Development and validation of an APP based tool for prescription and prediction of extracorporeal therapies

Pablo E. Galindo Vallejo\textsuperscript{1,3}, Mauricio Moreno Yañez\textsuperscript{2}, Luis Eduardo Morales Buenrostro\textsuperscript{3}, Olynka Vega\textsuperscript{3}

\textsuperscript{1}Nephrology fellow, \textsuperscript{2}Consultant computer engineer, \textsuperscript{3}Nephrology and Mineral Metabolism, Instituto Nacional de Ciencias Médicas y Nutrición Salvador Zubiran, Vasco de Quiroga No 15, Tlalpan. 14000, México

\texttt{@galindozip}
\texttt{@adequator_app}
\texttt{galindozip@gmail.com}

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Intermittent Therapies

HD EVALUATOR

1. \( r = 0.99, \quad 95\% \text{ CI} = (0.98 - 0.99), \quad R^2 = 0.9, \quad P < 0.0001 \)
2. Bias = 0.128, SD of Bias 2.43, 95% Limits of agreement (-4.6 – 4.905)

1. \( R = 0.87, \quad 95\% \text{ CI} = (0.84 - 0.90), \quad R^2 = 0.76, \quad P < 0.0001 \)
2. Bias = 0.26, SD of Bias 14.62, 95% Limits of agreement (-28 – 28)
1. $r = 0.99$, 95% CI = (0.98 to 0.99), $R^2 = 0.98$, $P < 0.0001$
2. Bias = 0.48, SD of Bias 2.5, 95% Limits of agreement (-5 – 4.5)

1. $r = 0.99$, 95% CI = (0.98 to 0.99), $R^2 = 0.98$, $P < 0.0001$
2. Bias = -1.008, SD of Bias 2.9 95% Limits of agreement (-6 – 4.6)
1. $r = 0.77$, 95% CI = (0.7 - 0.8), $R^2 = 0.6$, $P < 0.0001$
2. Bias = -0.3, SD of Bias 4.8 95% Limits of agreement (-9.8 – 9)

1. $r = 0.74$, 95% CI = (0.68 to 0.79), $R^2 = 0.57$, $P < 0.0001$
2. Bias = -1.2, SD of Bias 12.71 95% Limits of agreement (-26.1 – 23.71)
1. $r=0.996$, 95% CI $=(0.998 \text{ to } 0.994)$, $R^2=0.9936$, $P<0.0001$
2. Bias $=-0.38$, SD of Bias 1.021, 95% Limits of agreement (-1--2)

1. $r=0.86$, 95% CI $=(0.78 \text{ to } 0.91)$, $R^2=0.74$ $P<0.0001$
2. Bias $=-8$, SD of Bias 13.95, 95% Limits of agreement (-35--18)
Therapeutic apheresis

- 3 Refill patterns between treatments
  1. Independent of treatment number
  2. Independent of time between treatment
  3. Dependent of patient only
Refill during treatments

Apheresis kinetic simulator

1. $r=0.94$, 95% CI= (0.91 to 0.96), $R^2=0.88$, $P<0.0001$
2. Bias= 0.3, SD of Bias 23.45 95% Limits of agreement (-45– 46)

1. $r=0.89$, 95% CI= (0.84 - 0.92), $R^2=0.8$, $P<0.0001$
2. Bias= -8.4, SD of Bias 13.95, 95% Limits of agreement (-35– 19)
1. \( r = 0.89 \), 95% CI = (0.85 - 0.93), \( R^2 = 0.80 \) \( P < 0.0001 \)
2. Bias = -0.13, SD of Bias 29.4, 95% Limits of agreement (-58 – 58)
CRRT

- 5 treatments evaluated with blood and effluent samples
- 15 nested predictions with the simulator

HDF, Prescribed dose 32 ml/kg/hr, total time 42 hours, two filters.
\[ r = 0.91, \text{ 95\% CI} = (0.74 - 0.97), R^2 = 0.82 \text{ P: <0.0001} \]

Bias = -2.8, SD of Bias 4.2, 95\% Limits of agreement (-11.2 - 5.5)
Development and validation of an APP based tool for prescription and prediction of extracorporeal therapies

Pablo E. Galindo Vallejo1,2, Mauricio Moreno Yañez2, Luis Eduardo Morales Buenrostro1, Olyunka Vega2

1Nephrology fellow, 2Consultant computer engineer, 3Nephrology and Mineral Metabolism, Instituto Nacional de Ciencias Médicas y Nutrición Salvador Zubirán, Vasco de Quiroga No 15, Tlalpan. 14000, México.

