Kidney Disease in Dogs and Cats: How to Make the Most from an Early Diagnosis

Robert M. DuFort, DVM, DACVIM, FMS III
Key learning objectives

- To show why the IDEXX SDMA® Test is a more reliable indicator of kidney function than traditional diagnostics.
- To emphasize that clinical information and diagnostic results need to be evaluated together to determine if acute kidney injury (AKI) or chronic kidney disease (CKD) is present.
- To review what next steps should be taken when kidney disease is diagnosed.
- To review the International Renal Interest Society (IRIS) CKD guidelines.
- To highlight the benefits of diagnosing kidney disease earlier and more reliably.
Limitations of traditional kidney diagnostics

**Creatinine**
- Late marker
- Impacted by other factors including muscle mass

**BUN**
- Late marker
- Impacted by other factors including diet, liver disease

**GFR**
- Expensive
- Not practical
- Rarely done in practice

**Specific Gravity**
- Urine test
- Later marker
- Impacted by other factors and other diseases (e.g. diabetes)

**UPC**
- Urine test
- False positives with UTI
- Can be normal with kidney disease

**Microalbuminuria**
- Urine test
- False positives
- Not specific for kidney
What is SDMA?

- SDMA = Symmetric dimethylarginine
- Methylated form of arginine in intracellular proteins of all nucleated cells
- Released into circulation when intracellular proteins are processed
- Stable production of SDMA is part of daily cell activity
- Excreted by the kidneys
- A proven renal biomarker that has been shown to correlate with glomerular filtration rate (GFR) in humans, dogs, and cats

Now available from IDEXX Reference Laboratories
Available in late 2017 in-clinic on IDEXX Catalyst® platform
Why is SDMA more reliable than traditional diagnostics?

**SDMA is more sensitive:** SDMA increases earlier than creatinine.

### Sources
Why is SDMA more reliable than traditional diagnostics?

SDMA is more specific: Creatinine is impacted by lean body mass but SDMA is not.


How do I know it is accurate?

"Creatinine is so 1950s."

Over 40 peer-reviewed publications

Endorsement by IRIS

Human field takes interest in SDMA
When should you run SDMA on your patients?

...is for all patients in all cases.

...results are clinically actionable.

...increases with active and acute kidney injury.

...allows for early diagnosis and management of CKD.
Why should you run SDMA in all patients?

Because kidney disease is common!

In time, at least 1 in 3 cats\textsuperscript{1} and 1 in 10 dogs\textsuperscript{2} will develop some form of kidney disease in their lifetime.

Sources
When do we diagnose dogs and cats with kidney disease?

- Diagnostic testing for clinical signs of kidney disease
- Preventive screens during wellness visits
- Preanesthetic screening
- Diagnostic testing for clinical signs of other illnesses
- During evaluation for and treatment of hyperthyroidism
Case study: Molly
<table>
<thead>
<tr>
<th>Test</th>
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<th>Reference Range</th>
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<tbody>
<tr>
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<td>5.39 - 8.7 M/μL</td>
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<td>Hematocrit</td>
<td>43.0</td>
<td>38.3 - 56.5 %</td>
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<td>Hemoglobin</td>
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<td>13.4 - 20.7 g/dL</td>
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<tr>
<td>MCV</td>
<td>67</td>
<td>59 - 76 fL</td>
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<td>MCH</td>
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<td>21.9 - 26.1 pg</td>
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<tr>
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<td>% Reticulocyte</td>
<td>0.6</td>
<td>%</td>
</tr>
<tr>
<td>Reticulocyte</td>
<td>39</td>
<td>10 - 110 K/μL</td>
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<tr>
<td>WBC</td>
<td>16.2</td>
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<tr>
<td>Neutrophil</td>
<td>10.984</td>
<td>2.94 - 12.67 K/μL</td>
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<tr>
<td>Lymphocyte</td>
<td>3.677</td>
<td>1.06 - 4.95 K/μL</td>
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<tr>
<td>Monocyte</td>
<td>0.583</td>
<td>0.13 - 1.15 K/μL</td>
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<tr>
<td>Eosinophil</td>
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<td>0.07 - 1.49 K/μL</td>
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<tr>
<td>Basophil</td>
<td>0.016</td>
<td>0 - 0.1 K/μL</td>
</tr>
<tr>
<td>Platelet</td>
<td>232</td>
<td>142 - 413 K/μL</td>
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### Molly

**8/8/15 (Order Received)**

**8/9/15 4:54 AM (Last Updated)**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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<th>Notes</th>
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<tr>
<td>Glucose</td>
<td>113</td>
<td>63 - 114 mg/dL</td>
<td></td>
</tr>
<tr>
<td>IDEXX SDMA</td>
<td>20</td>
<td>0 - 14 μg/dL</td>
<td></td>
</tr>
<tr>
<td>Creatinine</td>
<td>1.0</td>
<td>0.5 - 1.5 mg/dL</td>
<td></td>
</tr>
<tr>
<td>BUN</td>
<td>30</td>
<td>9 - 31 mg/dL</td>
<td></td>
</tr>
<tr>
<td>Potassium</td>
<td>4.7</td>
<td>4.0 - 5.4 mmol/L</td>
<td></td>
</tr>
<tr>
<td>Total Protein</td>
<td>5.1</td>
<td>5.5 - 7.5 g/dL</td>
<td></td>
</tr>
<tr>
<td>Albumin</td>
<td>3.1</td>
<td>2.7 - 3.9 g/dL</td>
<td></td>
</tr>
<tr>
<td>Globulin</td>
<td>2.0</td>
<td>2.4 - 4.0 g/dL</td>
<td></td>
</tr>
<tr>
<td>Alb:Glob Ratio</td>
<td>1.6</td>
<td>0.7 - 1.5</td>
<td></td>
</tr>
<tr>
<td>ALT</td>
<td>31</td>
<td>18 - 121 U/L</td>
<td></td>
</tr>
<tr>
<td>ALP</td>
<td>91</td>
<td>5 - 160 U/L</td>
<td></td>
</tr>
</tbody>
</table>
Can we diagnose Molly with CKD?

