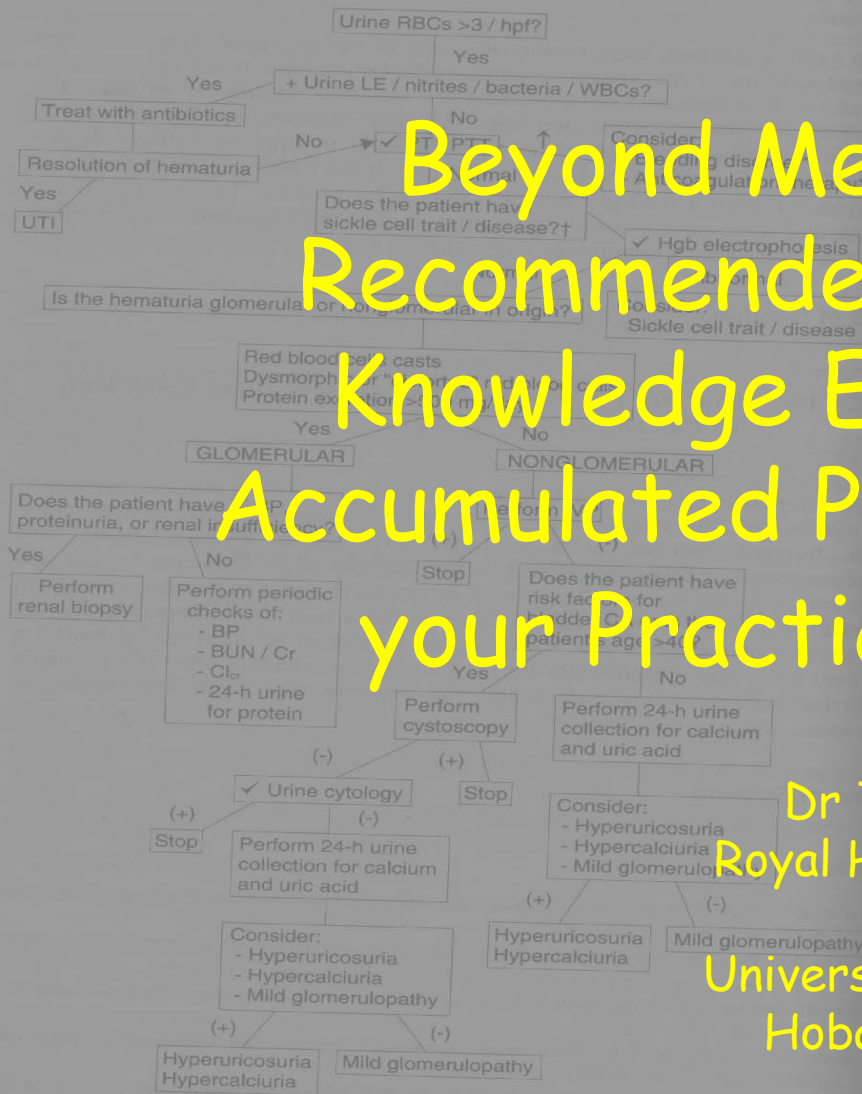


HEMATURIA



*Hematuria that occurs in the patient with an elevated PT / PTT may be the result of a bleeding disorder or therapy or a bleeding disorder. However, an underlying structural etiology must be excluded.
 †Sickle cell trait/disease may be the sole cause of hematuria; however, this diagnosis must be one of exclusion.

PROTEINURIA

It is important not to ignore proteinuria. While it is true that proteinuria may represent a benign finding, it may also indicate the presence of serious underlying renal or systemic disease.

How Much Protein Is Excreted Over a 24-Hour Period in the Normal Individual?

Normally, there is <150 mg of protein excreted in the urine over a 24-hour period.

What are the Types of Protein Are Normally Excreted in the Urine?

Excreted protein comes from plasma and the urinary tract. Plasma proteins include albumin and a globulin fraction. The major constituent of protein excretion from the urinary tract is immunoglobulin G, a small protein, which is secreted by the cells of the ascending limb of the loop of Henle and the distal tubule.

CONSTITUENTS OF NORMAL URINE PROTEIN	
IMMUNOGLOBULIN	40%
GLOBULINS	30%
TAMM-HORSFALL PROTEIN	40%

How Is Protein Handled by the Kidneys?

Plasma protein must traverse the glomerular barrier to enter the urine. In general, proteins with a molecular weight >20,000 daltons have considerable difficulty passing through glomerular capillary walls. The glomerular basement membrane is also negatively charged, and therefore impedes the passage of negatively charged plasma proteins such as albumin. Filtered protein may be reabsorbed by tubular cells. Proteins that are absorbed by tubular cells are generally low molecular weight in nature.

With this in mind, proteinuria can be classified as follows.

- Glomerular
- Glomerular proteinuria is the most common type of proteinuria, and may vary from several hundred milligrams to >100 grams of protein per day. It occurs as a result of increased glomerular permeability, which may be due to a variety of processes.

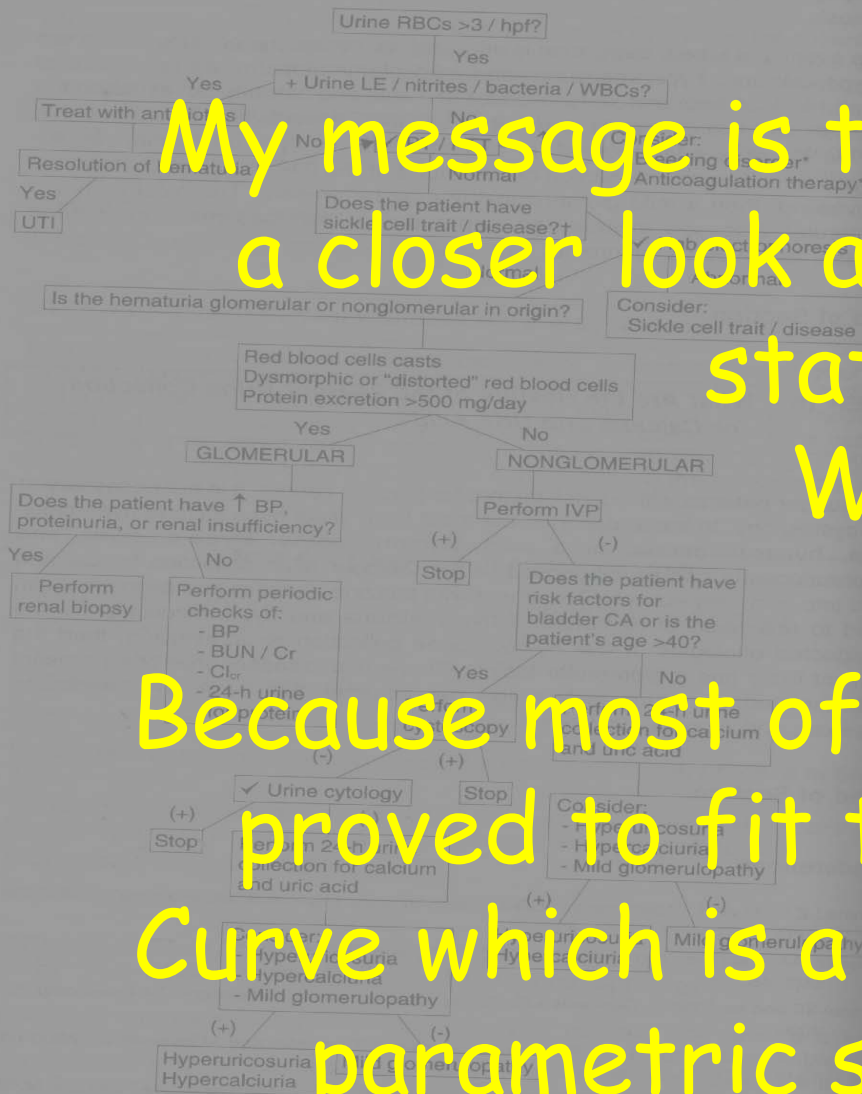
Any process that damages the proximal tubular epithelium will allow low molecular weight proteins to be excreted in the urine.

