

# How to detect inflammatory diseases in cats

Acute Inflammatory Marker, Serum Amyloid A

BIONOTE Marketing team

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# Introduction

## How to detect inflammatory diseases in cats

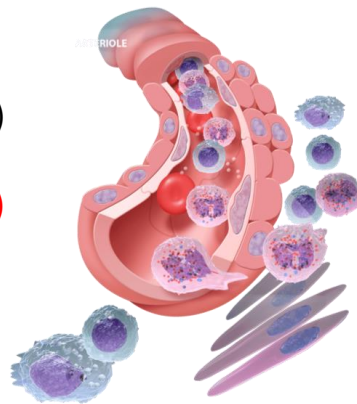
**Regular Check-up**  
(healthy cats)

**Sick cats with clinical signs**

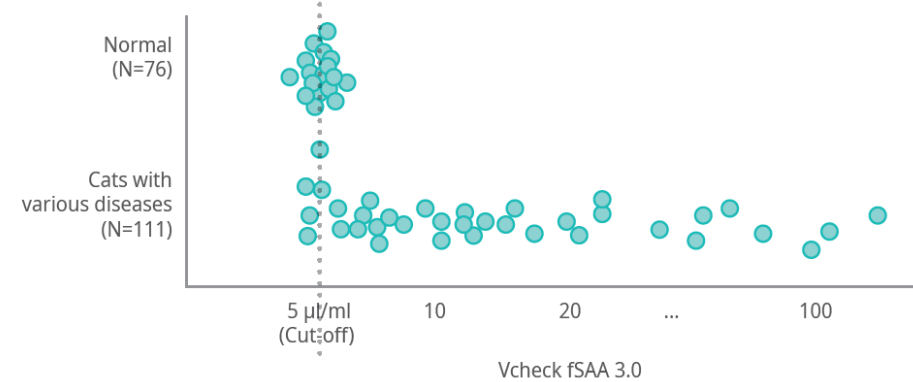
**Hospitalized cats during treatment**

### Inflammatory status

- White blood cells (WBCs)
- Band neutrophil counts
- **SAA (For early diagnosis)**