Need clinical information!
- Signalment
- Clinical signs: appetite, weight loss, vomiting, polyuria/polydipsia (PU/PD)
- Duration of clinical signs
- Physical examination findings: hydration status, renal palpation
- Documentation of azotemia previously
- Need urinalysis!
- Exposure to medications, toxins
- Exposure to and protection from infectious diseases
Molly
7-month-old, intact female shih tzu

Presenting reason:
Ovariohysterectomy (OVH)

History
- Healthy, from breeder at 2 months
- Indoor/outdoor Pacific Northwest suburb
- Vaccinations complete, including leptospirosis and rabies
- Using Revolution®, recently added Comfortis®
- Kirkland Signature® puppy food
- Occasional household urinary accidents
Molly’s physical examination

Physical examination
- Bright, alert, responsive, hydrated
- Temperature, pulse, respiration normal
- Body condition score 5–6/9
- Weight of 6.6 lb (3 kg)

Diagnostic plan
- Complete blood count (CBC)
- Chemistry panel including the IDEXX SDMA Test
# MOLLY

**8/8/15** (Order Received)
**8/9/15 4:54 AM** (Last Updated)

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<td>ALP</td>
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<td>5 - 160 U/L</td>
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</table>
SDMA reference interval in puppies is higher than in adults.

Puppyhood depends on breed and size.

SDMA units = µg/dL
What should be done now?

Delay spay and follow the IDEXX SDMA Test diagnostic algorithm

Ignore the SDMA?
Do the spay?
Recheck SDMA in a few weeks?
Measure blood pressure?
Urine culture?
Do radiographs?
IDEXX SDMA® Test diagnostic algorithm

IDEXX SDMA® Test Algorithm

SDMA can increase with both active or acute kidney injury, as well as chronic kidney disease.

Take action when SDMA® results are increased. Follow this algorithm to determine if kidney disease is probable and what steps you should take to investigate, manage, and monitor the disease.

When SDMA result is ≥20 µg/dL

Perform a complete urinalysis

When SDMA result is 15-19 µg/dL

Perform a complete urinalysis

Other evidence of kidney disease?

- Inappropriate urine specific gravity (USG) of <1.010 in a dog or <1.005 in a cat
- Active urinary sediment, particularly casts, white blood cells, or bacteria
- Proteinuria or urine protein creatinine (UPC) ratio >8.0 in a dog or >9.4 in a cat
- History of weight loss, decreased appetite, polyuria, polydipsia
- Physical examination findings, such as palpable kidney abnormalities
- Creatinine, BUN, and/or phosphorus above reference interval
- Creatinine increasing within reference interval
- Anemia
- Other diagnostic findings (abnormal kidney imaging, unexplained hypertension)

YES

Kidney disease probable—act immediately

NO

Recheck in 2-4 weeks

If SDMA remains increased

Follow IMM protocol

To identify an underlying cause, perform:

- Urine culture and MIC susceptibility
- Infectious disease testing (Lyme disease, leptospirosis, ehrlichiosis, FeLV, FIV, FIVp, complexus)
- Diagnostic imaging (ultrasound, pyeloureterography)
- History/possibility of toxin exposure?
- History/exposure to potentially nephrotoxic drugs?

For confounding conditions, assess:

- Hydration status
- Blood pressure
- Urine protein creatinine ratio
- Thyroid status

Investigate

Treat appropriately

- Unidentified disease if identified
- Clinical dehydration

Provide kidney support immediately

- Feed kidney-supportive diet
- Provide fresh, clean water sources

Adjust anesthesia protocols

- Provide intravenous fluids, before, during, and upon recovery
- Provide oxygen, before, during, and upon recovery

www.idexx.com/sdma
IDEXX SDMA® Test diagnostic algorithm

When SDMA result is $\geq 20 \, \mu g/dL$
- Perform a complete urinalysis

When SDMA result is $15-19 \, \mu g/dL$
- Perform a complete urinalysis
- Other evidence of kidney disease?
  - YES: Kidney disease probable—act immediately
    - Follow IMM protocol
  - NO: Recheck in 2–4 weeks
    - If SDMA remains increased
**MOLLY**