Overflow
 Overflow proteinuria is the result of overproduction of a particular protein. This overproduction leads to an increase in plasma protein concentration, which is then filtered at the glomerulus. The increased amount overwhelms the ability of the proximal tubular epithelium to catabolize filtered protein, resulting in urinary excretion of excess protein. In clinical practice, this occurs in multiple myeloma, where immunoglobulin light chains are excreted, or in myelomonocytic leukemia, where excessive lysozyme is excreted.

Beyond Means and SDs :
 Recommended Statistics for
 Knowledge Extraction from
 Accumulated Pathology Data and
 your Practice Experience

Dr Tom Hartley
 Royal Hobart Hospital
 &
 University of Tasmania
 Hobart, Australia
 tom.hartley@dhhs.tas.gov.au

HEMATURIA



*Hematuria that occurs in the patient with an elevated PT / PTT may be the result of anticoagulation therapy or a bleeding disorder. However, an underlying structural etiology cannot be excluded.
 †Sickle cell trait/disease may be the sole cause of hematuria; however, this diagnosis must be one of exclusion.

PROTEINURIA

It is important not to ignore proteinuria. While it is true that proteinuria may represent a benign finding, it may also indicate the presence of serious underlying renal or systemic disease.

How Much Protein Is Excreted Over a 24-Hour Period in the Urine? (Normal)

Normally, there is <150 mg of protein excreted in the urine over a 24-hour period.

What Different Types of Protein Are Normally Excreted in the Urine?

Excreted protein comes from plasma and the urinary tract. Plasma proteins include albumin and a globulin fraction. The major constituent of protein filtered from the urinary tract is the Tamm-Horsfall protein, which is secreted by the cells of the ascending limb of the loop of Henle and the distal tubule.

CONSTITUENTS OF NORMAL URINE PROTEIN	
ALBUMIN	30%
GLOBULINS	30%
TAMM-HORSFALL PROTEIN	40%

How Is Protein Handled by the Kidneys?

Plasma proteins that pass through the glomerular barrier to enter the urine. In general, proteins with a molecular weight >20,000 Dalton have considerable difficulty passing through glomerular capillary walls. The glomerular basement membrane is also negatively charged, and therefore impedes the passage of negatively charged plasma proteins such as albumin. Filtered protein may be reabsorbed in the proximal tubule. Proteins that are reabsorbed by tubular cells are generally low molecular weight in nature.

With this in mind, proteinuria can be classified as follows.

- **Glomerular**
 Glomerular proteinuria is the most common type of proteinuria, and may vary considerably, ranging from a few milligrams to >100 grams of protein per day. It occurs as a result of increased glomerular permeability, which may be due to a variety of processes.
- **Tubular**
 Any process that damages the proximal tubular epithelium will allow low molecular weight proteins to be excreted in the urine.
- **Overflow**
 Overflow proteinuria is the result of overproduction of a particular protein. This overproduction leads to an increase in plasma protein concentration, which is then filtered at the glomerulus. The increased amount overwhelms the ability of the proximal tubular epithelium to catabolize filtered protein, resulting in urinary excretion of excess protein. In clinical practice, this occurs in multiple myeloma, where immunoglobulin light chains are excreted, or in myelomonocytic leukemia, where excessive lysozyme is excreted.

My message is that we should take a closer look at non-parametric statistics. Why? Because most of our data cannot be proved to fit the Normal Error Curve which is a prerequisite for all parametric statistical tests

TOPIC 1 : CORRELATION

PROTEINURIA

It is important not to ignore proteinuria. While it is true that proteinuria may represent a benign finding, it may also indicate the presence of serious underlying renal or systemic disease.

How Much Protein Is Excreted Over a 24-Hour Period in the Normal Individual?

Normally, there is <150 mg of protein excreted in the urine over a 24-hour period.

What Different Types of Protein Are Normally Excreted in the Urine?

Excreted protein comes from plasma and the urinary tract. Plasma proteins include albumin and a globulin fraction. The major constituent of protein derived from the urinary tract is the Tamm-Horsfall protein, which is secreted by the cells of the ascending limb of the loop of Henle and the distal tubule.

CONSTITUENTS OF NORMAL URINE PROTEIN	
ALBUMIN	30%
GLOBULINS	30%
TAMM-HORSFALL PROTEIN	40%

Can Protein Be Filtered by the Kidneys?

Plasma protein must traverse the glomerular barrier to enter the urine. In general, proteins with a molecular weight >20,000 daltons have considerable difficulty passing through glomerular capillary walls. The glomerular basement membrane is also negatively charged, and therefore impedes the passage of negatively charged plasma proteins. Small proteins are filtered more readily than large ones. Small proteins are absorbed by tubular cells are generally low molecular weight in nature.

Glomerular Proteinuria

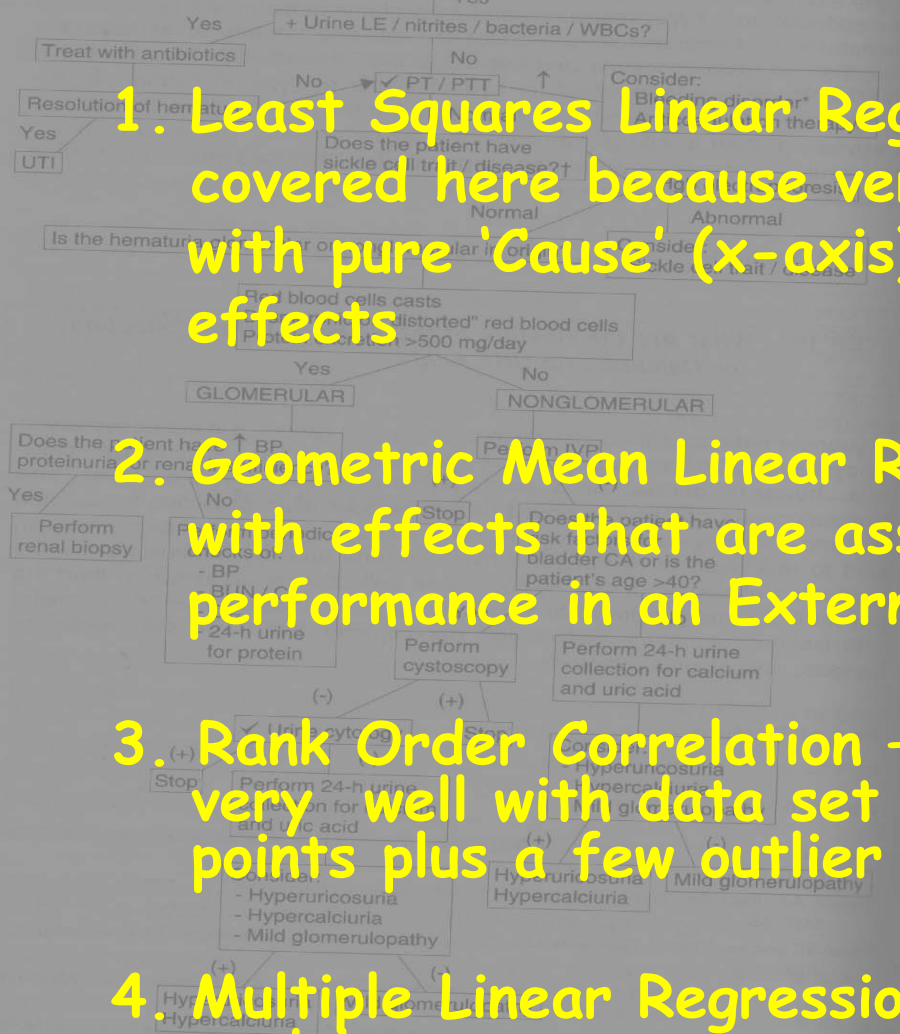
Glomerular proteinuria is the most common type of proteinuria, and may vary from several hundred milligrams to >100 grams of protein per day. It occurs as a result of increased glomerular permeability, which may be due to a variety of processes.

