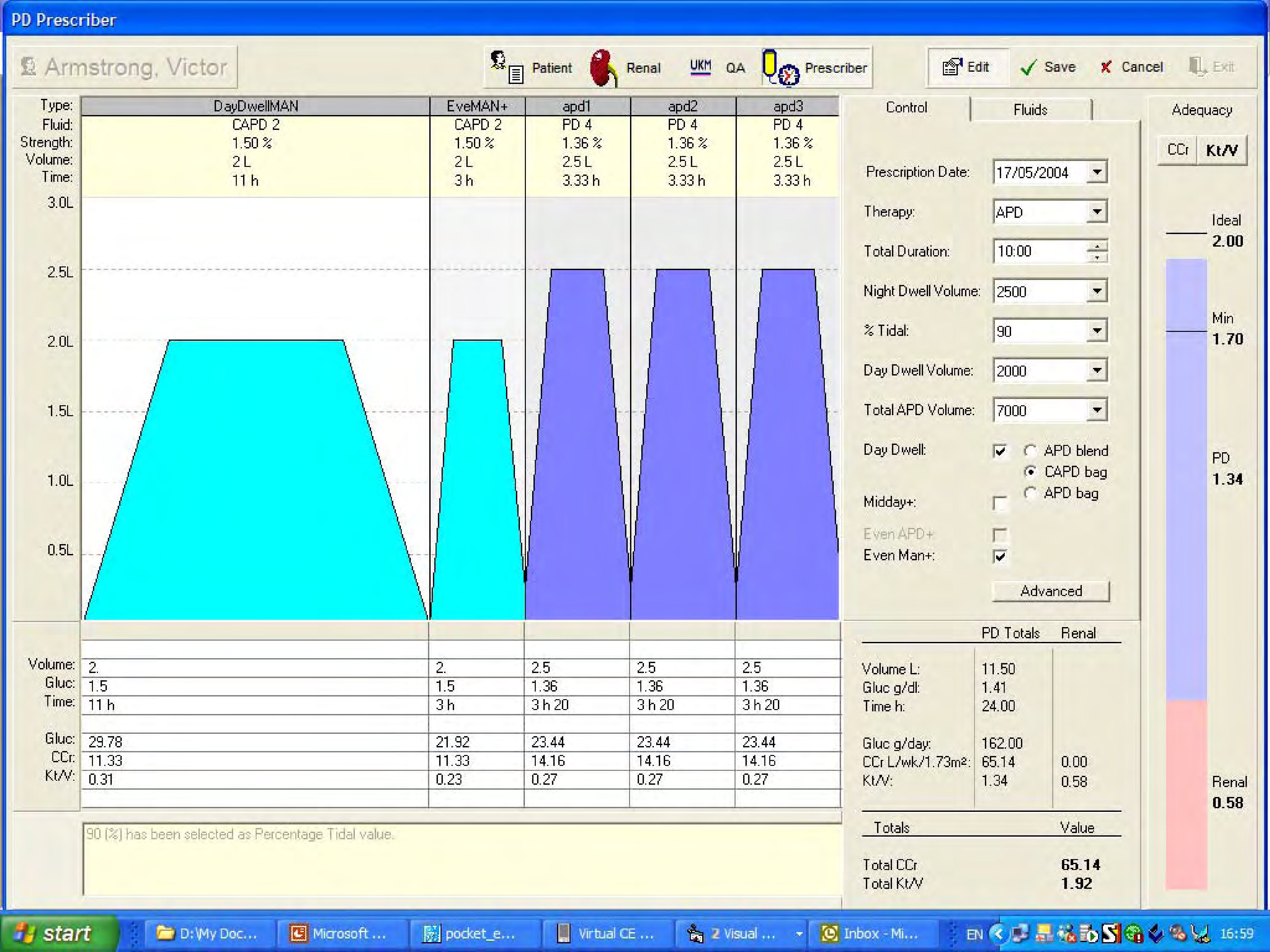
# Home Hemodialysis

# Dialisi peritoneale

The largest PD program in Europe

*All patients treated with PD: a truly home-based therapy*


Med
Mediqal : Training
Arkader, Victor
PD
All
Active interventions
Training schedule
Patient summ
All modalities
All PD systems
All Locations
All PD statuses
Print
Patient summary
Worksheet
Notes
Observations
Interventions
PD Prescription
Quality assurance
Care schedule
Fluid
Name
Modality
System
Location
PD status
Arkader, Victor APD Home In-patient training
Bloggs, Francine CAPD Home
Cleaver, Leonard CAPD Main unit
Cleaves, Doris CAPD Home
Cobbleigh, Anthony CAPD Main unit
De Ville, Cruella CAPD Annex
Dogget, Keith CAPD Westgate sate... Catheter in situ
Forwarson, Joan CAPD Annex
Green, Giovanni APD Annex
Gumtre, William APD Annex
Hajji, Denise APD Home In-patient training
Hexsonbury, Olivia APD Annex In-patient training
Huxtable, Henrietta APD Westgate sate...
Jam, Pearl CAPD Main unit
Jewerson, Doris CAPD Annex In-patient training
Juseykn, Linda CAPD Annex Out-patient train...
Juttgn, Brian CAPD Westgate sate...
Newtonbury, Dennis CAPD Annex
Offshoot, William APD Annex
Positron, Alfie CAPD Main unit
Arkader, Victor APD
Hospital number: Z415608
NHS number:
Date of Birth: 08/08/1930
Address:
Rose Cott
2 Eckingt
Staveley
S43 3XZ
Telephone:
Home:
14537789
Work:
Mobile:
Next of kin:
Great-grar
Telephone:
01582 71
GP:
Dr H. J. M
Telephone:
0182 571


PD Prescriber
Armstrong, Victor
Patient
Renal
UKM QA
Prescriber
Edit
Save
Cancel
Exit
Type: DayDwellMAN EveMAN+ apd1 apd2 apd3
Fluid: CAPD 2 CAPD 2 PD 4 PD 4 PD 4
Strength: 1.50 % 1.50 % 1.36 % 1.36 % 1.36 %
Volume: 2 L 2 L 2.5 L 2.5 L 2.5 L
Time: 11 h 3 h 3.33 h 3.33 h 3.33 h
3.0L
2.5L
2.0L
1.5L