<table>
<thead>
<tr>
<th>Date</th>
<th>Test Result</th>
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<tbody>
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<td>CYSTOCENTESIS</td>
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<tr>
<td>8/14/2015</td>
<td>YELLOW</td>
</tr>
<tr>
<td></td>
<td>CLOUDY</td>
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<tr>
<td></td>
<td>1.022</td>
</tr>
<tr>
<td></td>
<td>6.5</td>
</tr>
<tr>
<td></td>
<td>NEGATIVE</td>
</tr>
<tr>
<td></td>
<td>NEGATIVE</td>
</tr>
<tr>
<td></td>
<td>NEGATIVE</td>
</tr>
<tr>
<td></td>
<td>NEGATIVE</td>
</tr>
<tr>
<td></td>
<td>NEGATIVE</td>
</tr>
<tr>
<td></td>
<td>WHITE BLOOD CELLS</td>
</tr>
<tr>
<td></td>
<td>6-10</td>
</tr>
</tbody>
</table>
Kidney disease probable: Follow IMM protocol

When SDMA result is ≥20 μg/dL
- Perform a complete urinalysis
- Kidney disease probable—act immediately
- Follow IMM protocol

When SDMA result is 15–19 μg/dL
- Perform a complete urinalysis
- Other evidence of kidney disease?
  - YES
    - If SDMA remains increased
  - NO
    - Recheck in 2–4 weeks
What if Molly’s SDMA result had been 18 µg/dL?
Look for other evidence of kidney disease

Consider other evidence of kidney disease:

- Inappropriate urine specific gravity (USG) of <1.030 in a dog or <1.035 in a cat
- Active urinary sediment—particularly casts, white blood cells, or bacteria
- Proteinuria or urine protein:creatinine (UPC) ratio >0.5 in a dog or >0.4 in a cat
- History of weight loss, decreased appetite, polydipsia, polyuria
- Physical examination findings, such as palpable kidney abnormalities
- Creatinine, BUN, and/or phosphorus above reference interval
- Creatinine increasing within reference interval
- Anemia
- Other diagnostic findings (abnormal kidney imaging, unexplained hypertension)
Kidney disease probable: Follow IMM protocol

When SDMA result is $\geq 20 \, \mu g/dL$
- Perform a complete urinalysis

When SDMA result is 15–19 $\mu g/dL$
- Perform a complete urinalysis

Other evidence of kidney disease?

- YES
  - Kidney disease probable—act immediately
  - Follow IMM protocol

- NO
  - Recheck in 2–4 weeks
  - If SDMA remains increased
Molly’s diagnostic assessment

Assessment
Kidney disease probable – act immediately!

Differential diagnoses
Acute kidney injury versus chronic kidney disease

- Etiologies
  - Infectious: pyelonephritis, leptospirosis, Lyme disease
  - Familial: renal dysplasia
  - Toxic: jerky treats, grapes, raisins, medications
  - Glomerulonephritis
  - Tubulointerstitial disease
  - Nephrolithiasis
  - Neoplasia
Molly: Investigate

To identify an underlying cause, perform:

- Urine culture and MIC susceptibility
- Infectious disease testing (Lyme disease, leptospirosis, ehrlichiosis, FeLV, FIV, FIP, toxoplasmosis)
- Diagnostic imaging (stones, pyelonephritis)
- History/possibility of toxin exposure?
- History/exposure to potentially nephrotoxic drugs?

For confounding conditions, assess:

- Hydration status
- Blood pressure
- Urine protein:creatinine ratio
- Thyroid status
**MOLLY**

8/9/2015 @ 11:21 AM

<table>
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<tr>
<th>Test</th>
<th>Result</th>
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<tbody>
<tr>
<td>Heartworm Antigen</td>
<td>Negative</td>
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<tr>
<td>Ehrlichia canis / ewingii</td>
<td>Negative</td>
</tr>
<tr>
<td>Lyme (Borrelia burgdorferi)</td>
<td>Negative</td>
</tr>
<tr>
<td>Anaplasma phagocytophilum / platys</td>
<td>Negative</td>
</tr>
</tbody>
</table>
Molly’s ultrasound

Findings
- Kidneys both slightly small
- Mild bilateral renal pelvic dilation
- Renal cortices are mildly thinned

Conclusions
- Renal dysplasia
- Concurrent pyelonephritis
Molly

Urine culture and MIC susceptibility
- Not performed and Molly was treated empirically
- Best practice to confirm infection and choose appropriate long-term antibiotic
Molly: Manage

**Treat appropriately**
- Underlying disease if identified
- Clinical dehydration
- Persistent hypertension
- Persistent proteinuria
- Hyperthyroidism

**Provide kidney support immediately**
- Feed kidney-supportive diet
- Provide fresh, clean water sources
- Discontinue all potentially nephrotoxic drugs if possible

**Adjust anesthesia protocols**
- Provide intravenous fluids, before, during, and upon recovery
- Provide oxygen, before, during, and upon recovery
- Maintain and monitor blood pressure and body temperature
- Analgesia use narcotic for pain management,
Anesthetizing Molly for her spay

Ensure adequate oxygen delivery to the kidneys

- Maintain perfusion
  - Intravenous (IV) fluids
- Maintain oxygen-carrying capacity
  - Supplemental oxygen
- Prevent hypothermia
  - Active warming devices
- Monitor
  - Blood pressure, heart rate and rhythm, oxygenation, ventilation, and body temperature

Avoid potentially nephrotoxic drugs

- Buprenorphine for analgesia

Photo courtesy of Dr. Jennifer Hess, DVM, DACVA
Molly: Monitor

Underlying or confounding disease identified
Monitor as indicated

Underlying or confounding disease not identified
Recheck in 2 weeks

SDMA returns to normal
- Kidney function has returned to normal
- Monitor confounding conditions and other underlying disease if present

