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*Form Approved*  
OMB No. 0704-0188

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<b>1. REPORT DATE (DD-MM-YYYY)</b> 08/26/2017		<b>2. REPORT TYPE</b> Presentation		<b>3. DATES COVERED (From - To)</b> 08/26/2017-08/30/2017	
<b>4. TITLE AND SUBTITLE</b> Utilizing Creatinine Kinetics to Better Understand Instantaneous Creatinine Clearance				<b>5a. CONTRACT NUMBER</b>	
				<b>5b. GRANT NUMBER</b>	
				<b>5c. PROGRAM ELEMENT NUMBER</b>	
				<b>5d. PROJECT NUMBER</b>	
				<b>5e. TASK NUMBER</b>	
				<b>5f. WORK UNIT NUMBER</b>	
<b>6. AUTHOR(S)</b> LT Col Jonathan Sosnov				<b>8. PERFORMING ORGANIZATION REPORT NUMBER</b>  17330	
<b>7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)</b> 59th Clinical Research Division 1100 Willford Hall Loop, Bldg 4430 JBSA-Lackland, TX 78236-9908 210-292-7141				<b>10. SPONSOR/MONITOR'S ACRONYM(S)</b>	
<b>9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)</b> 59th Clinical Research Division 1100 Willford Hall Loop, Bldg 4430 JBSA-Lackland, TX 78236-9908 210-292-7141				<b>11. SPONSOR/MONITOR'S REPORT NUMBER(S)</b>	
<b>12. DISTRIBUTION/AVAILABILITY STATEMENT</b> Approved for public release. Distribution is unlimited.					
<b>13. SUPPLEMENTARY NOTES</b>					
<b>14. ABSTRACT</b>					
<b>15. SUBJECT TERMS</b>					
<b>16. SECURITY CLASSIFICATION OF:</b>			<b>17. LIMITATION OF ABSTRACT</b>	<b>18. NUMBER OF PAGES</b>	<b>19a. NAME OF RESPONSIBLE PERSON</b> Clarice Longoria
<b>a. REPORT</b>	<b>b. ABSTRACT</b>	<b>c. THIS PAGE</b>			<b>19b. TELEPHONE NUMBER (Include area code)</b> 210-292-7141

# Utilizing Creatinine Kinetics to Better Understand Instantaneous Creatinine Clearance

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## Disclaimers

- The views expressed are the authors and do not reflect the official view or policy of the Department of Defense or its Components. A waiver was obtained for informed consent of the subjects used in this research as required by 32 CFR 219 and DODI 3216.02\_AFI 40-402

# Acute Kidney Injury

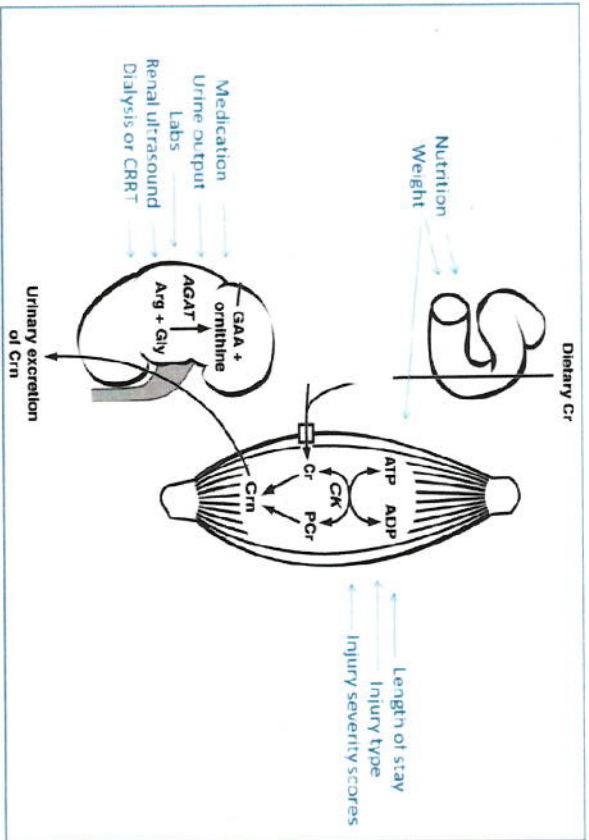
- In military combat casualties, AKI develops 34.3% of the time and is associated with 21.7% mortality
- Standard definitions of AKI use either the absolute value or the change in creatinine or urine output (THE PATIENT STATE)
- Nephrologists often look for the underlying cause (THE EVENT) and whether the damage is ongoing