1.0L
0.5L
Volume: 2. 2. 2.5 2.5 2.5
Gluc: 1.5 1.5 1.36 1.36 1.36
Time: 11 h 3 h 3 h 20 3 h 20 3 h 20
Gluc: 29.78 21.92 23.44 23.44 23.44
CCr: 11.33 11.33 14.16 14.16 14.16
Kt/V: 0.31 0.23 0.27 0.27 0.27
90 (%) has been selected as Percentage Tidal value.
Control
Fluids
Prescription Date: 17/05/2004
Therapy: APD
Total Duration: 10:00
Night Dwell Volume: 2500
% Tidal: 90
Day Dwell Volume: 2000
Total APD Volume: 7000
Day Dwell:
APD blend
CAPD bag
APD bag
Midday+:
Even APD+
Even Man+:
Advanced
PD Totals Renal
Volume L: 11.50
Gluc g/dl: 1.41
Time h: 24.00
Gluc g/day: 162.00
CCr L/wk/1.73m²: 65.14 0.00
Kt/V: 1.34 0.58
Totals Value
Total CCr 65.14
Total Kt/V 1.92
Adequacy
CCr
Kt/V
Ideal
2.00
Min
1.70
PD
1.34
Renal
0.58
start
D:\My Doc...
Microsoft ...
pocket_e...
Virtual CE ...
2 Visual ...
Inbox - Mi...
EN
16:59


TASSINARI BILANCE

PD QA

ADAMS, HAYDN    Options

| date | test | result | attribute |
|---|---|---|---|
| 21/04/1998 | Urine Prot | 1.56 | |
| 21/04/1998 | Urine Urea | 92 | |
| 21/04/1998 | Urine Creat | 4.6 | |
| 21/04/1998 | Urine Vol 24 | 2.48 | |

## ADAMS, HAYDN

Hospital Number
**696969**

Date of birth
**23/02/1930**

NHS Number
**3499876734**

## PET
## Tuesday 21/04/98

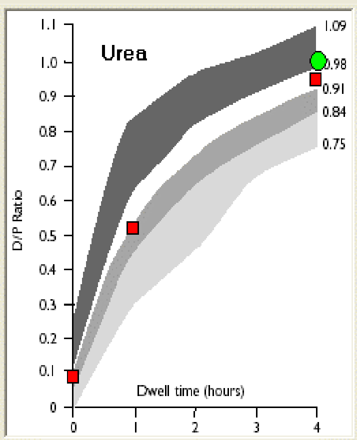
Transport state
2.27/2.5 2Litres

Urea
High

Creatinine
High

Ultrafiltration (Litres)
0.5

Plot Creatinine




Save    Cancel

| PET Blood | Urea | Creat | Glucose | Tot.Protein |
|---|---|---|---|---|
| | 23.4 mmol/L | 636 umol/L | 22.4 mmol/L | 63 mg/dL |

| | Sample time | Urea | Creat | Glucose |
|---|---|---|---|---|
| PET time 0 | 09:00 | 2 mmol/L | 123 umol/L | 145 mmol/L |
| PET 1hr | 10:00 | 12 mmol/L | 234 umol/L | 34 mmol/L |
| PET 4hr | 13:00 | 22 mmol/L | 600 umol/L | 29 mmol/L |