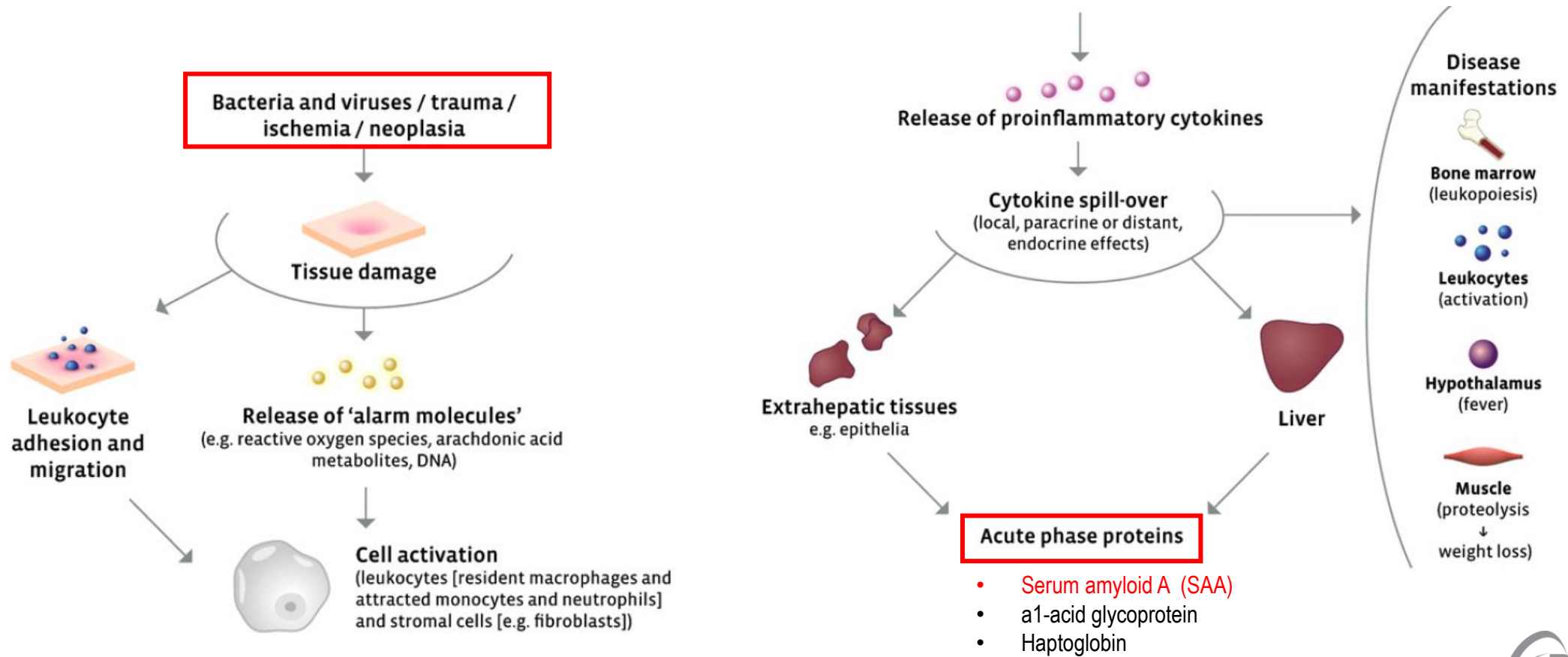
Measurement of SAA concentrations



# Serum Amyloid A (SAA)

## What is Serum amyloid A (SAA) ?

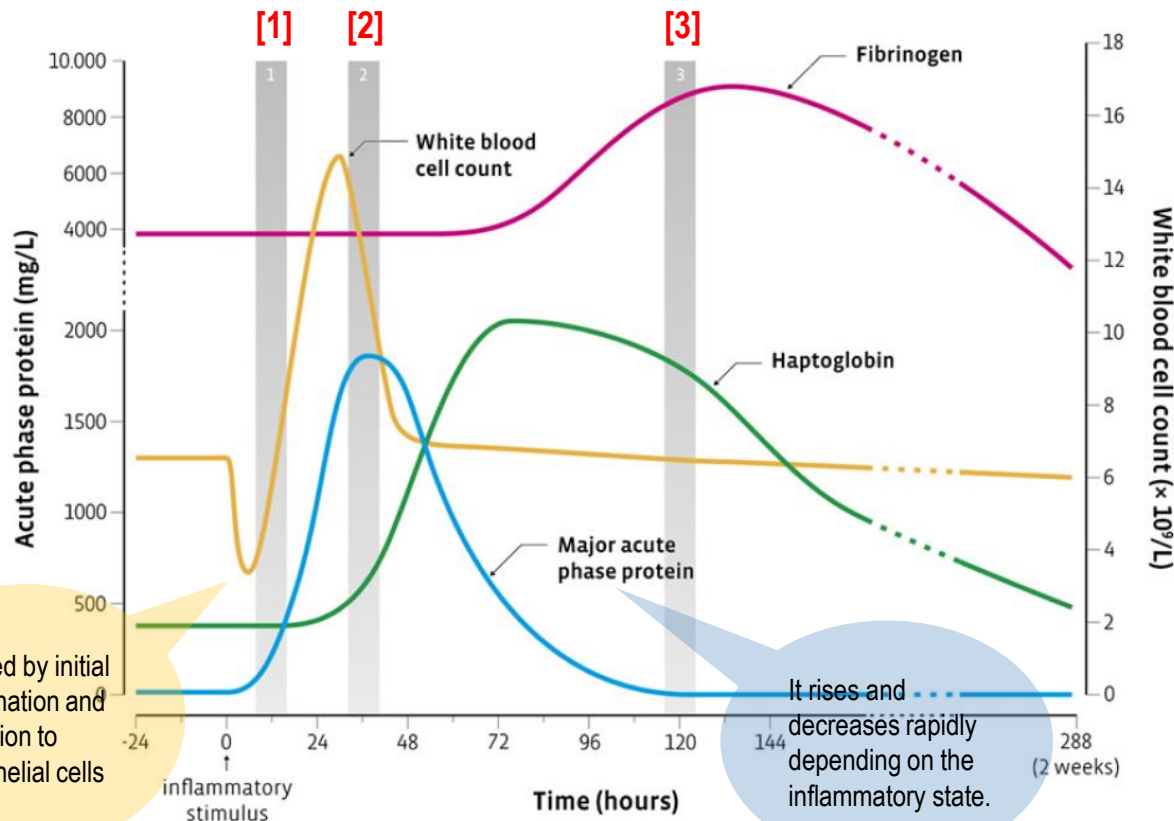
- The Acute Phase Response



# Serum Amyloid A (SAA)

## What is Serum amyloid A (SAA) ?

- The Acute Phase Response



### Changes of WBC and SAA in diseases cats

#### [1] At the inflammatory stimulus (8~12 hours after)

- **WBC counts:** decreased, normal or somewhat increased
- **SAA:** slightly increased

#### [2] 36 hours after

- **WBC counts:** increased more than the normal range
- **SAA:** increased more than the normal range

#### [3] 5 days after - After inflammation has been resolved

- **WBC counts:** return to baseline
- **SAA:** quickly return to baseline

# Advantages of **SAA Testing** over WBC counts

## SAA is...

### 1<sup>st</sup>. More sensitive than WBC (Earlier detection of inflammation)

- Short lag time (6-8 hours) from onset of inflammation to a measurable increase

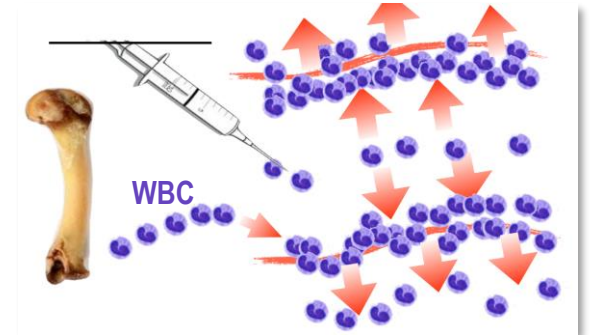
### 2<sup>nd</sup>. Significantly rises and decreases

- Increases up to 1,000-fold due to inflammatory stimulus
- Prompt decreases after resolution of the stimulus