SDMA remains increased but stable
- If SDMA and creatinine are stable, chronic kidney disease (CKD) is diagnosed
- Initiate appropriate treatment based on International Renal Interest Society (IRIS) CKD staging

SDMA continues to increase
- If SDMA and/or creatinine are increasing, consider ongoing, active kidney injury
- Perform additional diagnostics to determine cause and to guide treatment
Molly: Monitor

<table>
<thead>
<tr>
<th></th>
<th>10/2/15 (Order Received)</th>
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<tbody>
<tr>
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<tr>
<td>IDEXX SDMA</td>
<td>12</td>
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<tr>
<td>Creatinine</td>
<td>0.9</td>
<td></td>
</tr>
<tr>
<td>BUN</td>
<td>21</td>
<td></td>
</tr>
</tbody>
</table>

- **IDEXX SDMA**
  - Value: 12
  - Normal range: 0 - 14 μg/dL
- **Creatinine**
  - Value: 0.9
  - Normal range: 0.5 - 1.5 mg/dL
- **BUN**
  - Value: 21
  - Normal range: 9 - 31 mg/dL

**Collection**
- Method: CYSTOCENTESIS
- Color: YELLOW
- Clarity: CLEAR
- Specific Gravity: 1.037

**Source:** URINE-CYSTO
**Status:** FINAL
**Completed Culture Results:** NO GROWTH

**Images:**
- **Left kidney**
- **Right kidney**
Molly: Monitor

Pyelonephritis successfully treated, but Molly has renal dysplasia so she does have CKD

- SDMA returns to normal
  - Kidney function has returned to normal
  - Monitor confounding conditions and other underlying disease if present

- SDMA remains increased but stable
  - If SDMA and creatinine are stable, chronic kidney disease (CKD) is diagnosed
  - Initiate appropriate treatment based on International Renal Interest Society (IRIS) CKD staging

- SDMA continues to increase
  - If SDMA and/or creatinine are increasing, consider ongoing, active kidney injury
  - Perform additional diagnostics to determine cause and to guide treatment
Staging Molly’s CKD Using the IRIS CKD Staging Guidelines

<table>
<thead>
<tr>
<th>Stage</th>
<th>No azotemia</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
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<tbody>
<tr>
<td>Canine</td>
<td>&lt;1.4</td>
<td>1.4–2.0</td>
<td>2.1–5.0</td>
<td>&gt;5.0</td>
</tr>
<tr>
<td>Feline</td>
<td>&lt;1.6</td>
<td>1.6–2.8</td>
<td>2.9–5.0</td>
<td>&gt;5.0</td>
</tr>
</tbody>
</table>

- **SDMA in µg/dL**
  - >14 Moderately increased
  - >45 Markedly increased

- Consider understaged based on creatinine

**SDMA = IDEXX SDMA™ Test**
Treat based on IRIS CKD staging

- **Stage 1**
  - No azotemia
  - Investigate for and treat underlying disease
  - Treat hypertension if systolic blood pressure persistently >160 or evidence of end-organ damage
  - Treat persistent proteinuria with therapeutic diet and medication (UPC >0.5 in dogs; UPC >0.4 in cats)
  - Keep phosphorus <4.6 mg/dL. If required, use kidney therapeutic diet +/- phosphate binder
  - Use with caution potentially nephrotoxic drugs
  - Correct prerenal and postrenal abnormalities
  - Fresh water available at all times

- **Stage 2**
  - Mild
  - Same as Stage 1
  - Kidney therapeutic diet
  - Treat hypokalemia in cats
  - Treat metabolic acidosis
  - If SDMA ≥25, consider treatment for Stage 3

- **Stage 3**
  - Treat azotemia
  - Treat hypokalemia in cats
  - Treat metabolic acidosis
  - Treat azotemia
  - If SDMA ≥45, consider treatment for Stage 4

- **Stage 4**
  - Treat azotemia
  - Treat hypokalemia in cats
  - Treat metabolic acidosis
  - Treat azotemia
  - If SDMA <45, consider treatment for Stage 3

Consider treatment of next stage. Creatinine may underestimate degree of kidney dysfunction in patients with poor muscle mass.
What are the benefits of diagnosing kidney disease earlier and more reliably?
The benefits of diagnosing kidney disease earlier and more reliably

- Find active and potentially reversible disease.
- Treat confounding conditions.
- Prevent acute on chronic kidney injuries.
- Better detect and co-manage concurrent diseases.
- Easier treatment so that pets live longer, happier lives.
- Delay progression of CKD and increase survival time by using the IRIS CKD staging and treatment guidelines.
- Monitor closely and intervene earlier with appropriate treatment as disease progresses.
Find active and potentially treatable disease

**Infectious disease**

- Lyme Quant C6 Antibody by ELISA: 163
- IDEXX SDMA: 30
- Creatinine: 0.7
- BUN: 15
- Urine Protein:Creatinine Ratio: 4.5

**Pyelonephritis**

- Pelvic dilation

**Urinary stone**

- Leptospira spp. RealPCR - Blood: POSITIVE
- Leptospira spp. RealPCR - Urine: NEGATIVE
CKD is irreversible and often progressive