Save    Cancel

| | | |
|---|---|---|
| SRI - KT/V | 1.76 | |
| Creatinine clearance | 82 | L/wk/1.73m 2 |
| Ultrafiltration | 0.4 | Litres/day |
| Glucose absorption | 93 | g/day |
| nPNA | 1.14 | g/Kg/day |

Transport state

**Urea**

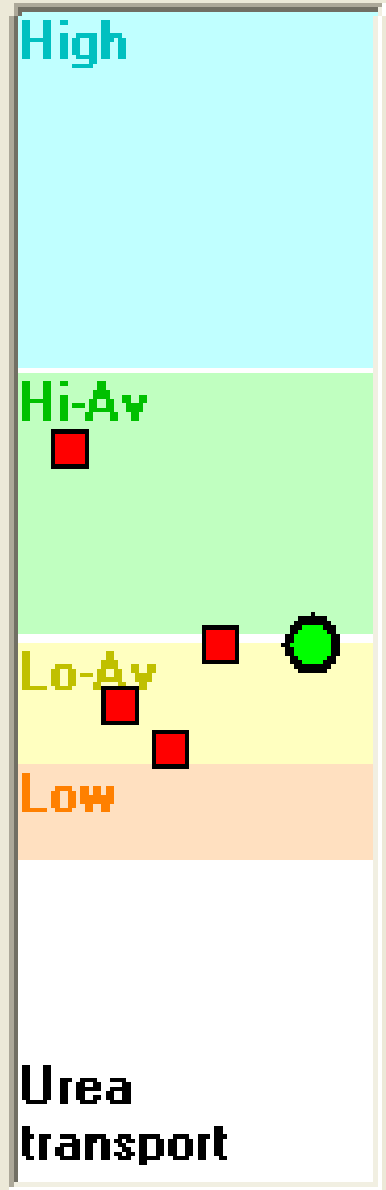
High-average

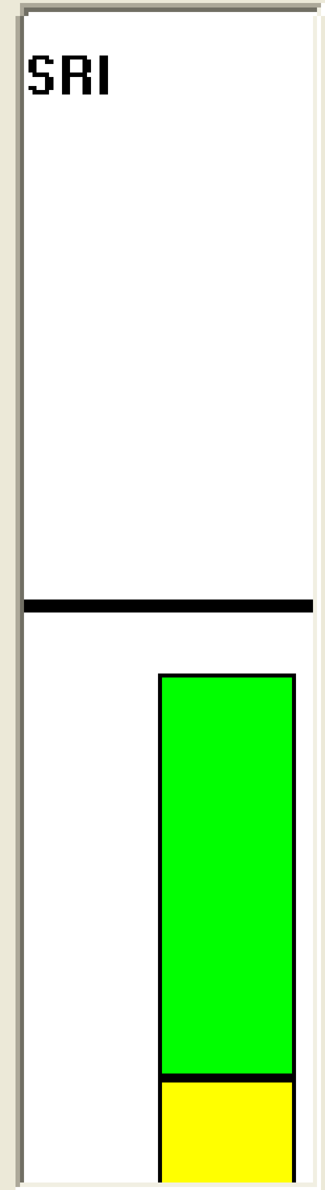
**Creatinine**

High-average

Detailed results

Plot creatinine




Save

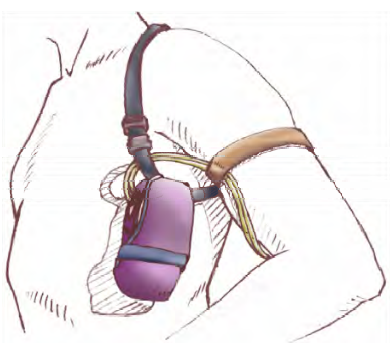
Cancel

Four Areas where telemedicine can be useful in Nephrology

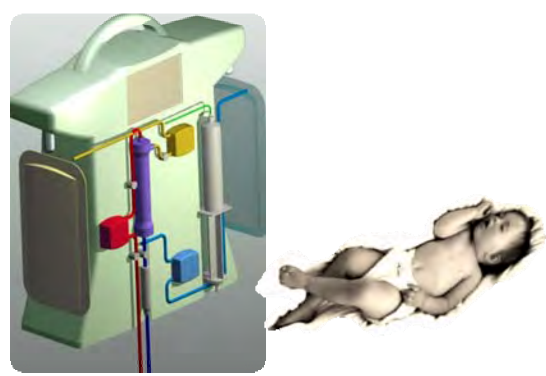
- Integrated inter-hospital networks
- Integrated in-hospital networks
- Home hemo- and peritoneal dialysis
- Wearable devices for dialysis and heart failure