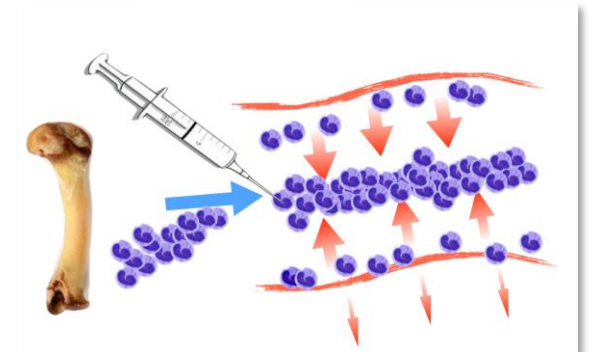
### 3<sup>rd</sup>. Proportional to the severity of inflammation

- Short half-life (20-24 hours) causing to decrease soon after inflammation has subsided
- → Can be used for monitoring response to treatment

### 4<sup>th</sup>. Not affected by stress, steroids, NSAIDs or antibiotics



▲ Severe inflammation (early phase)



▲ Effect of steroid, epinephrine

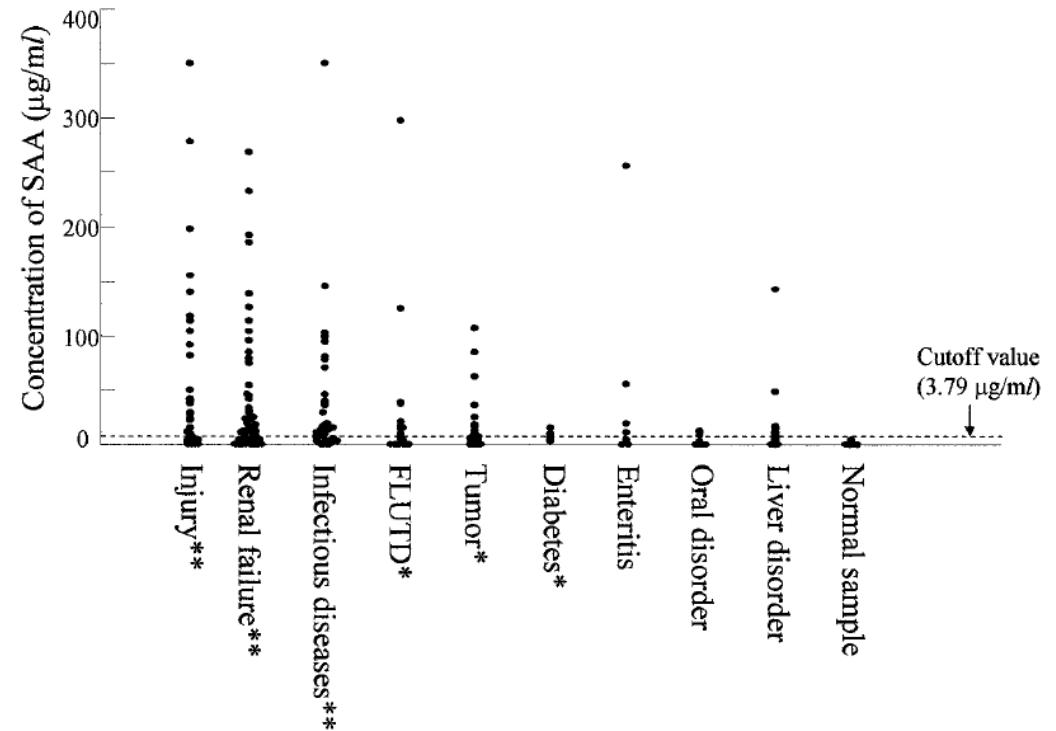
# SAA levels in various diseases

## Diseases with increased SAA levels

- Injury
- Infectious disease (bacteria, virus)
- Tumor
- Surgery

### Specific diseases

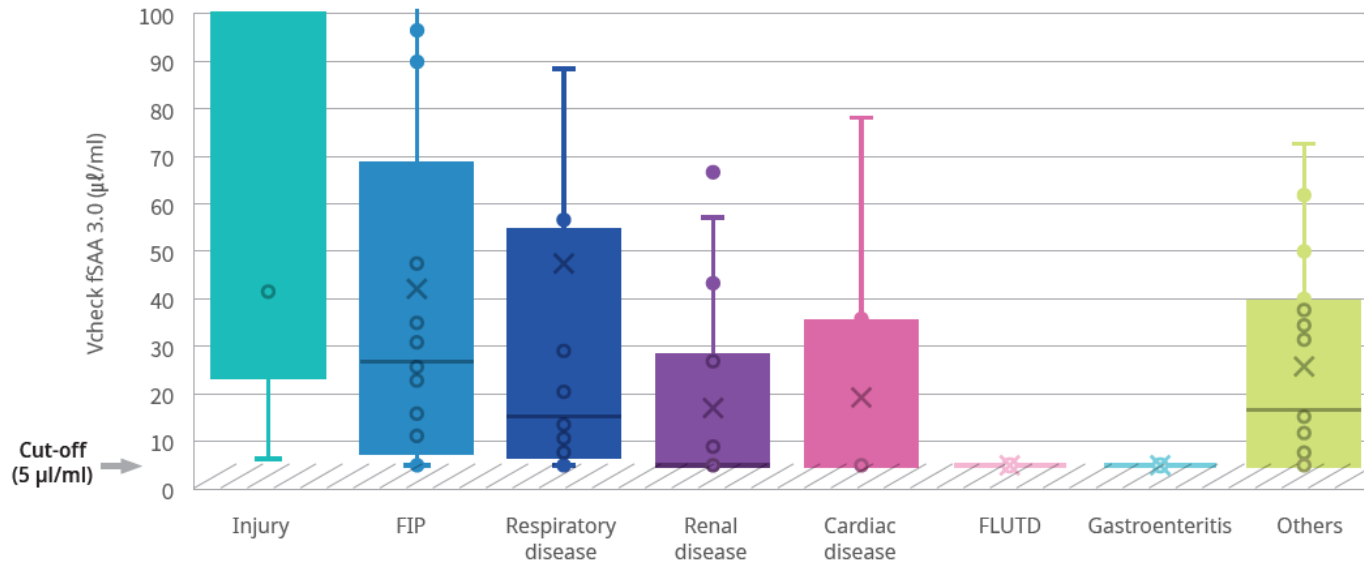
- Pancreatitis
- Feline infectious peritonitis (FIP)
- Chronic kidney disease (CKD)
- Pyometra
- Cardiomyopathy
- Hepatitis / cholangitis
- Pneumonia / Respiratory tract infections