Tubular Proteinuria

Any process that damages the proximal tubular epithelium will allow low molecular weight proteins to be excreted in the urine.

Overflow

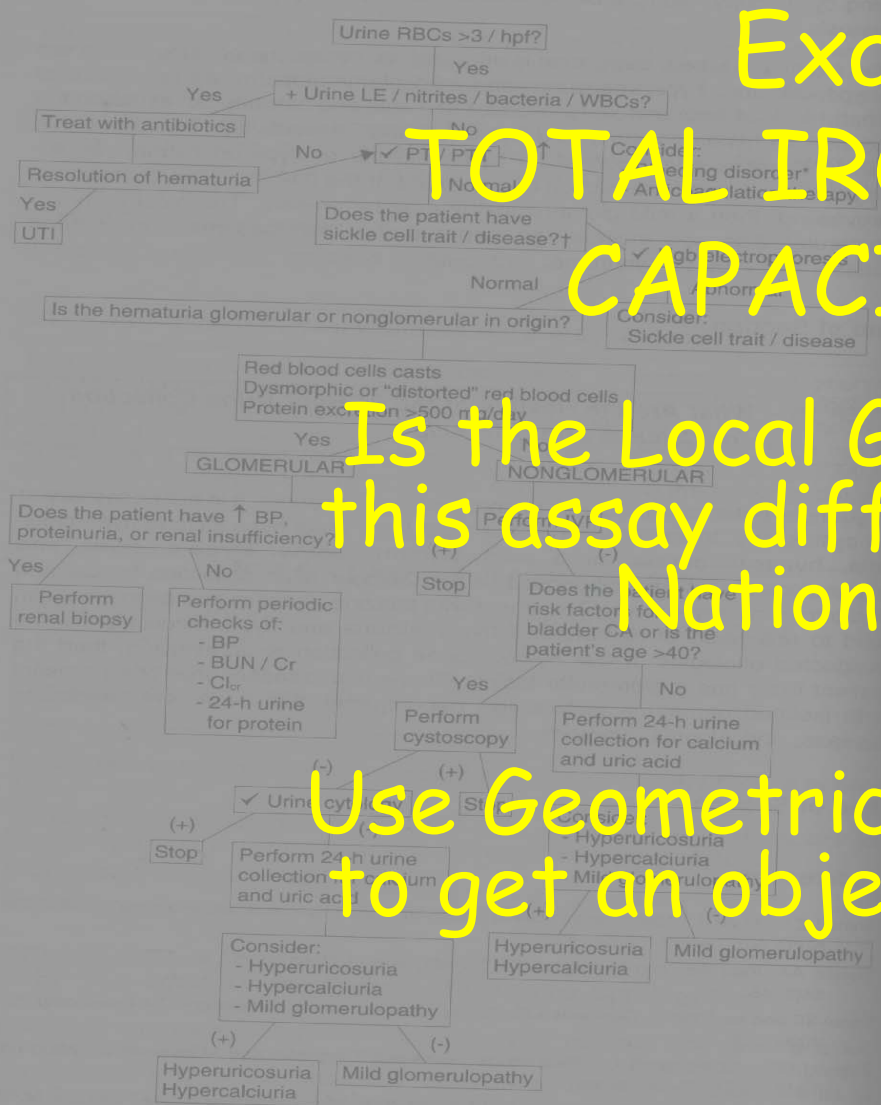
Overflow proteinuria is the result of overproduction of a particular protein. This overproduction leads to an increase in plasma protein concentration, which is then filtered at the glomerulus. The increased amount overwhelms the ability of the proximal tubular epithelium to catabolize filtered protein, resulting in urinary excretion of excess protein. In clinical practice, this occurs in multiple myeloma, where immunoglobulin light chains are excreted, or in myelomonocytic leukemia, where excessive lysozyme is excreted.



*Hematuria that occurs in the setting of an elevated PT / PTT may be the result of anticoagulation therapy or a bleeding disorder. However, an underlying structural etiology cannot be excluded.
 †Sickle cell trait/disease may be the sole cause of hematuria; however, this diagnosis must be one of exclusion.

1. Least Squares Linear Regression - not covered here because very often we are not dealing with pure 'Cause' (x-axis) and 'Effect' (y-axis) effects
2. Geometric Mean Linear Regression - deals very well with effects that are associated eg comparative performance in an External QAP program
3. Rank Order Correlation - (a Non-parametric test) deals very well with data set where there is a cluster of points plus a few outlier points.
4. Multiple Linear Regression - deals with multiparameter models

HEMATURIA



*Hematuria that occurs in the patient with an elevated PT / PTT may be the result of anticoagulation therapy or a bleeding disorder. However, an underlying structural etiology cannot be excluded.
 †Sickle cell trait/disease may be the sole cause of hematuria; however, this diagnosis must be one of exclusion.

PROTEINURIA

It is important not to ignore proteinuria. While it is true that proteinuria may be a benign finding, it may also indicate the presence of serious underlying renal or systemic disease.

How much protein is excreted Over a 24-Hour Period in the Normal Individual?

Normally, there is <150 mg of protein excreted in the urine over a 24-hour period.

What different Types of Protein Are Normally Excreted in the Urine?

Excreted protein comes from plasma and the urinary tract. Plasma proteins include albumin and a globulin fraction. The major constituent of protein derived from the urinary tract is the Tamm-Horsfall protein, which is secreted by the cells of the ascending limb of the loop of Henle and the distal tubule.