# AKIN Criteria

Classification/Staging System for AKIN Criteria	Definitions
AKIN 1	<ul style="list-style-type: none"><li>-Urine Output: &lt; 0.5 ml/kg per hour for 6 hours</li><li>-Serum Creatinine: Increase in SC &gt; 0.3 mg/dl in 48hours</li><li>-Serum Creatinine: Increase in SC from baseline &gt; 150%</li></ul>
AKIN 2	<ul style="list-style-type: none"><li>-Urine Output: &lt; 0.5 ml/kg per hour for 12 hours</li><li>-Serum Creatinine: Increase in SC from baseline &gt; 200%</li></ul>
AKIN 3	<ul style="list-style-type: none"><li>-Urine Output: &lt; 0.3 ml/kg per hour for 24 hours, or anuria for 12 hours</li><li>-Serum Creatinine: value being equal or greater than 4.0 mg/dl with an acute increase of at least 0.5mg/dl</li><li>-Serum Creatinine: Increase in SC from baseline &gt; 300%</li></ul>

# The Real Question

- Is the patient getting better, worse or staying the same?
- Production of creatinine takes time
- The *changes* in renal function are seen more in the *changes* of serum creatinine as compared to production rather than the current absolute value
- For example, a patient with a creatinine of 1 mg/dl and instantaneous removal of all kidney function would still result in a creatinine of approximately 1 mg/dl a few minutes later



- GAA + ornithine  
 AGAT  
 Arg + Siv

Length of stay  
 Injury type  
 Injury severity scores

# Kinetic Estimate GFR (keGFR)

$$keGFR = \frac{SSPCr \times CrCl}{MeanPCr} \times \left( 1 - \frac{24 \times \Delta PCr}{\Delta Time(h) \times Max \Delta PCr / Day} \right)$$

Stable Patients CrCl : MDRD, CKD Epi

# Predicted Peak Creatinine

- We re-worked the keGFR equation to help us answer whether the patient was getting better, worse or staying the same
- At any time with 2 creatinines, we can predict the third and determine whether it is higher, lower or the same as predicted

$$\text{Predicted Peak Creatinine} = \frac{\text{Max}\Delta\text{PCr}/\text{Day} \times \Delta\text{Time} \times \text{MeanPCr}}{\text{Max}\Delta\text{PCr}/\text{Day} \times \Delta\text{Time} - 24 \times \Delta\text{PCr}}$$

# AKIN Calculator

File Edit Help

Age: 36 yrs    Weight: 63.39 kg    Present ID:     Lead Patient:

Race:  Not Black     Black

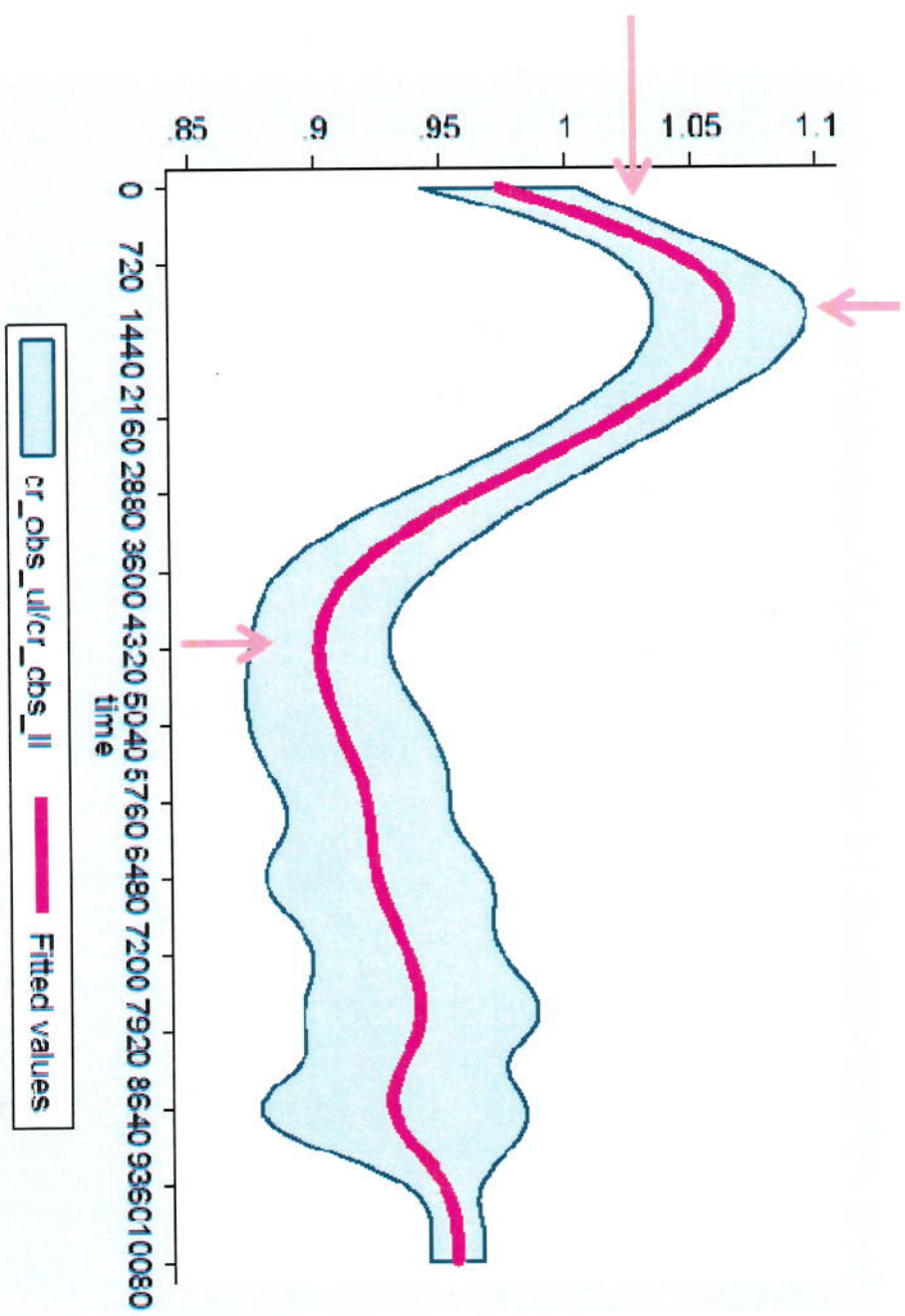
Gender:  Male     Female

Creatinine	Date	Time	AKIN	CG		MDRD		Pred Cr	Severity %	Outcome
				egFR	egFR	keGFR	egFR			
0.8	1/8/2003	0932	0	114.45	116.26	123.9	0.77	9.09		
0.8	1/10/2003	0550	0	114.45	116.26	116.26	0.8	3.75		
0.8	1/11/2003	0636	0	114.45	116.26	116.26	0.8	0		
0.8	1/18/2003	0951	0	114.45	116.26	116.26	0.8	0		

Add Row    Calculate



Clear    Cancel



## Next Steps

- Determine thresholds naïve model
- Build model that includes creatinine production factors
- Compare models
- Compare to nephrologists best guess of when an injury occurred

# Future Renal Function Kinetics Calculator

- Focus on **EVENTS** that harm the kidney and not the **STATE** of the laboratory results
- Tell us whether the patient is getting better, worse or staying the same
- Assist the clinician with triage and treatment
- Assist the researcher in developing better treatments

# References

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**Questions?**