Background
Nephrologists, intensivists, and multidisciplinary teams are in contact with extracorporeal therapies during AKI and critical care. The most commonly used therapies are hemodialysis, hemodiafiltration, therapeutic apheresis, and CRRT. Each of these therapies is complex to prescribe, evaluate, and predict their outcome.

Aim
To develop a tool that:
- Can help PRESCRIBE these therapies through a friendly step method, and patient based platform.
- Accurately EVALUATE the therapies after being done.
- Accurately PREDICT therapies before being done.

Methods
We developed two formula based calculators for HDF and HD

We compared it with a formal urea kinetic model:
“Solute Solver”

Results
The evaluation calculator had strong correlation with the formal ULM
The predictor calculator gave accurate results

Conclusions
The calculator is a SIMPLE and ACCURATE tool for prescribing and predicting intermittent therapies, therapeutic apheresis and CRRT. A validation cohort is being evaluated for the apheresis simulator and more patients are being recruited for the CRRT calculator validation.
Development and validation of an APP based tool for prescription and prediction of extracorporeal therapies.

Pablo E. Galindo Vallejo\(^1\), Mauricio Moreno Yañez\(^2\), Luis Eduardo Morales Buenrostro\(^3\), Olynka Vega Vega\(^3\)

Affiliations: \(^1\)Nephrology fellow, \(^2\)Consultant computer engineer, \(^3\)Nephrology and Mineral Metabolism, Instituto Nacional de Ciencias Médicas y Nutrición Salvador Zubiran.

Background: Nephrologists are in contact with different types of extracorporeal therapies. These treatments include hemodialysis and hemodiafiltration for maintenance of ESRD, plasmapheresis for treatment of acute diseases affecting the kidney, and CRRT in AKI and critical ill patients. Each of these therapies are complex to prescribe, understand, and evaluate. The development of an simple, accurate, and accessible tool that can predict, evaluate, and help prescribe, could be of great value for clinicians in contact with these therapies.

METHODS: We developed three main calculators in a spreadsheet format (Excel®) and then programed them in Xcode® for a smartphone and tablet APP. The three main calculators included: Intermittent therapies (HD, HDF) with their evaluation and predicting calculator, plasmapheresis with a predictor and albumin calculator, and CRRT with an initial dose calculator, prescription calculator and a delivered dose predicting calculator. For validation of results we conducted two different studies and a third one that is under process. For the intermittent therapy calculator we analyzed 300 sessions of HD and 70 sessions of HDF and compared the results using a formal urea kinetic model (Solute Solver®). For the plasmapheresis calculator we evaluated 15 patients with antibody graft rejection who received 5 sessions of plasmapheresis. We obtained samples for IgG, IgA, IgM, and LDL before and after each session. We determined the residual intravascular macromolecule percentage and the refill percentage for each treatment and compared it with the results obtained with the calculator. For the CRRT predictor we plan to obtain 50 treatments and measure the delivered dose every 12 hours using BUN pre-filter, FUN, and effluent volume, then compare it with the one predicted by the calculator.

RESULTS: The HD evaluation calculator had strong correlation with the formal UKM: SpKtV (r=0.98), eKtV (r=0.98), stdKtV (r=0.98), nPCR (r=0.98) Modeled volume compared with solved Volume (r=0.88), Modeled Volume/Anthropometric volume ratio (r=0.70). For the HDF calculator we found Kd (r=0.98), and total Kd (r=0.99). For the HD predictor calculator we found: URR (r=0.7), and eKtV (r=0.74). For the HDF predictor calculator we found KtV (r=0.8). For the plasmapheresis predictor calculator we identified three main groups of refilling percentage. When classifying each patient to a refilling group we obtained good correlation: IgG distribution prediction (r=0.87), IgA distribution prediction (r=0.89), IgM distribution prediction (r=0.83), LDL distribution prediction (r=0.87). Concordance by Bland-Altman was high (XXXX)

CONCLUSIONS: The APP based tool calculator is an easy and accurate tool for prescribing and predicting intermittent therapies and plasmapheresis. The CRRT calculator has a friendly and step method prescription tool for CVVH, CVVHD, CVVHDF and SCUF.