# Clinical Evaluation - 1

## High SAA levels in various diseases

- Injury
- Neoplasia
- Feline infectious peritonitis (FIP)
- Chronic kidney disease (CKD)
- Pyometra
- Cardiomyopathy
- Hepatitis / Cholangitis
- Pneumonia / Respiratory tract infections

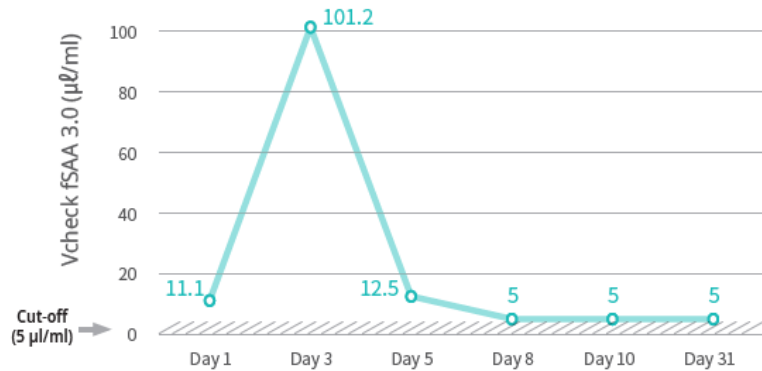


SAA levels in diseased cats (N=111)

# Clinical Evaluation - 2

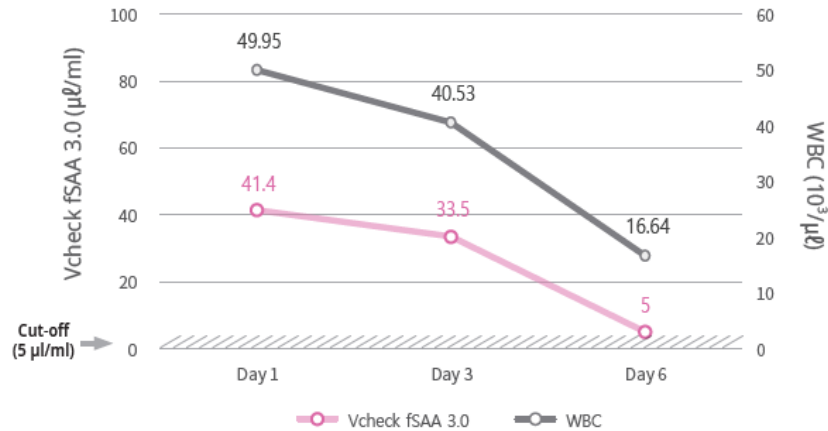
## Treatment Monitoring of SAA Levels

Case 1 : Cat under treatment for FIP



- High SAA levels in a cat with FIP
- After treatment, SAA levels decreased, reflecting the inflammatory status.

Case 2 : Cat under treatment for trauma



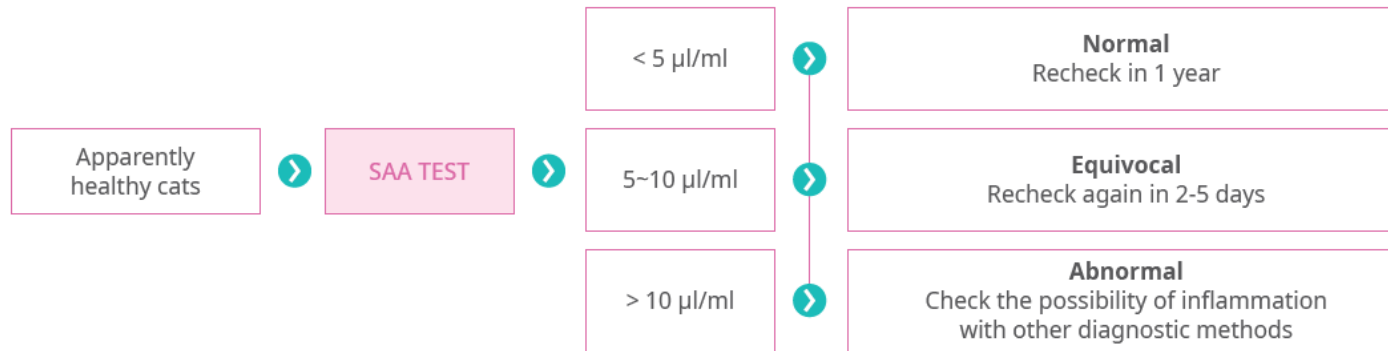
- High SAA & WBC levels indicate presence of infection.
- The concentrations declined rapidly following recovery.