# μ3D

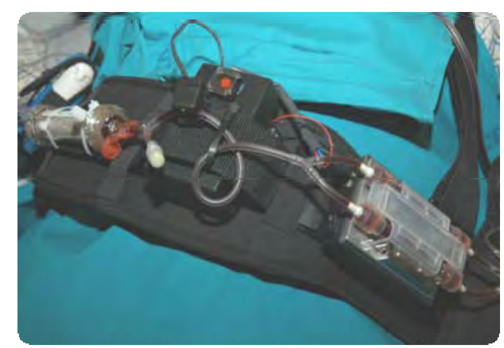
WUF

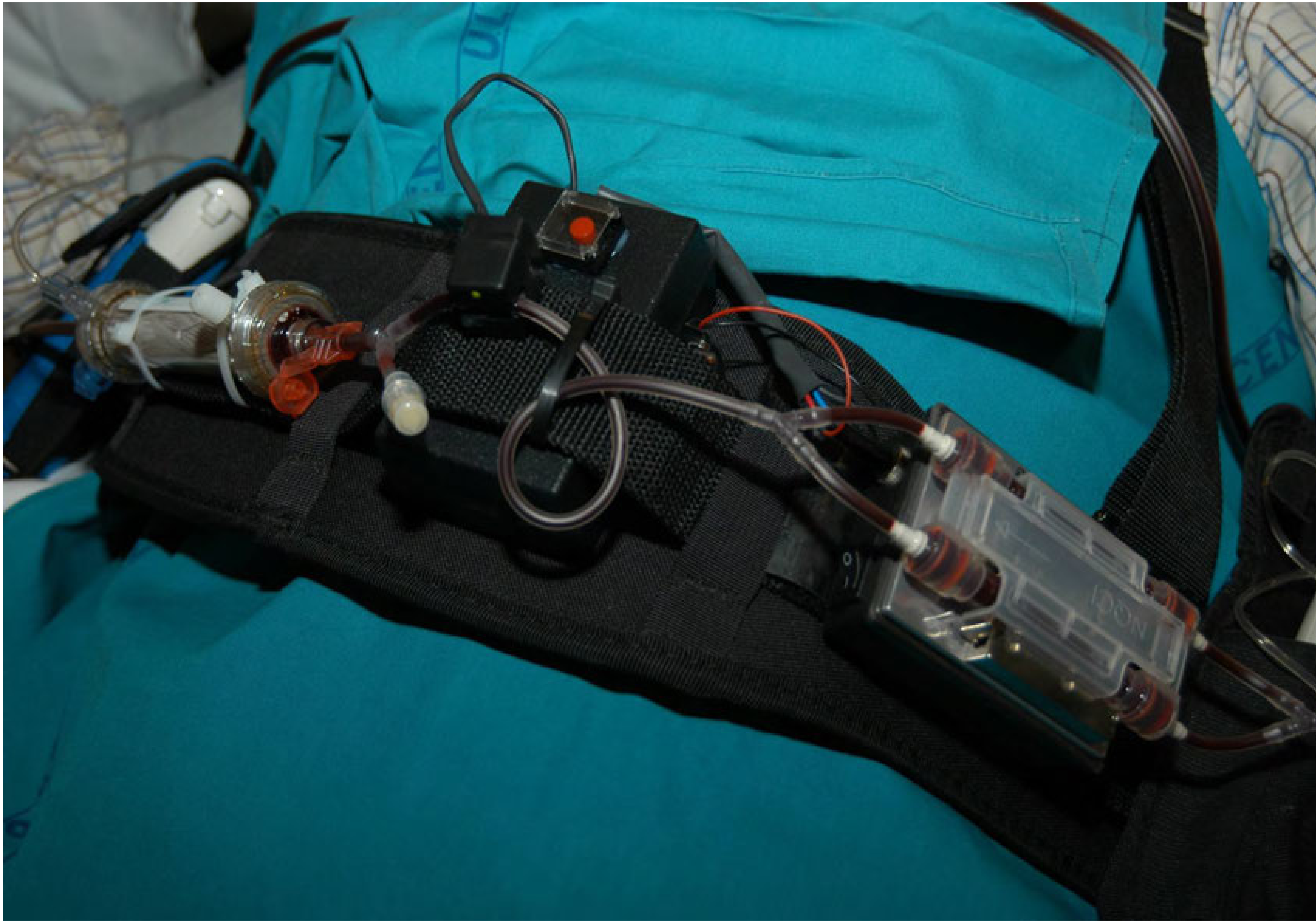


CARPEDIEM



WAK





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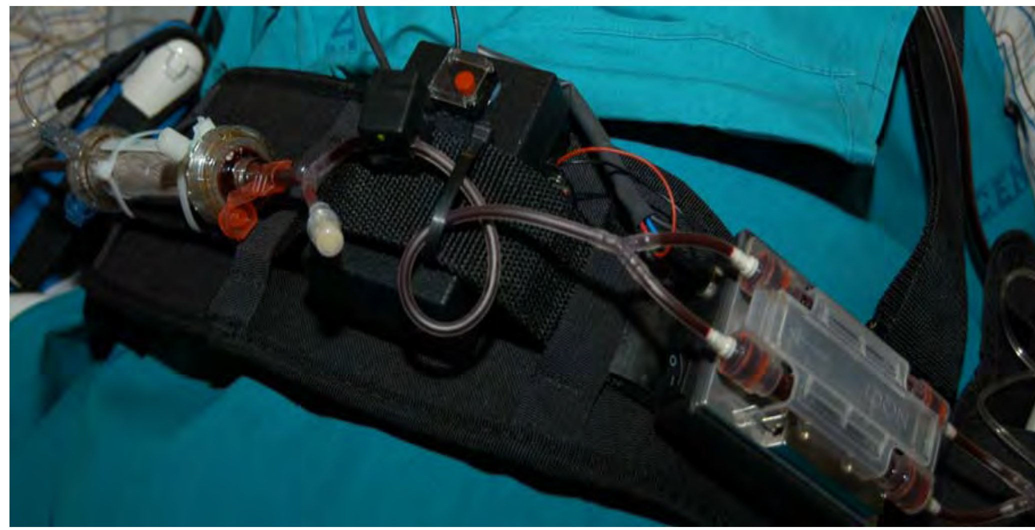

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Original Paper

Blood Purification

Blood Purif 145
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Published

# The Vicenza Wearable Artificial Kidney for Peritoneal Dialysis (ViWAK PD)

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[a]Department of Nephrology, St. Bortolo Hospital, Vicenza, and [b]R&D Department, Medica Srl, Medolla, Italy

# A wearable haemodialysis device for patients with end-stage renal failure: a pilot study

*Andrew Davenport, Victor Gura, Claudio Ronco, Masoud Beizai, Carlos Ezon, Edmond Rambod*

## Summary

*Background* More frequent haemodialysis can improve both survival and quality of life of patients with chronic kidney disease. However, there is little capacity in the UK to allow patients to have more frequent haemodialysis treatments in hospital and satellite haemodialysis units. New means of delivering haemodialysis are therefore required. Our aim

Centre for Nephrology,
Division of Medicine, Royal

# SmartPD

IMPROVED PATIENT FREEDOM:
ONE BAG EXCHANGE
BEFORE NIGHT,
SECOND BAG EXCHANGE
AT WAKE-UP +
LOADING OF SmartPD BELT,
ENHANCED EFFICIENCY IN
CATABOLYTES REMOVAL