Important to determine if active injury is present that could potentially be treated and reversed!
Reese Ayers visit observations
16-year-old, spayed female, DSH

Presenting reason: Annual check up

History: Doing well

Physical examination: Unremarkable

Wellness diagnostic results
- Creatinine 2.1 mg/dL
- BUN 39 mg/dL
- USG 1.018
- Urinalysis: >100 WBC/hpf, marked bacteria

IDEXX SDMA: 19 µg/dL
### Staging Reese’s CKD Using the IRIS CKD Staging Guidelines

<table>
<thead>
<tr>
<th>Stage</th>
<th>Creatinine in mg/dL</th>
<th>SDMA in μg/dL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>&lt;1.4</td>
<td>&gt;14</td>
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<tr>
<td>2</td>
<td>1.4–2.0</td>
<td>&gt;14</td>
</tr>
<tr>
<td>3</td>
<td>2.1–5.0</td>
<td>Moderately increased</td>
</tr>
<tr>
<td>4</td>
<td>&gt;5.0</td>
<td>Markedly increased</td>
</tr>
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**Consider understaged based on creatinine**

- **SDMA = IDEXX SDMA™ Test**
Reese Ayers: Preventive care visit

**Investigate:** Urine culture and susceptibility

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<tbody>
<tr>
<td>Status:</td>
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</tr>
<tr>
<td>Completed Culture Results</td>
<td>Escherichia coli - GREATER THAN 100,000 ORGANISMS PER ML</td>
</tr>
<tr>
<td>Amoxicillin</td>
<td>Sensitive (8 ug/ml)</td>
</tr>
<tr>
<td>Amoxicillin / Clavulanic Acid</td>
<td>Sensitive (4 ug/ml)</td>
</tr>
</tbody>
</table>

Investigation that should have been considered
- Abdominal ultrasound
- Blood pressure measurement

**Manage:** Clavamox® 62.5 mg BID for 1 month
Reese Ayers: Follow-up visit

**Monitor**: 1 month recheck
- Urine culture negative
- SDMA improved

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</tr>
</tbody>
</table>

**SDMA declined 19 → 15**

<table>
<thead>
<tr>
<th>Test</th>
<th>Value</th>
<th>Normal Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>IDEXX SDMA</td>
<td>15</td>
<td>0 - 14 μg/dL</td>
</tr>
<tr>
<td>Creatinine</td>
<td>2.0</td>
<td>0.9 - 2.5 mg/dL</td>
</tr>
<tr>
<td>BUN</td>
<td>40</td>
<td>16 - 37 mg/dL</td>
</tr>
</tbody>
</table>
# Staging Reese’s CKD Using the IRIS CKD Staging Guidelines

<table>
<thead>
<tr>
<th>Stage 1</th>
<th>Stage 2</th>
<th>Stage 3</th>
<th>Stage 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>No azotemia</td>
<td>Mild</td>
<td>Moderate</td>
<td>Severe</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Creatinine in mg/dL</th>
<th>Canine</th>
<th>1.4–2.0</th>
<th>2.1–5.0</th>
<th>&gt;5.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feline</td>
<td>&lt;1.6</td>
<td>1.6–2.8</td>
<td>2.9–5.0</td>
<td>&gt;5.0</td>
</tr>
<tr>
<td></td>
<td>&gt;14</td>
<td>&gt;14</td>
<td>Moderately increased</td>
<td>Markedly increased</td>
</tr>
</tbody>
</table>

| SDMA in μg/dL | ≥25 | ≥45 |

*SDMA = IDEXX SDMA™ Test*
Reese Ayers: Wellness visit

Diagnosis
- Suspect pyelonephritis
- Active injury superimposed on CKD (i.e. acute on chronic disease)

Long-term management
- Treat for IRIS stage 2 CKD including feeding a kidney therapeutic diet.
- Recheck urine culture monthly for 3 negative consecutive months.
- Then recheck minimum database and urine culture every 3 months.

Why does SDMA matter to Reese?
- Increased SDMA led to diagnosis and treatment for suspect pyelonephritis and improvement in kidney function.
The benefits of diagnosing kidney disease earlier and more reliably

- Find active and potentially reversible disease.
- **Treat confounding conditions.**
- Prevent acute on chronic kidney injuries.
- Better detect and co-manage concurrent diseases.
- Easier treatment so that pets live longer, happier lives.
- Delay progression of CKD and increase survival time by using the IRIS CKD staging and treatment guidelines.
- Monitor closely and intervene earlier with appropriate treatment as disease progresses.
Diagnose and treat confounding conditions

Dehydration

Proteinuria

Hypertension

Urine protein to creatinine ratio:

> 0.5 dog

> 0.4 cat
The benefits of diagnosing kidney disease earlier and more reliably

- Find active and potentially reversible disease.
- Treat confounding conditions.
- Prevent acute on chronic kidney injuries.
- Better detect and co-manage concurrent diseases.
- Easier treatment so that pets live longer, happier lives.
- Delay progression of CKD and increase survival time by using the IRIS CKD staging and treatment guidelines.
- Monitor closely and intervene earlier with appropriate treatment as disease progresses.
Prevent acute on chronic kidney injuries