# Diagnostic Algorithm

## ∴ Regular check-up



## ∴ First choice in symptomatic cats



How to detect inflammatory diseases in cats

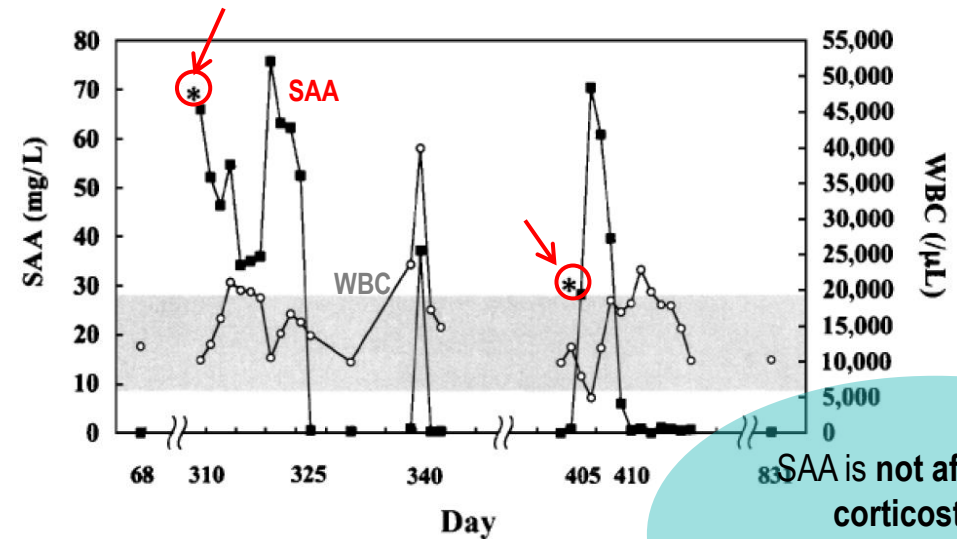
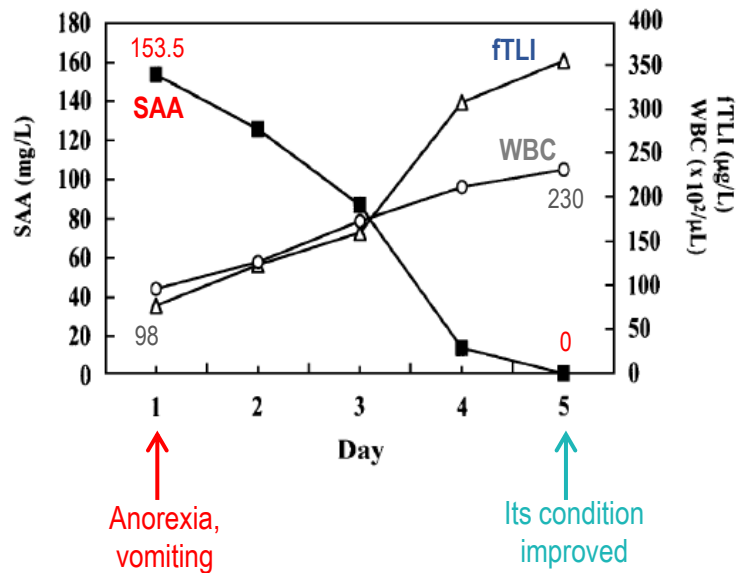
# Case Study

- Case 1 : **Pancreatitis**
- Case 2 : **Chronic kidney disease (CKD)**
- Case 3 : **Feline infectious peritonitis (FIP)**
- Case 4 : **Sepsis**
- Case 5 : **Surgery**

# Case Study

## Case 1 : Pancreatitis

- **Patient Information:** 6-year-old, neutered male, domestic shorthair
- **History:** Treated with prednisolone for asthma for 9 months
- **Clinical sign:** anorexia, vomiting, and fever for 2 days
- **Blood test:** normal WBC (9800/uL), **abnormal SAA (153.5 ug/ml)**, azotemia
- **Ultrasonography:** enlarged pancreas with hypoechoic lesions
- **Histopathology:** parenchymal necrosis, leukocyte infiltration with necrosis of the fat tissue → **Diagnosis: acute pancreatitis**