FROM 4 BAGS PER DAY
TO
2 BAGS PER DAY

DAILY
BATTERY
OPERATED
ADSORPTION
SYSTEM

IRRIV
International Renal Research Institute Vicenza

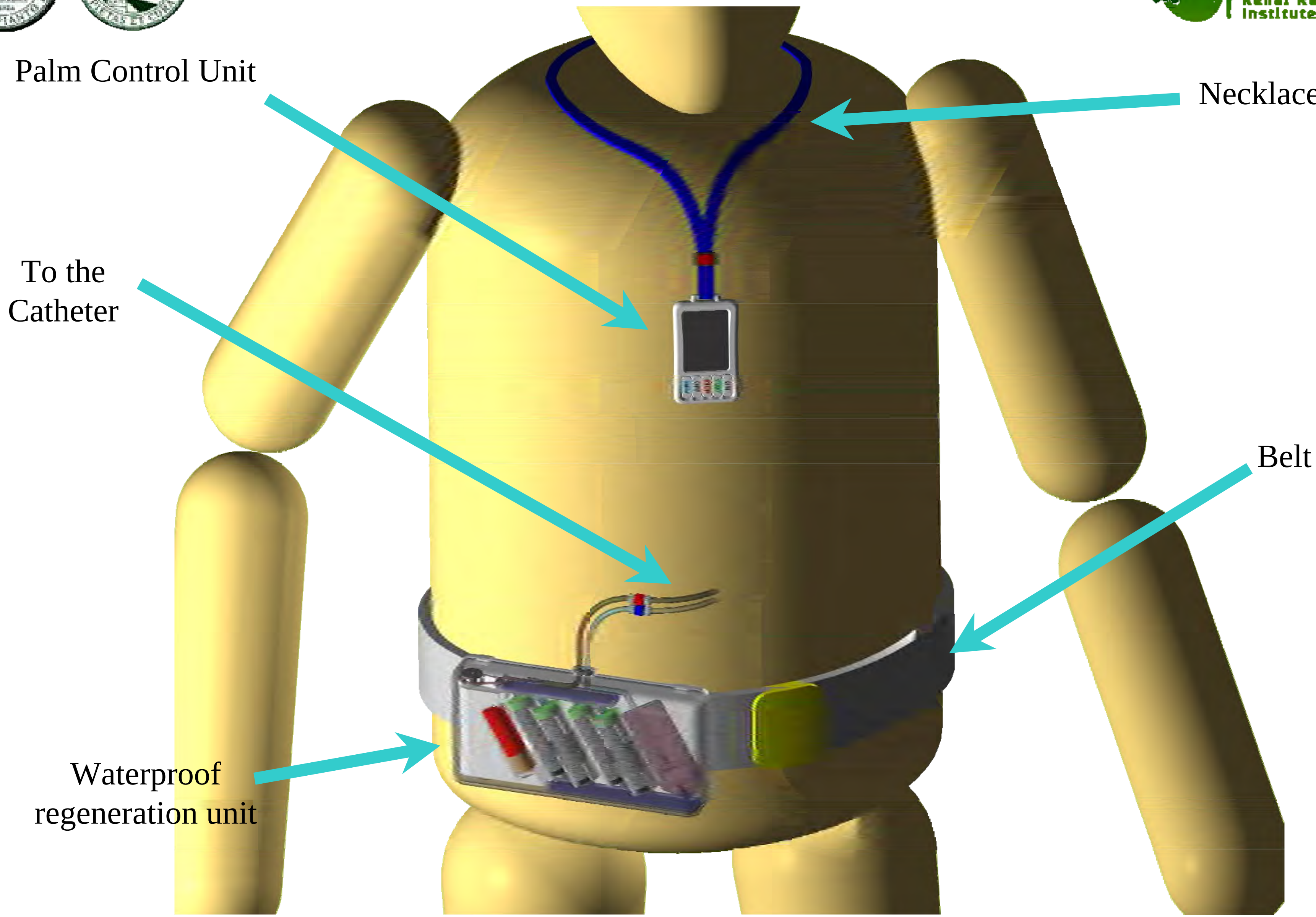
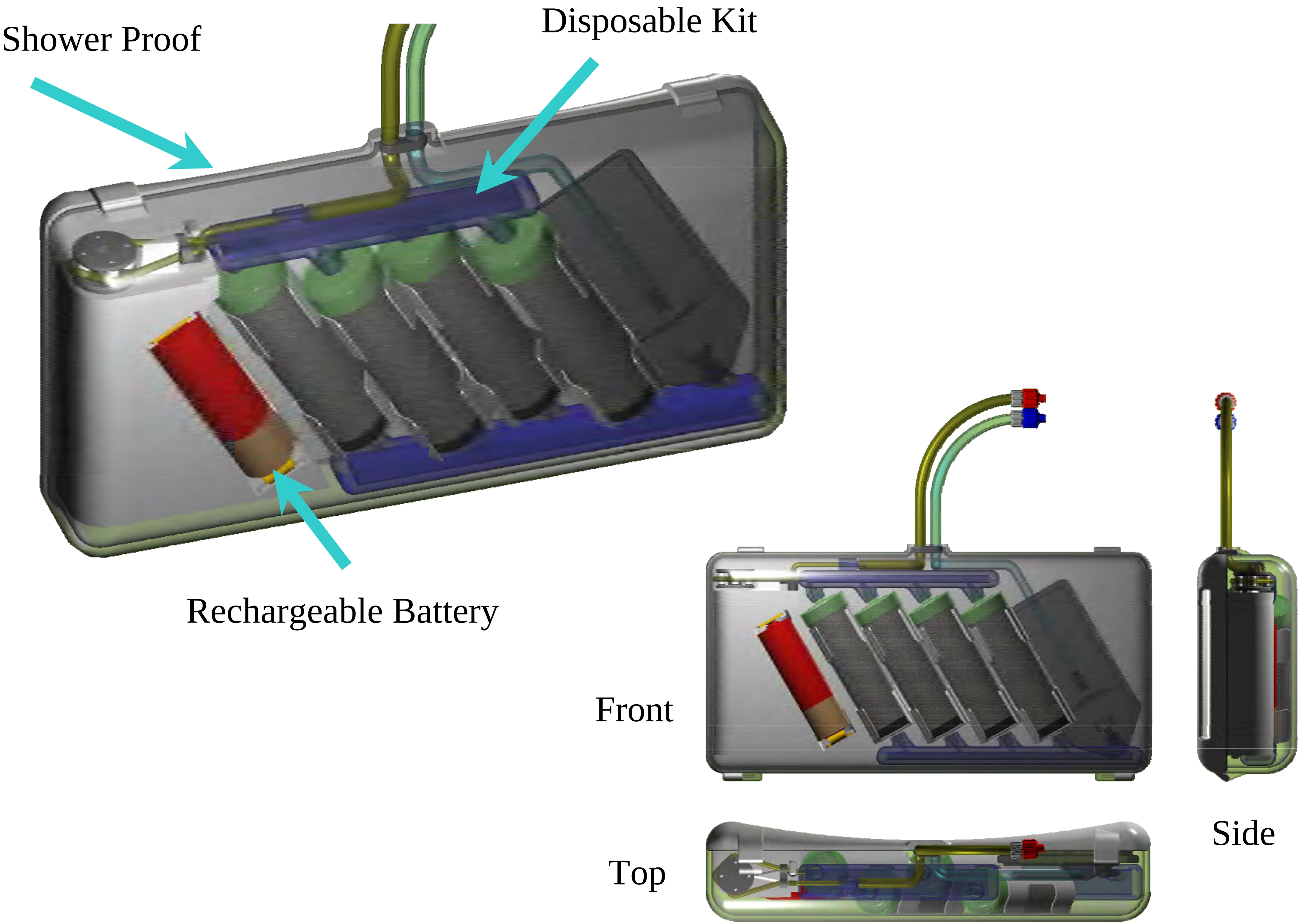
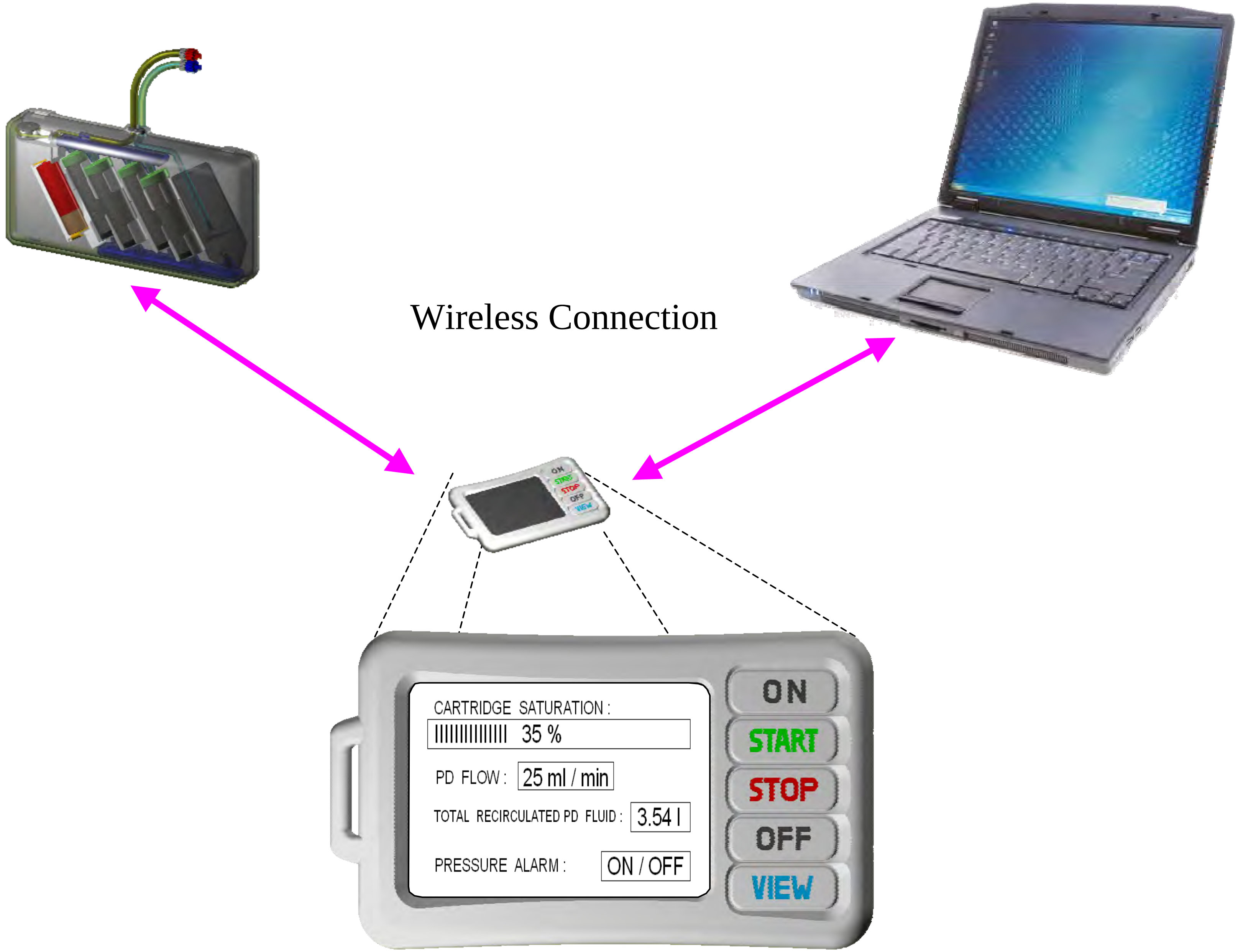