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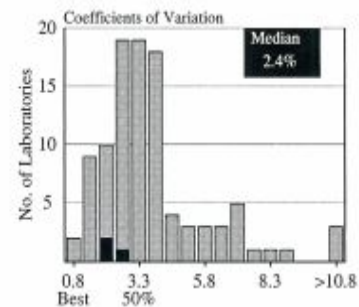
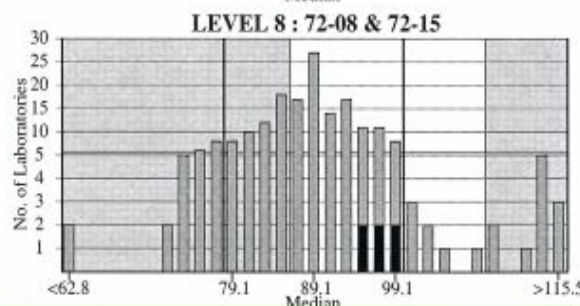
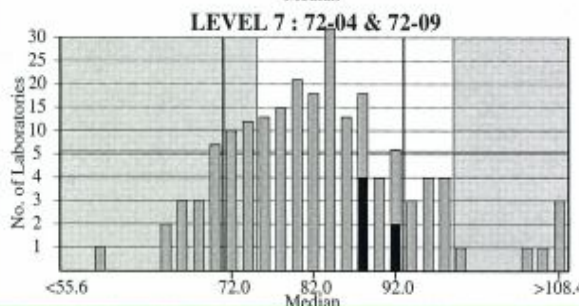
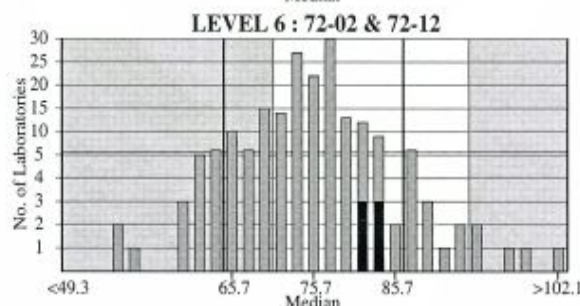
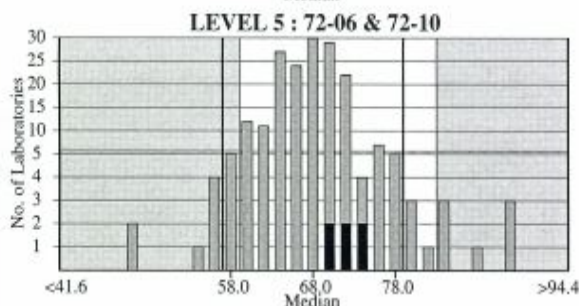
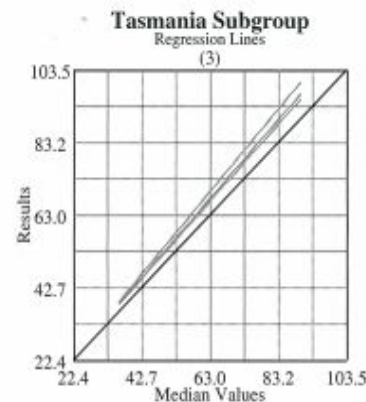
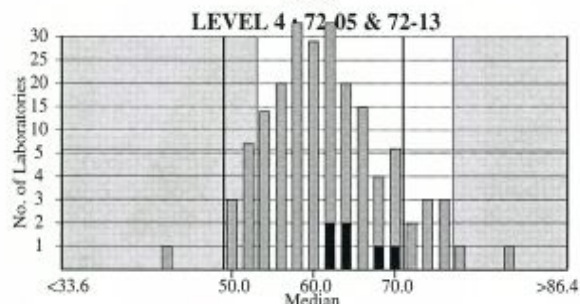
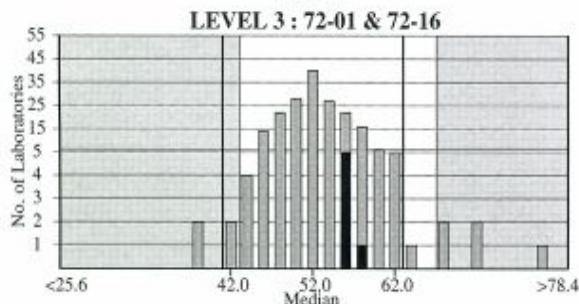
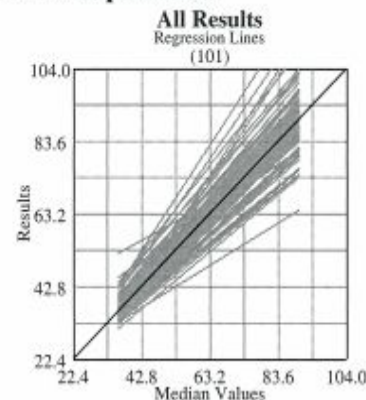
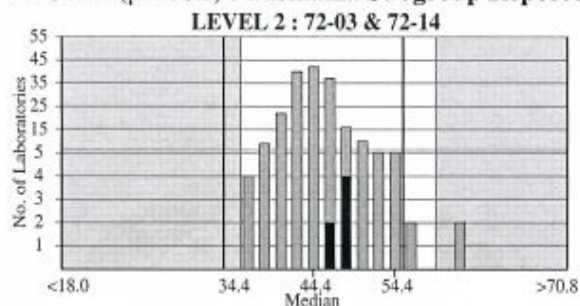
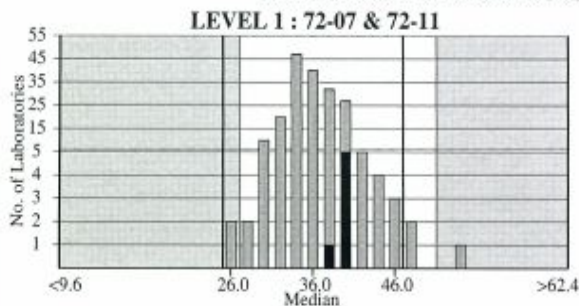
Proteinuria in which the protein can be classified as follows.

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 Glomerular proteinuria is the most common type of proteinuria, and may vary from several hundred milligrams to >100 grams of protein per day. It occurs as a result of increased glomerular permeability, which may be due to a variety of processes.
- **Tubular**
 Any process that damages the proximal tubular epithelium will allow low molecular weight proteins to be excreted in the urine.
- **Overflow**
 Overflow proteinuria is the result of overproduction of a particular protein. This overproduction leads to an increase in plasma protein concentration, which is then filtered at the glomerulus. The increased amount overwhelms the ability of the proximal tubular epithelium to catabolize filtered protein, resulting in urinary excretion of excess protein. In clinical practice, this occurs in multiple myeloma, where immunoglobulin light chains are excreted, or in myelomonocytic leukemia, where excessive lysozyme is excreted.

Example 1
TOTAL IRON BINDING CAPACITY EQAP

Is the Local Group performing this assay differently from the National Group?
 Use Geometric Mean Regression to get an objective assessment

TOTAL IRON BINDING CAPACITY (µmol/L) : Tasmania Subgroup Report for Cycle 72 - All Specimens



While it is true that proteinuria may indicate the presence of serious under-

Over a 24-Hour Period in

creted in the urine over a 24-hour

are Normally Excreted

the urinary tract. Plasma proteins are the major constituent of proteinuria. The major constituent of proteinuria is albumin, which is secreted at the proximal end of Henle and the distal tubule.