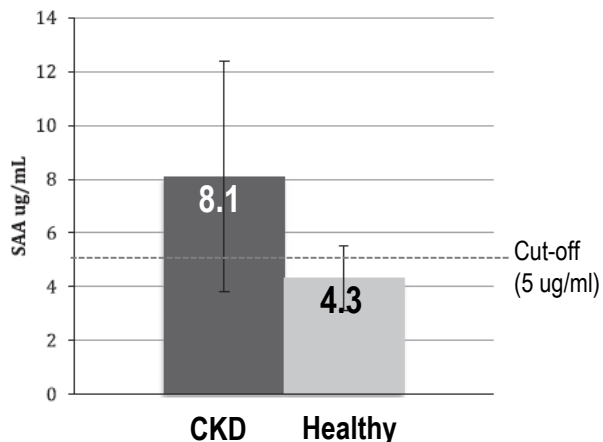


SAA is not affected by corticosteroid administration, in contrast to the WBC count

# Case Study

## Case 2 : Chronic kidney disease (CKD)

- **CKD in 15-30% of geriatric cats**
  - An estimated **30–65% of cats with CKD will develop anemia** as their renal disease progresses.
- In human patients, **chronic inflammation** and oxidative stress **play key roles in the development and progression of CKD.**
  - But, not well characterized in veterinary medicine



- **High SAA levels in CKD cats (especially, anemic cats)**
  - CKD in cats is associated with systemic inflammation.

Table 1. CKD VS. Healthy cats

	Hct (%)	Creatinine (μmol/L)	SAA (μg/mL)	HAP (μg/mL)	Iron (μg/mL)
CKD	29.4 (7.7)	280 (158)	8.1 (6.5)	4.5 (3.3)	85.5 (32.9)
Healthy	41.2 (3.7)	117 (22)	4.3 (1.2)	3.6 (1.6)	100.7 (21.7)
<i>P</i> -value	< .0001	< .0001	.002	.9	.01

Table 2. CKD cats (Anemic VS. Non-anemic cats)

CKD group	Hct (%)	Creatinine (μmol/L)	SAA (μg/mL)	HAP (μg/mL)	Iron (μg/mL)
Anemic	21.9 (5.7)	374 (215)	11.2 (6.8)	5.0 (4.0)	86.3 (40.4)
Nonanemic	33.7 (4.6)	225 (75)	6.3 (5.6)	4.2 (2.9)	84.9 (28.5)
<i>P</i> -value	<.0001	.02	.003	.4	.8

# Case Study

	Not FIP	FIP
<b>SAA (ug/ml)</b>	<b>10.21 ± 8.32</b>	<b>82.88 ± 50.23</b>

The Veterinary Journal 167 (2004) 38–44

## Case 3 : Feline infectious peritonitis (FIP)

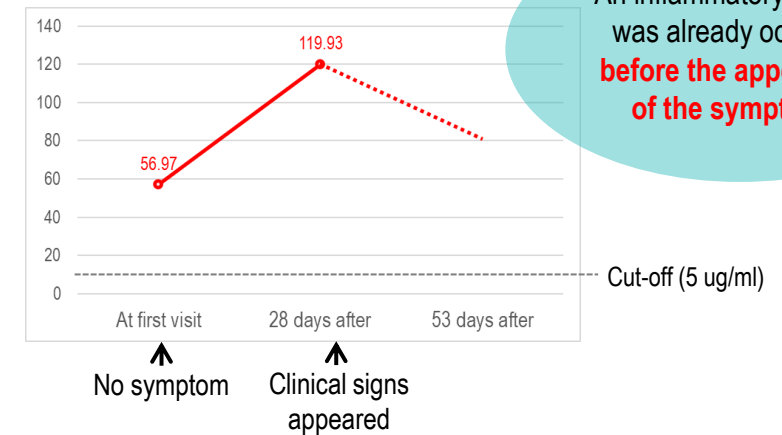
- **Patient Information:** 12 m, female, Persian
- **History:** no clinical signs, from a cattery which FIP was diagnosed
- **28 days later, it developed a FIP (wet form)**

• **Blood test**

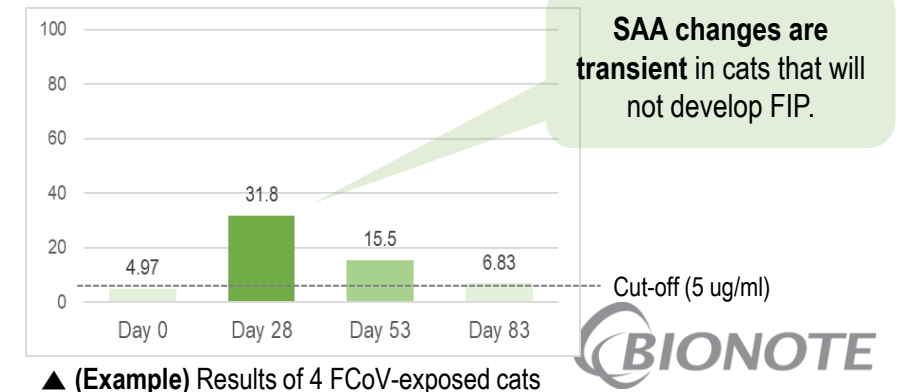
- **FCoV Ab:** positive (+)
- **Biochemistry**

Unit: g/dL	At first visit (No symptom)	28 days after (symptoms)	53 days after
<b>Total protein</b>	9.1	7.6	9.8
<b>A/G ratio</b>	0.38	0.41	0.38
<b>Albumin</b>	2.5	2.2	2.7
<b>Globulin</b>	6.6	5.4	7.1
<b>SAA (ug/ml)</b>	56.97	119.93	N/A