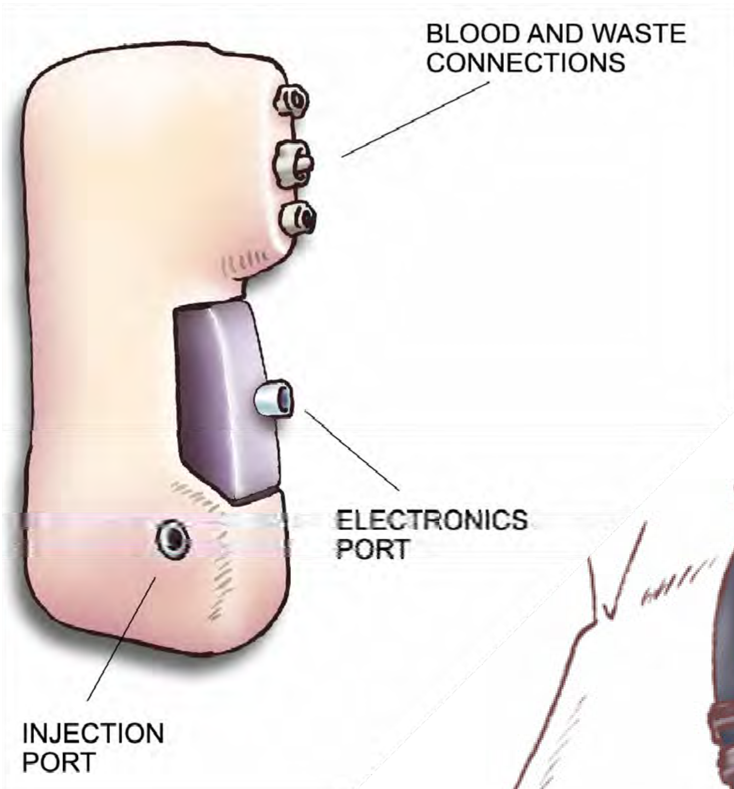

Fig 2

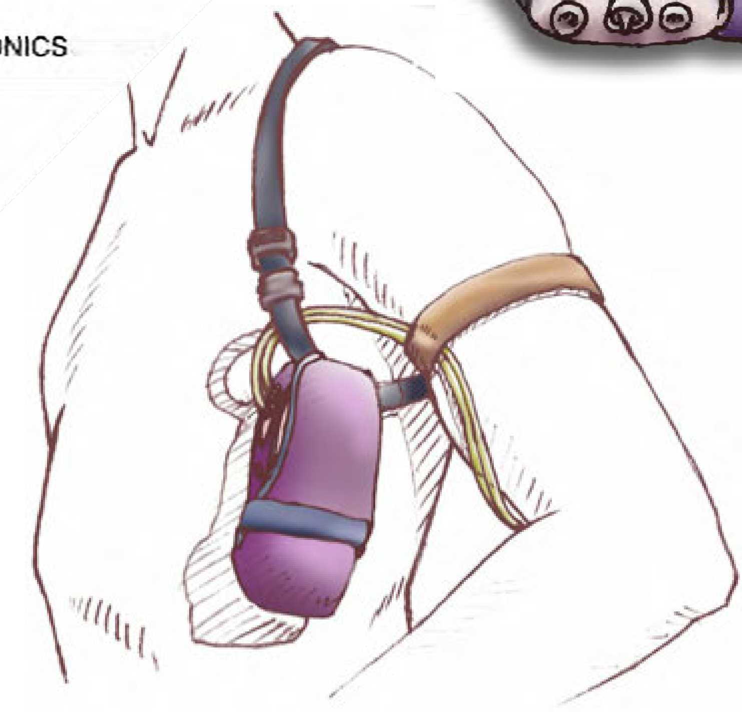

Shower Proof
Disposable Kit
Rechargeable Battery
Front
Side
Top

IRRIV International Renal Research Institute Vicenza



# A Wearable Continuously Functioning Artificial Nephron



Design Concept

IRRIV
International Renal Research Institute Vicenza

Department of Nephrology, Dialysis and Transplantation
International Renal Research Institute
Vicenza - Italy

IRRIV
International Renal Research Institute Vicenza

# World Conference on Portable, Wearable and Miniaturized Dialysis Systems

Vicenza (Italy)
October 1-2, 2010

# Telemedicine

- It will never be a substitute for personal doctor care
- It may help to vevelop a dehospitalization strategy
- It may result useful in several areas of Nephrology
- In particular:
    - for inter-hospital communications
    - for in-hospital interdisciplinary care
    - for home-based therapies
- It may become successfull if proven cost-effective