ALBUMIN PROTEIN

both suggest either a + 8% or a -8%

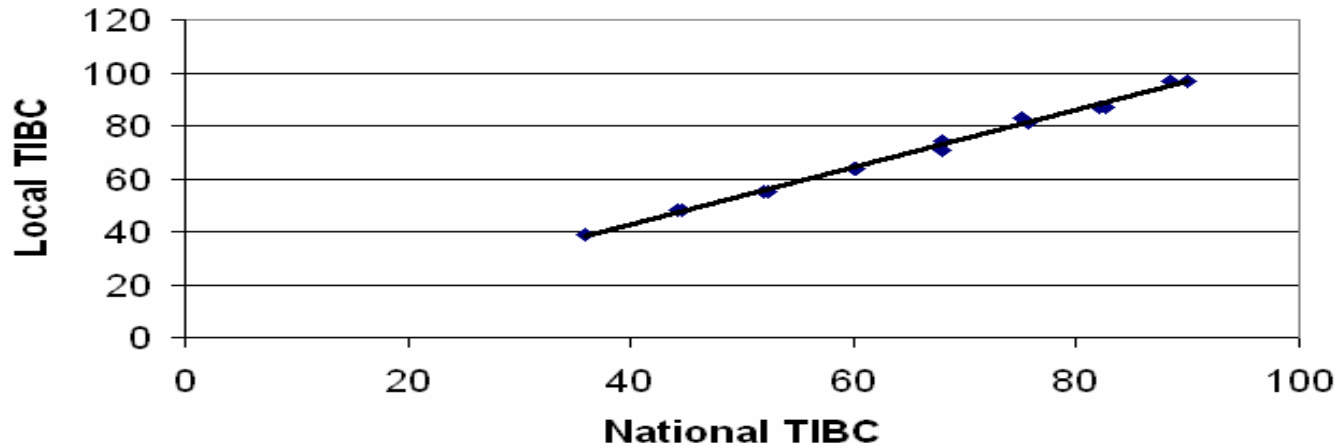
systematic bias depending upon your point of view, local or National.

Common type of proteinuria, and may be associated with proteinuria >100 grams of protein per day. It is characterized by increased glomerular permeability, which may be

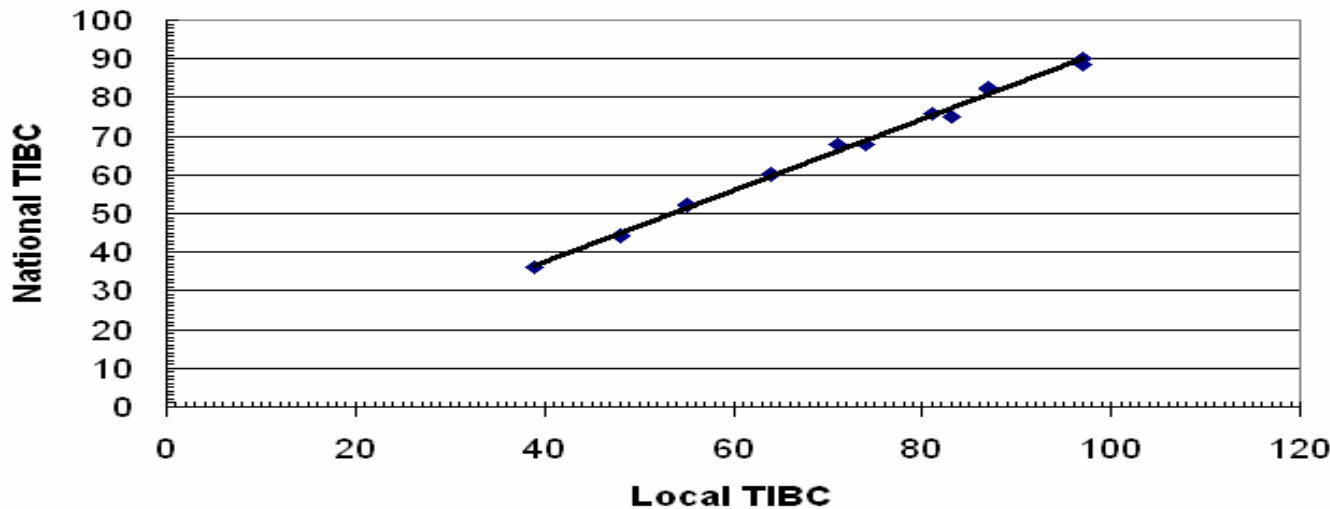
renal tubular epithelium will allow low protein to be excreted in the urine.

reproduction of a particular protein. In the case of proteinuria, the increase in plasma protein concentration, which is due to the increased amount of protein excreted by the renal epithelium to catabolize filtered protein. In clinical practice, proteinuria is characterized by the presence of immunoglobulin light chains in the urine, where excessive lysozyme is

National vs Local TIBC $y = 1.0785x - 0.3537$
 $R^2 = 0.996$



Local vs National TIBC $y = 0.9236x + 0.5783$
 $R^2 = 0.996$



Geometric Mean (GM) Regression Formulae

The slope is easily calculated from the two equations we have already got :

$$\begin{aligned}\text{GM Slope} &= \text{SquareRoot} (\text{Slope}_{y \text{ on } x} / \text{Slope}_{x \text{ on } y}) \\ &= \text{SquareRoot} (1.0785/0.9236) = 1.081\end{aligned}$$

$$\text{Alternatively GM Slope} = \text{SDy} / \text{SDx}$$

$$\begin{aligned}\text{GM Intercept} &= \text{Mean of } y \text{ data} - \text{GM Slope} * \text{Mean of the } x \text{ data} \\ &= 68.0625 - 1.0806 * 63.4375 \\ &= -0.4881\end{aligned}$$

$$\text{Geometric Mean Regression : Local} = 1.081 * \text{National} - 0.4881$$

The geometric mean regression analysis suggests that the consensus agreement should be that the local labs are reading 8% higher than the National labs.

*Hematuria that occurs in the patient with an elevated PT/PTT may be the result of anticoagulation therapy or a bleeding disorder. However, the presence of red blood cells in the urine is not diagnostic of a bleeding disorder. Sickle cell trait/disease may be the cause of hematuria; however, this diagnosis must be one of exclusion.

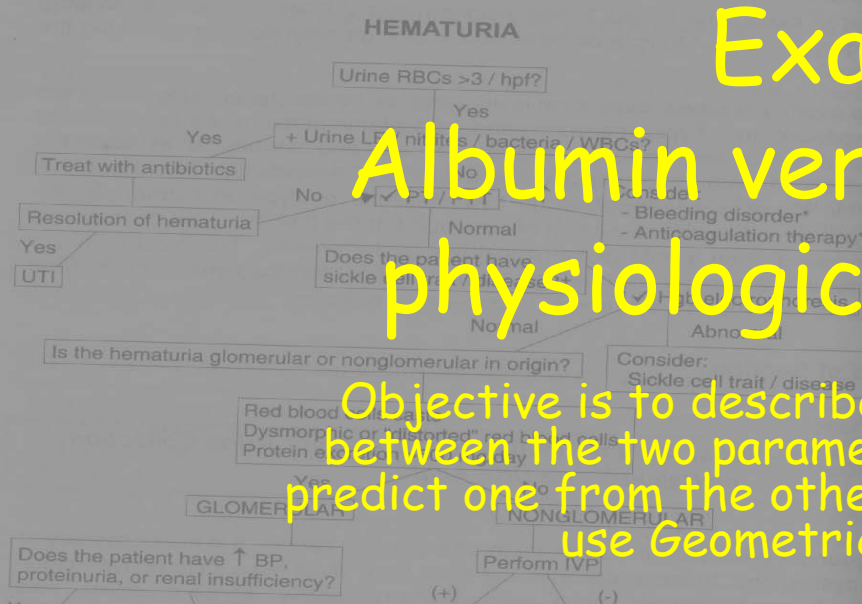
molecular weight proteins to be excreted in the urine.

* Overflow
This overproduction leads to an increase in plasma protein concentration, which in turn leads to a greater amount of protein being filtered, overwhelming the ability of the proximal tubular epithelium to catabolize filtered protein, resulting in urinary excretion of excess protein. In clinical practice, this occurs in multiple myeloma, where immunoglobulin light chains are excreted, or in myelomonocytic leukemia, where excessive lysozyme is excreted.