• **Changes of SAA levels**



• **What if the cat is only exposed to FCoV (Not FIP) ?**



▲ (Example) Results of 4 FCoV-exposed cats

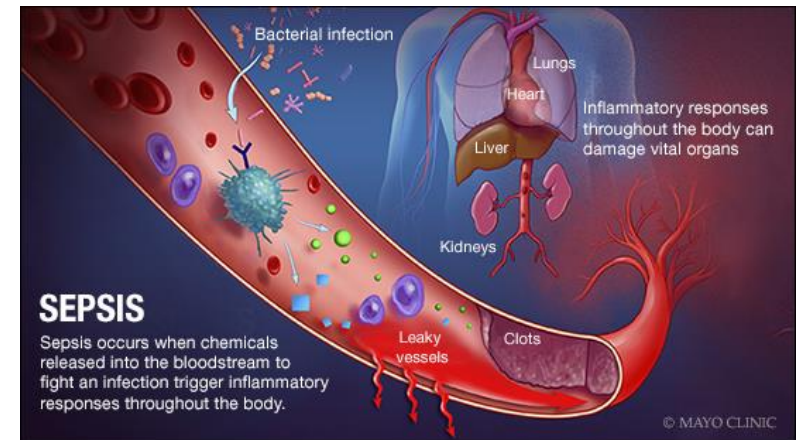


# Case Study

## Case 4 : Feline sepsis

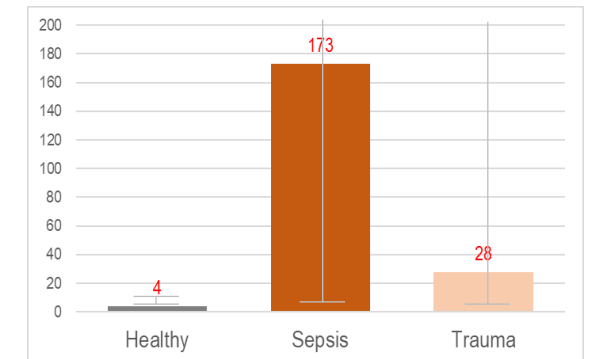
Diagnosis of feline sepsis is still challenging.

- A higher percentage of circulating **band neutrophils** (Leukocytosis with left shift)
- Severe **hypoalbuminemia**
- Higher frequency of **toxic neutrophil changes** (blood smears)
- High **total bilirubin**
- **High SAA levels** (> 81 ug/ml: 79.3% sensitivity)
- Leukocyte counts → **Not recommended! (Poor diagnostic value)**



Variable	Controls (n = 18)	Sepsis (n = 29)	Trauma (n = 27)
SAA (mg/L)	4 (1–9)	173 <sup>a</sup> (1–265)	28 <sup>ab</sup> (1–258)
ALT (U/L)	51 (35–80)	49 (15–3,600)	292 <sup>ab</sup> (70–3,300)
AST (U/L)	24 (15–36)	130 <sup>a</sup> (20–4,000)	310 <sup>ab</sup> (43–2,500)
Total bilirubin (μmol/L)	1.7 (1.2–5.8)	6.8 <sup>a</sup> (1.7–114)	3.4 <sup>ab</sup> (1.7–32)
Albumin (g/L)	37 (33–41)	34 <sup>a</sup> (10–41)	28 <sup>ab</sup> (15–38)
Total protein (g/L)	81 (72–88)	67 <sup>a</sup> (44–107)	59 <sup>ab</sup> (29–83)
A/G	0.87 (0.63–1.2)	0.51 <sup>a</sup> (0.25–0.94)	0.92 <sup>a</sup> (0.51–1.3)
Creatinine (μmol/L)	131 (113–169)	98 <sup>a</sup> (45–1,630)	101 <sup>ab</sup> (70–597)
Glucose (mmol/L)	5.6 (1.8–8.2)	5.8 (0.3–15.0)	9.3 <sup>ab</sup> (3.1–19.1)
Leukocytes (cells × 10 <sup>9</sup> /L)	8.4 (2.7–14.9)	27.0 <sup>a</sup> (0.5–63.6)	13.8 <sup>a</sup> (4.3–37.9)
Hematocrit (L/L)	0.41 (0.35–0.47)	0.33 <sup>a</sup> (0.18–0.50)	0.31 <sup>a</sup> (0.06–0.42)