Adjust anesthetic protocols

Use with caution any potentially nephrotoxic drugs and monitor

Correct prerenal and postrenal abnormalities as they arise

Photo courtesy of Tanya Duke-Novakovski BVetMed MSc DVA DACVAA DECVA
The benefits of diagnosing kidney disease earlier and more reliably

- Find active and potentially reversible disease.
- Treat confounding conditions.
- Prevent acute on chronic kidney injuries.
- **Better detect and co-manage concurrent diseases.**
- Easier treatment so that pets live longer, happier lives.
- Delay progression of CKD and increase survival time by using the IRIS CKD staging and treatment guidelines.
- Monitor closely and intervene earlier with appropriate treatment as disease progresses.
Baxter: Wellness visit
14-year-old, neutered male domestic shorthair

Presenting reason:
Biannual wellness visit

Additional history:
Possible weight loss but eating well

Physical examination:
• Slightly thin with low body condition score (BCS) 2.5 of 9
• Tachycardic; heart rate 240 bpm
• Palpable thyroid nodule
**Baxter: Wellness visit**

14-year-old, neutered male domestic shorthair

<table>
<thead>
<tr>
<th>Test</th>
<th>Value</th>
<th>Reference Range</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IDEXX SDMA</strong></td>
<td>15</td>
<td>0 - 14 µg/dL</td>
</tr>
<tr>
<td><strong>Creatinine</strong></td>
<td>0.9</td>
<td>0.9 - 2.5 mg/dL</td>
</tr>
<tr>
<td><strong>BUN</strong></td>
<td>37</td>
<td>16 - 37 mg/dL</td>
</tr>
<tr>
<td><strong>Total T4</strong></td>
<td>9.0</td>
<td>0.8 - 4.7 µg/dL</td>
</tr>
<tr>
<td><strong>Specific Gravity</strong></td>
<td>1.016</td>
<td></td>
</tr>
</tbody>
</table>
Baxter: Wellness visit
14-year-old, neutered male domestic shorthair

Clinical impact of increased SDMA:
- Increased SDMA led to diagnosis of kidney disease prior to treatment of hyperthyroidism.
- Methimazole dose adjustments made to avoid hypothyroidism.
- Baxter’s kidney function was monitored closely during treatment.
- Baxter treated appropriately for IRIS CKD stage 3 because of the disproportionately high SDMA.

<table>
<thead>
<tr>
<th>IDEXX SDMA</th>
<th>10/8/15 (Order Received)</th>
<th>IDEXX Reference Laboratories</th>
<th>9/24/15</th>
<th>9/3/15</th>
</tr>
</thead>
<tbody>
<tr>
<td>IDEXX SDMA</td>
<td>23</td>
<td>0 - 14 µg/dL</td>
<td>25</td>
<td>15</td>
</tr>
<tr>
<td>Creatinine</td>
<td>1.9</td>
<td>0.9 - 2.5 mg/dL</td>
<td>1.5</td>
<td>0.9</td>
</tr>
<tr>
<td>BUN</td>
<td>36</td>
<td>16 - 37 mg/dL</td>
<td>44</td>
<td>37</td>
</tr>
<tr>
<td>Total T4</td>
<td>2.1</td>
<td>0.8 - 4.7 µg/dL</td>
<td>0.7</td>
<td>9.0</td>
</tr>
</tbody>
</table>
Kidney disease is common in cats with hyperthyroidism.¹

Hyperthyroidism can mask kidney disease.¹,²,³

Creatinine affected by decreased muscle mass and hyperfiltration.¹

SDMA not impacted by muscle mass and is a more sensitive biomarker.⁴,⁵

Sources:
Better co-manage concurrent diseases including hyperthyroidism

- Kidney disease is common in cats with hyperthyroidism.
  - occur in 15%–49% of hyperthyroid cats.²

- Hyperthyroidism is common in older cats.
  - Up to 10% of cats in North America >10 years.¹

- Hyperthyroidism can mask kidney disease.

Sources:
Jasper: Annual visit
9-year-old, neutered male Siamese

Presenting reason:
Overall healthy but a little weight loss

Physical examination:
• Slightly thin with body condition score (BCS) 4 of 9
• Rest of physical examination unremarkable
Jasper: Annual visit
9-year-old, neutered male Siamese

<table>
<thead>
<tr>
<th>Test</th>
<th>Result</th>
<th>Normal Range</th>
<th>Graph</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>IDEXX SDMA</td>
<td>21</td>
<td>0 - 14 µg/dL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creatinine</td>
<td>2.2</td>
<td>0.8 - 2.4 mg/dL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BUN</td>
<td>28</td>
<td>16 - 36 mg/dL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total T4</td>
<td>1.9</td>
<td>0.8 - 4.7 µg/dL</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Test</th>
<th>Result</th>
<th>Normal Range</th>
<th>Graph</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific Gravity</td>
<td>1.022</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red Blood Cells</td>
<td>6 - 20 /HPF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urine Protein</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Jasper: Annual visit

9-year-old, neutered male Siamese

Investigation:
- Radiographs: Bilateral nephrolithiasis with left kidney decreased in size
- Ultrasound: No evidence of obstruction
- Urine culture: negative

Diagnosis: Chronic kidney disease with nephrolithiasis
Jasper: Annual visit
9-year-old, neutered male Siamese

Clinical impact of increased SDMA:

- Increased SDMA led to diagnosing Jasper with nephrolithiasis.
- Owners instructed to monitor for sudden change in appetite, behavior, or urinary habits.
- Management to focus on preventing additional uroliths from forming and preserving right kidney function:
  - Renal therapeutic diet.
  - Water intake encouraged.
  - Recheck in 3 months and then twice yearly with blood testing and radiographs.
Max: Preventive care visit
6-year-old, neutered male goldendoodle

SNAP® 4Dx® Plus Test:
Positive for *Ehrlichia*
Dogs exposed to Lyme and *Ehrlichia* have an increased risk of developing CKD and should be screened at least annually.