Example 2

Albumin versus Calcium - a physiological relationship

Objective is to describe the functional relationship between the two parameters. The objective is not to predict one from the other. Recommendation is that you use Geometric Mean Regression



PROTEINURIA

This report is not to ignore proteinuria. While it is true that proteinuria may represent a benign finding, it may also indicate the presence of serious underlying renal or systemic disease.

How Much Protein Is Excreted Over a 24-Hour Period in the Normal Individual?

Normally, there is <150 mg of protein excreted in the urine over a 24-hour period.

What Different Types of Protein Are Normally Excreted in the Urine?

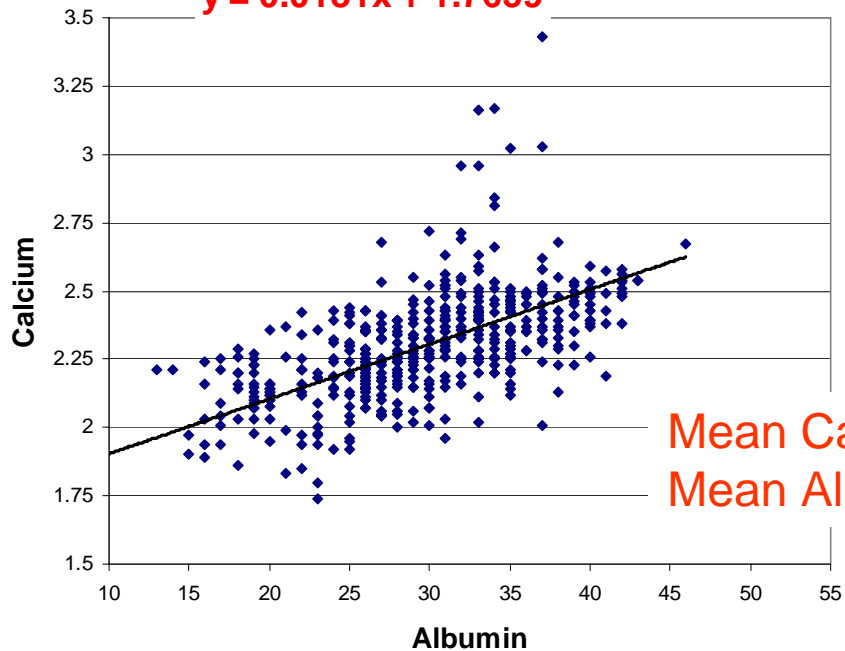
Filtered proteins come from the blood and are normally reabsorbed in the urinary tract. Plasma proteins include albumin and a globulin fraction. The major constituent of protein derived from the liver is the protein transferrin, which is secreted by the cells of the ascending limb of the loop of Henle and the distal tubule.

QUANTITIES OF NORMAL URINE PROTEIN

ALBUMIN	30%
---------	-----

Calcium Regressed on Albumin

$$y = 0.0181x + 1.7659$$

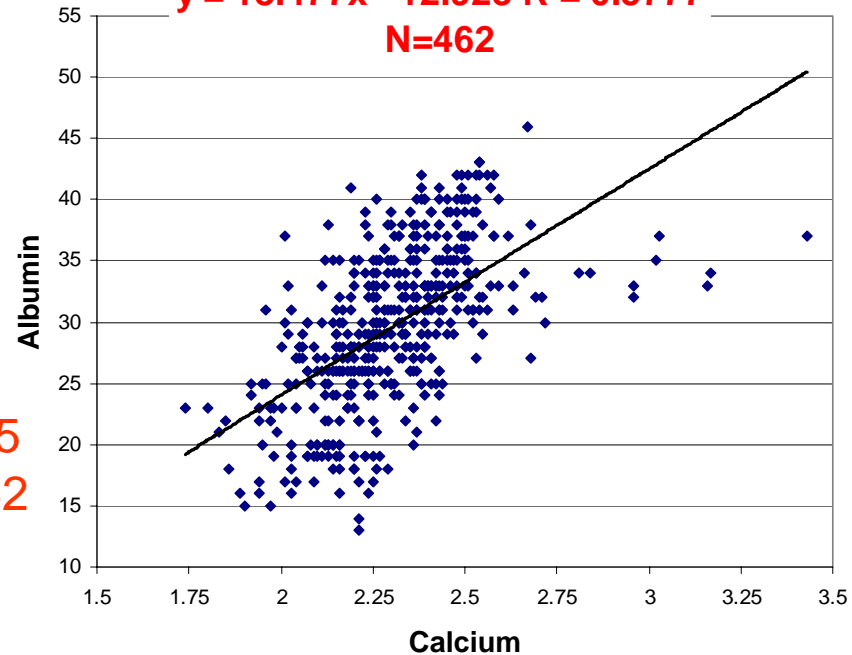


Mean Ca = 2.295
Mean Alb = 29.52

Albumin Regressed on Calcium

$$y = 18.477x - 12.923 \quad R = 0.5777$$

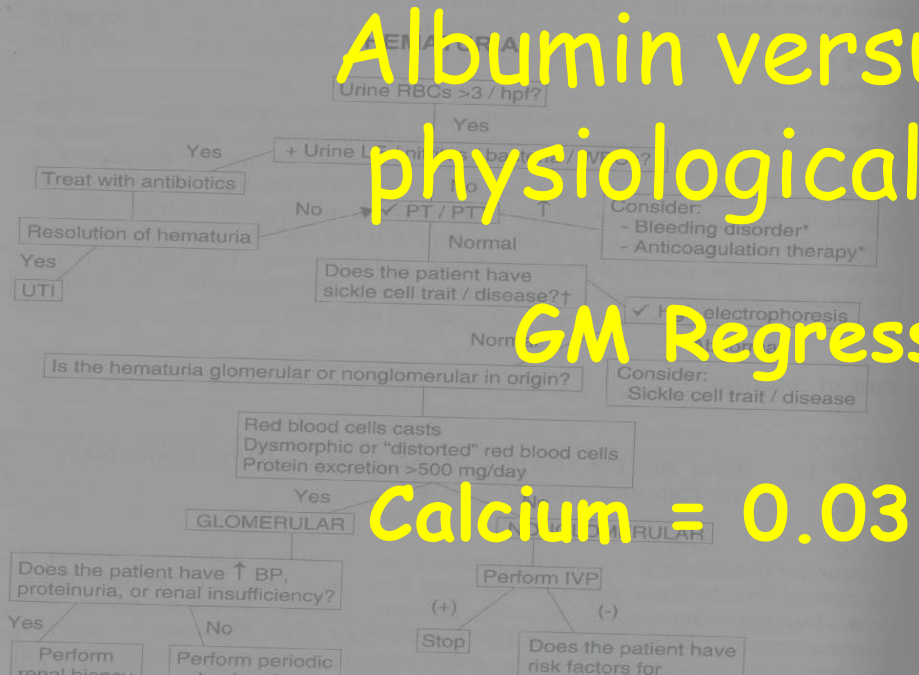
N=462



Albumin versus Calcium - a physiological relationship

GM Regression Equation

$$\text{Calcium} = 0.03130 * \text{Alb} + 1.37$$



PROTEINURIA

It is important not to ignore proteinuria. While it is true that proteinuria may represent a benign finding, it may also indicate the presence of serious underlying renal or systemic disease.