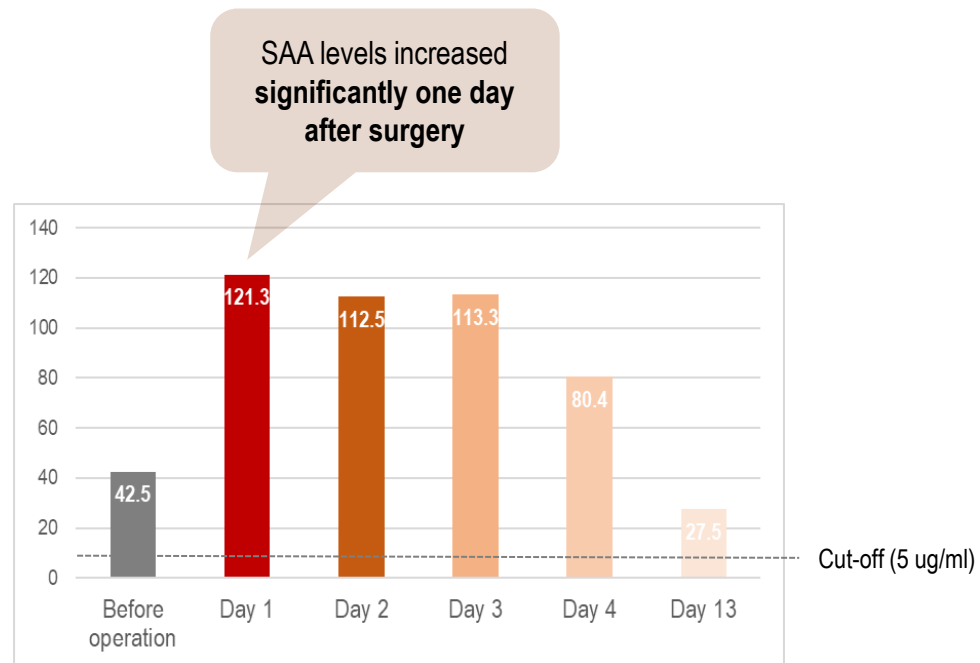
### ✓ SAA levels



# Case Study

## Case 5 : Surgery

Feline SAA concentration was found to increase earliest, with other acute phase proteins beginning to increase thereafter. → **SAA is an acute phase reactant at the early stage of inflammation.**



▲ Changes of SAA levels in cats subjected to surgery for urinary diversion

# Summary

## Clinical Application



AFTER  
SURGERY

### Monitoring the post-operative effects and recovery

Screening interval (Recommendation)

- ① Before surgery    ② After surgery    ③ 2-3 times every 12 hours



CONTINUOUS  
MONITORING

### Serial monitoring of the response to treatment

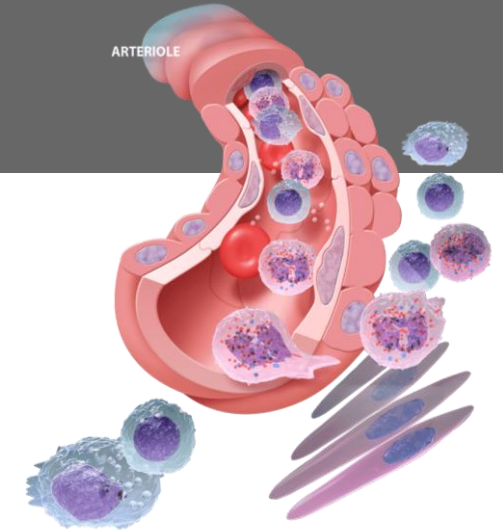
Decrease in SAA levels between two consecutive time points could be associated with positive response to treatment.



REGULAR  
CHECK-UP

### Early detecting the presence of inflammation

SAA increases in the early stage of inflammation, enabling an early detection of inflammation before the presence of clinical symptoms.





# Possible Questions

## 1) SAA levels in Chronic inflammation?

Despite the name, they can also change during chronic inflammatory processes.

**Chronic inflammation can be perceived as a consecutive series of separate inflammatory stimuli.**

In such conditions, increased concentrations of APPs are generally observed.

**However, the increase is lower than during acute episodes of inflammation or infection.**

## 2) SAA levels in Congestive heart failure?

CHF is an inflammatory disorder, and outcome in CHF may be determined by the extent of inflammation.

→ **SAA levels are significantly high in cats with heart failure**, but not in cats with preclinical hypertrophy.

## 3) Monitoring of SAA or fPL in cats with pancreatitis?

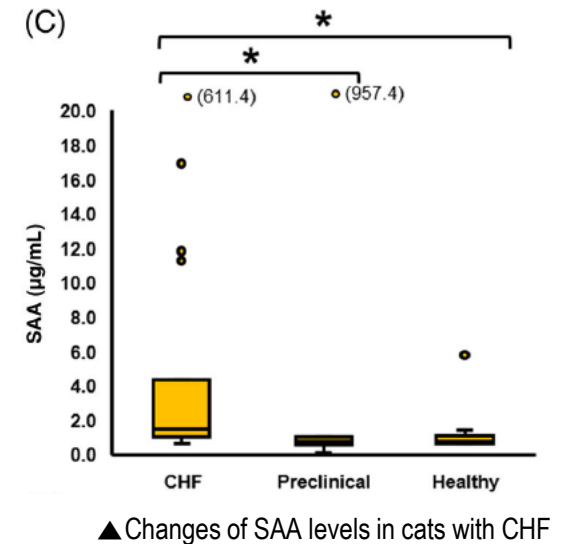
Monitoring using SAA levels is more recommended if there is an economic burden during treatment monitoring.

**SAA reflects relatively accurately the severity of pancreatic inflammation compared to fPL enzymes.**

→ So, patients can be monitored using SAA levels during treatment, and fPL and SAA tests can be evaluated simultaneously after treatment.

J Pharm Bioallied Sci. 2011 Jan-Mar; 3(1): 118–127.

J Vet Intern Med. 2020;1–13.



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# Q & A session

- Acute phase proteins for detecting inflammation



SAA for Cats



CRP for Dogs

BIONOTE Marketing team

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