New research based on 846,626 dogs with at least one IDEXX test result for vector-borne diseases, creatinine, and SDMA confirms the importance of comprehensive annual screening.

**Exposure to Lyme**

- 43% Increased risk CKD

**Exposure to *Ehrlichia***

- 300% Increased risk CKD

*Source:* Data on file at IDEXX Laboratories, Inc. Westbrook, Maine USA

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Max: Preventive care visit
6-year-old, neutered male goldendoodle

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
<th>Reference Range</th>
<th>Device</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hematocrit</td>
<td>45.0</td>
<td>37.3 - 61.7 %</td>
<td>ProCyte Dx Hematology Analyzer</td>
</tr>
<tr>
<td>WBC</td>
<td>8.0</td>
<td>2.87 - 17.02 K/μL</td>
<td></td>
</tr>
<tr>
<td>Platelet</td>
<td>225</td>
<td>148 - 484 K/μL</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
<th>Reference Range</th>
<th>Device</th>
</tr>
</thead>
<tbody>
<tr>
<td>IDEXX SDMA</td>
<td>11</td>
<td>0 - 14 μg/dL</td>
<td>Catalyst Dx Chemistry Analyzer</td>
</tr>
<tr>
<td>Creatinine</td>
<td>1.0</td>
<td>0.5 - 1.8 mg/dL</td>
<td></td>
</tr>
<tr>
<td>BUN</td>
<td>17</td>
<td>7 - 27 mg/dL</td>
<td></td>
</tr>
<tr>
<td>Urine Protein:Creatinine Ratio</td>
<td>0.1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Max: Preventive care visit
6-year-old, neutered male goldendoodle

Clinical impact of normal SDMA:
- Increased confidence that kidneys are currently functioning well
- Owners instructed on clinical signs to watch for
- Annual monitoring to allow for early intervention if kidney disease develops
Zeke: Wellness visit

14-year-old, neutered male, domestic shorthair

Presenting reason: Biannual wellness visit

Additional history: Possible weight loss, eating well, increased vocalization

Wellness diagnostic results

- Creatinine 0.9 mg/dL
- BUN 37 mg/dL
- T₄ 9.0 µg/dL
- USG 1.016

SDMA: 15 µg/dL
### Staging Zeke’s CKD Using the IRIS CKD Staging Guidelines

<table>
<thead>
<tr>
<th>Stage</th>
<th>No azotemia</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creatinine (Canine)</td>
<td>&lt;1.4</td>
<td>1.4–2.0</td>
<td>2.1–5.0</td>
<td>&gt;5.0</td>
</tr>
<tr>
<td>Creatinine (Feline)</td>
<td>&lt;1.6</td>
<td>1.6–2.8</td>
<td>2.9–5.0</td>
<td>&gt;5.0</td>
</tr>
<tr>
<td>SDMA (Canine)</td>
<td>&gt;14</td>
<td>&gt;14</td>
<td>Moderately increased</td>
<td>Markedly increased</td>
</tr>
<tr>
<td>SDMA (Feline)</td>
<td>≥25</td>
<td>≥45</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SDMA = IDEXX SDMA™ Test**
Zeke: Wellness visit

14-year-old, neutered male, domestic shorthair

Manage
- Methimazole 2.5 mg BID

Monitor: 1 month recheck
- Renal parameters increased
- Iatrogenic hypothyroidism
- Reduce methimazole to 2.5 mg once daily

<table>
<thead>
<tr>
<th>Test</th>
<th>Result</th>
<th>Reference Range</th>
<th>Status</th>
<th>Norm Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>IDEXX SDMA</td>
<td>17</td>
<td>0 - 14 µg/dL</td>
<td>c</td>
<td>15</td>
</tr>
<tr>
<td>Creatinine</td>
<td>1.8</td>
<td>0.9 - 2.5 mg/dL</td>
<td></td>
<td>0.9</td>
</tr>
<tr>
<td>BUN</td>
<td>42</td>
<td>16 - 37 mg/dL</td>
<td></td>
<td>37</td>
</tr>
<tr>
<td>Total T4</td>
<td>0.7</td>
<td>0.8 - 4.7 µg/dL</td>
<td></td>
<td>9</td>
</tr>
</tbody>
</table>
Staging Zeke’s CKD Using the IRIS CKD Staging Guidelines

<table>
<thead>
<tr>
<th>Stage</th>
<th>Canine Creatinine (mg/dL)</th>
<th>Feline Creatinine (mg/dL)</th>
<th>SDMA (μg/dL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>&lt;1.4</td>
<td>&lt;1.6</td>
<td>&gt;14</td>
</tr>
<tr>
<td></td>
<td>1.4–2.0</td>
<td>1.6–2.8</td>
<td>&gt;14</td>
</tr>
<tr>
<td></td>
<td>2.1–5.0</td>
<td>2.9–5.0</td>
<td>Moderately increased</td>
</tr>
<tr>
<td></td>
<td>&gt;5.0</td>
<td>&gt;5.0</td>
<td>Markedly increased</td>
</tr>
</tbody>
</table>