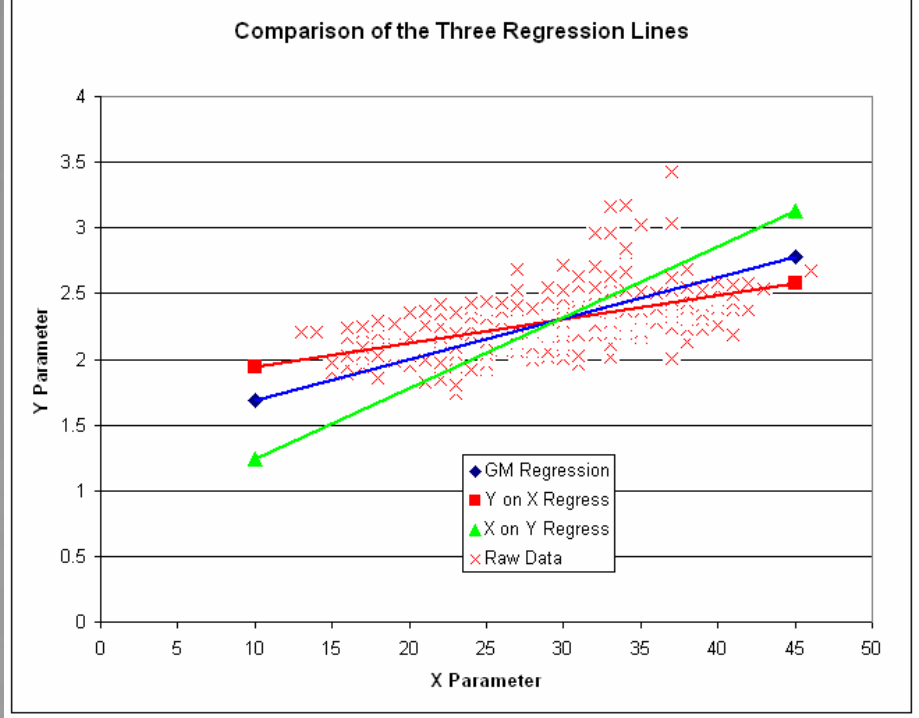
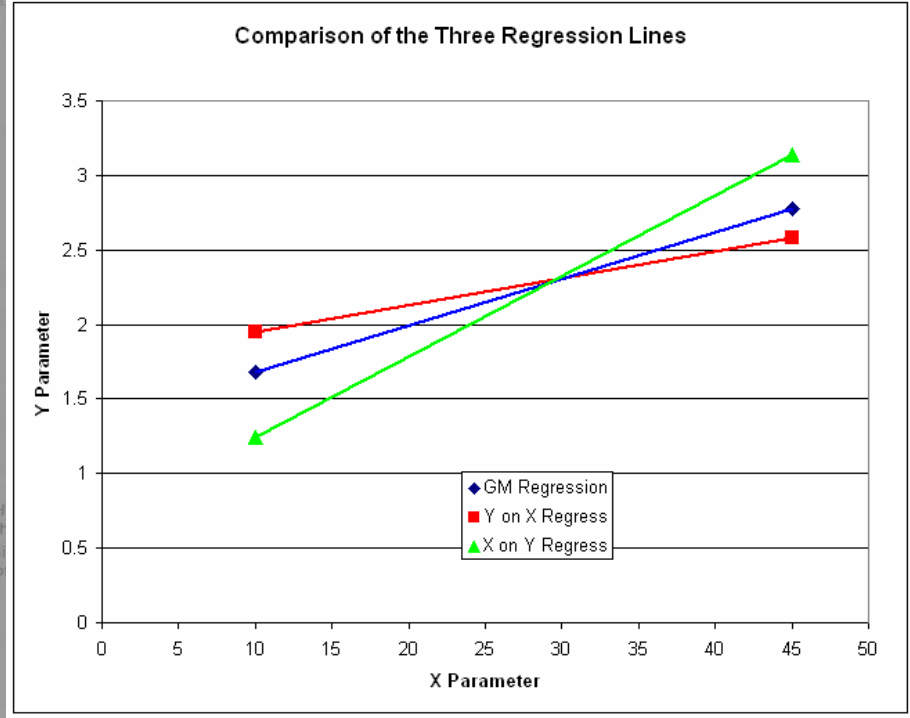
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What Urinary Types of Protein Are Normally Excreted in the Urine?

Excreted protein comes from plasma and the urinary tract. Plasma proteins include albumin and a globulin fraction. The major constituent of protein derived from the urinary tract is the Tamm-Horsfall protein, which is secreted by the cells of the ascending limb of the loop of Henle and the distal tubule.

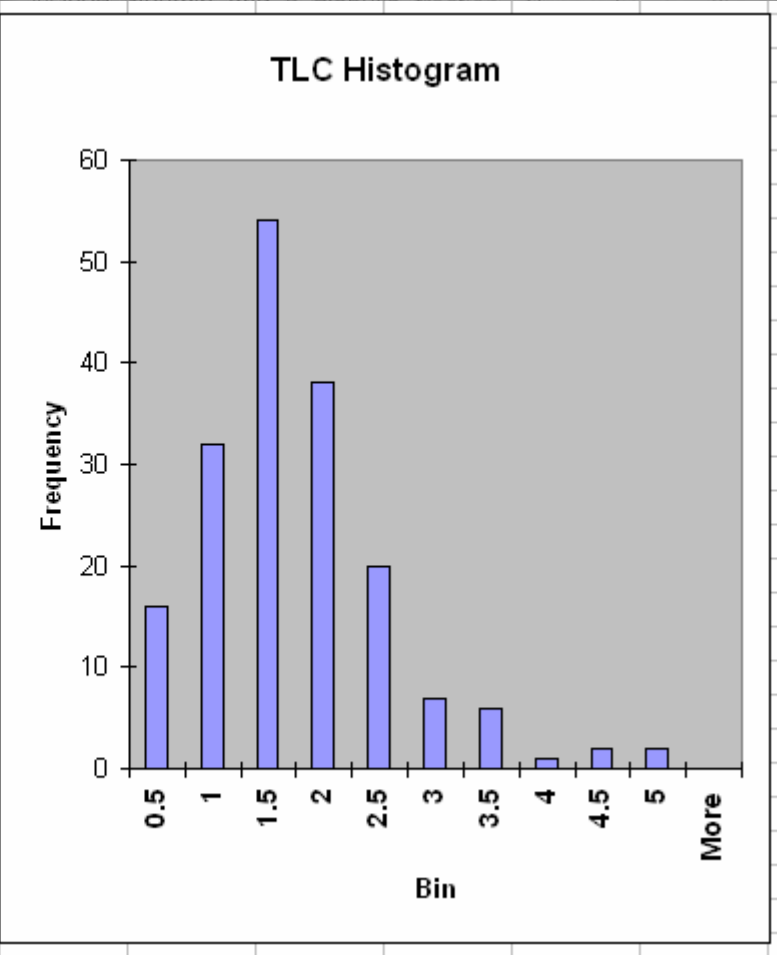
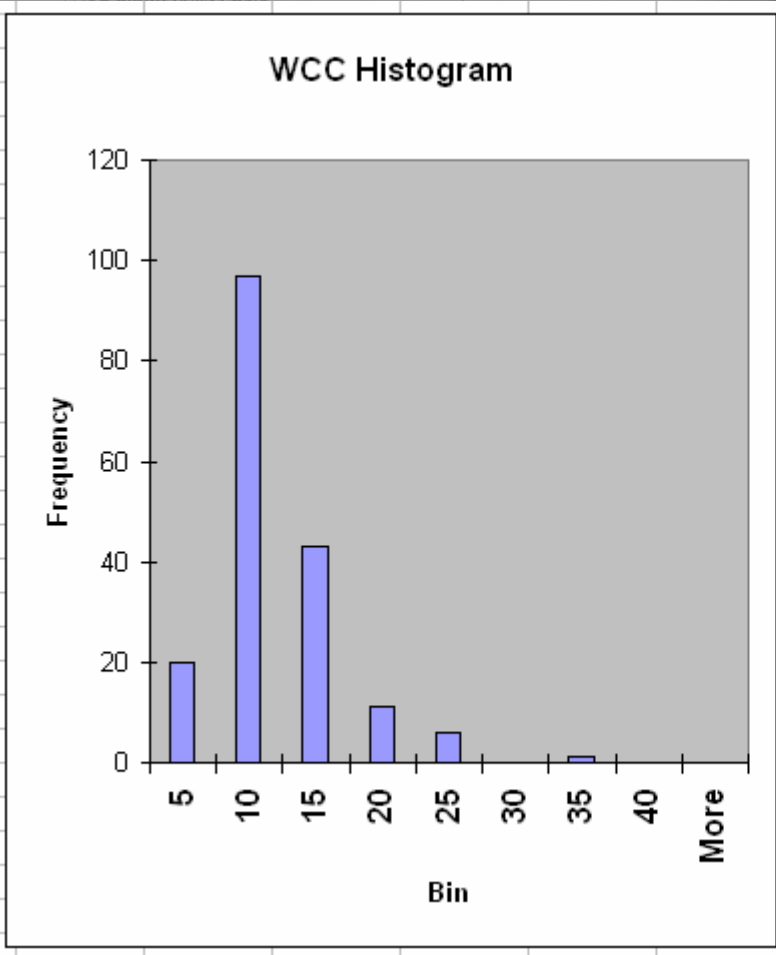
CONSTITUENTS OF NORMAL URINE PROTEIN	
ALBUMIN	30%
GLOBULINS	30%
TAMM-HORSFALL PROTEIN	40%