Consider understaged based on creatinine

SDMA = IDEXX SDMA™ Test

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Zeke: Wellness visit

14-year-old, neutered male, domestic shorthair

Diagnosis
- Hyperthyroidism
- Chronic kidney disease
  - IRIS CKD stage 2

Long-term management
- Aim to keep euthyroid
- Concurrent management of CKD
- Monitor every 3 months

Why does SDMA matter to Zeke?
- Increased SDMA led to close monitoring of his kidney function during treatment for hyperthyroidism
The benefits of diagnosing kidney disease earlier and more reliably

- Find active and potentially reversible disease.
- Treat confounding conditions.
- Prevent acute on chronic kidney injuries.
- Better detect and co-manage concurrent diseases.
- **Easier treatment so that pets live longer, happier lives.**
- Delay progression of CKD and increase survival time by using the IRIS CKD staging and treatment guidelines.
- Monitor closely and intervene earlier with appropriate treatment as disease progresses.
Easier treatment so that pets live longer, happier
The benefits of diagnosing kidney disease earlier and more reliably

- Find active and potentially reversible disease.
- Treat confounding conditions.
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- Easier treatment so that pets live longer, happier lives.
- Delay progression of CKD and increase survival time by using the IRIS CKD staging and treatment guidelines.
- Monitor closely and intervene earlier with appropriate treatment as disease progresses.
Study: Earlier diagnosis and treatment may slow rate of progression and increase lifespan

# Survival time in cats by IRIS stage

<table>
<thead>
<tr>
<th>IRIS stage</th>
<th>2b*</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medial survival (days)</td>
<td>1,151</td>
<td>778</td>
<td>103</td>
</tr>
<tr>
<td>Range (days)</td>
<td>2–3,107</td>
<td>22–2,100</td>
<td>1–1,920</td>
</tr>
</tbody>
</table>

n = 211 cats

*2b = Creatinine of 2.3–2.8 mg/dL (203–249 µmol/L)

Delay progression of CKD and increase survival time by using the IRIS CKD staging and treatment guidelines

The only therapy shown to improve survival and quality of life in both cats and dogs with CKD is…

therapeutic renal food.
Renal therapeutic diets are more than just controlled protein

- Protein
- Phosphorus
- N-3 FA
- Acid - Base
- Potassium
- Antioxidants

Tastier options now available!
The benefits of diagnosing kidney disease earlier and more reliably

- Find active and potentially reversible disease.
- Treat confounding conditions.
- Prevent acute on chronic kidney injuries.
- Better detect and co-manage concurrent diseases.
- Easier treatment so that pets live longer, happier lives.
- Delay progression of CKD and increase survival time by using the IRIS CKD staging and treatment guidelines.
- Monitor closely and intervene earlier with appropriate treatment as disease progresses.
Monitor closely and intervene earlier with appropriate treatment as disease progresses

<table>
<thead>
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<th>Stage 1</th>
<th>Stage 2</th>
<th>Stage 3</th>
<th>Stage 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>No azotemia</td>
<td>Mild</td>
<td>Moderate</td>
<td>Severe</td>
</tr>
<tr>
<td>Investigate for and treat underlying disease</td>
<td>Same as Stage 1</td>
<td>Same as Stage 2</td>
<td>Same as Stage 3</td>
</tr>
<tr>
<td>Treat hypertension if systolic blood pressure persistently &gt; 160 or evidence of end-organ damage</td>
<td>Kidney therapeutic diet</td>
<td>Keep phosphorus &lt; 5.0 mg/dL</td>
<td>Keep phosphorus &lt; 6.0 mg/dL</td>
</tr>
<tr>
<td>Treat persistent proteinuria with therapeutic diet and medication (UPC &gt; 0.5 in dogs; UPC &gt; 0.4 in cats)</td>
<td>Treat hypokalemia in cats</td>
<td>Treat anemia (PCV &lt; 25% in dogs; PCV &lt; 20% in cats)</td>
<td>Consider feeding tube for nutritional and hydration support and for ease of medicating</td>
</tr>
<tr>
<td>Keep phosphorus &lt; 4.6 mg/dL</td>
<td>Treat metabolic acidosis</td>
<td>SDMA &gt; 25, consider treatment for Stage 3</td>
<td></td>
</tr>
<tr>
<td>If required, use kidney therapeutic diet +/− phospho binder</td>
<td>Use with caution potentially nephrotoxic drugs</td>
<td>SDMA &gt; 40, consider treatment for Stage 4</td>
<td></td>
</tr>
<tr>
<td>Correct prerenal and postrenal abnormalities</td>
<td>Fresh water available at all times</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Key takeaways

- IDEXX SDMA Test is a more reliable:
  - Increases earlier than creatinine.
  - Not impacted by lean muscle mass.
- Clinical presentation should be considered.
- Investigate to determine if AKI or CKD.
- There are benefits to diagnosing kidney disease early.
- Earlier treatment is easier and outcomes are better.
Thank you!
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IDEXX is green

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