Example 3

Rank Order Correlation

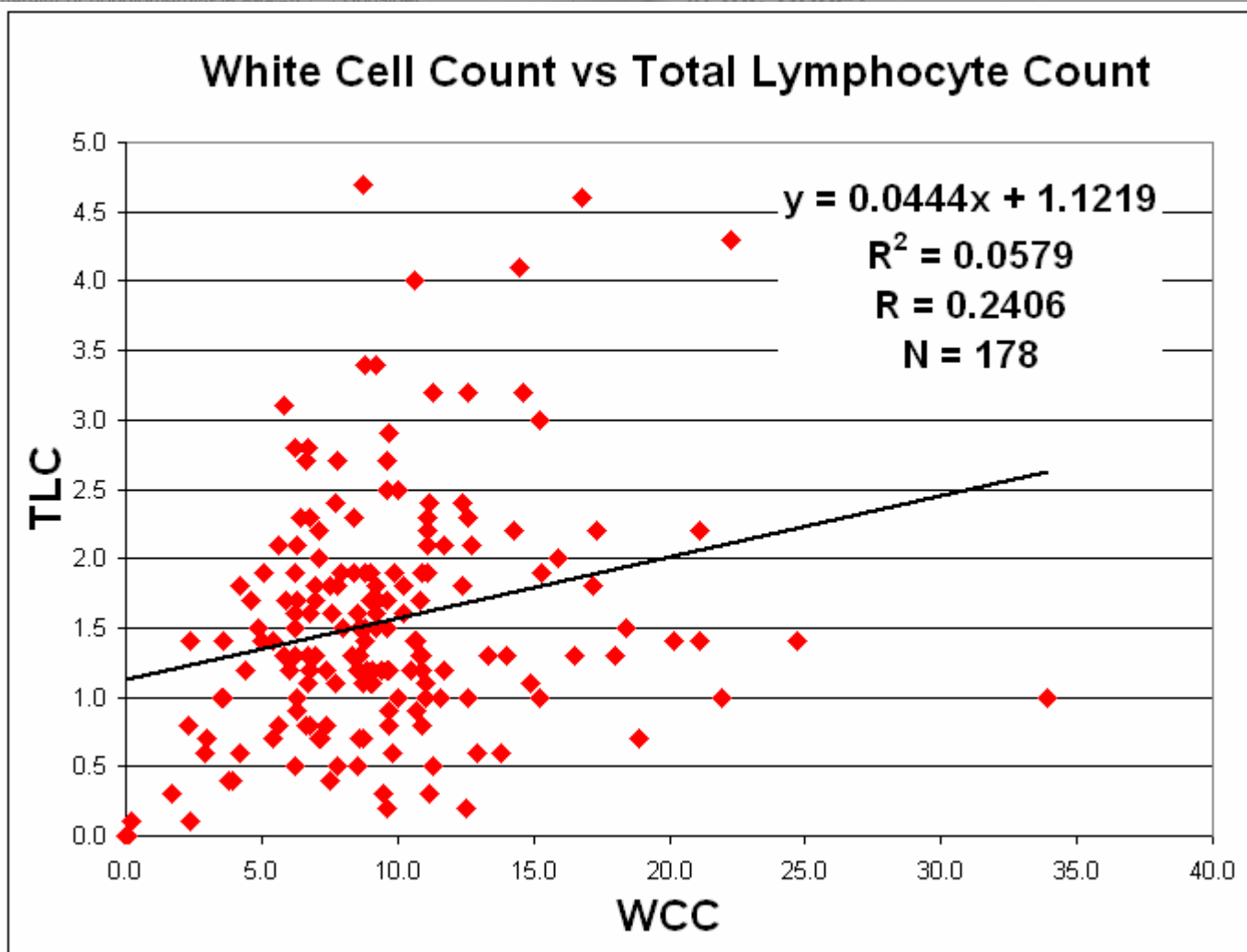
WCC versus TLC : no real physiological relationship but tend to parallel each other and have skewed histograms



Example 3

Rank Order Correlation

WCC versus TLC : no real physiological relationship but tend to parallel each other and have skewed histograms



Rank Order Correlation: WCC vs TLC

VassarStats: Web Site for Statistical Computation

- Utilities
- Clinical Research Calculators
- Probabilities
- Distributions
- Frequency Data
- Proportions
- Ordinal Data
- Correlation & Regression
- t-Tests & Procedures
- ANOVA
- ANCOVA
- Miscellanea
- HOME

After data have been entered, click one or the other of the «Calculate» buttons according to you are starting out with ranks or raw data. If you wish to perform another analysis with a set of data: click the «Reset» button if the value of n for the new set of data is exactly 17. Reload or Refresh button of your browser if the value of n is greater or smaller than 178.

<http://faculty.vassar.edu/lowry/VassarStats.html>

Data Entry

pairs	Ranks for		Raw Data for		Data Import
	X	Y	X	Y	
1	1	1.5	0.03	0	0.03 0
2	2	1.5	0.1	0	0.1 0
3	3	3.5	0.2	0.1	0.2 0.1
4	4	8	1.7	0.3	1.7 0.3
5	5	32	2.3	0.8	2.3 0.8
6	6.5	89.5	2.4	1.4	2.4 1.4
7	6.5	3.5	2.4	0.1	2.4 0.1
8	8	19	2.9	0.6	2.9 0.6
9	9	25	3	0.7	3 0.7
10	10	43.5	3.5	1	3.5 1
11	11.5	89.5	3.6	1.4	3.6 1.4
12	11.5	43.5	3.6	1	3.6 1
13	13	11	3.8	0.4	3.8 0.4
14	14	11	3.9	0.4	3.9 0.4

Import Raw Data

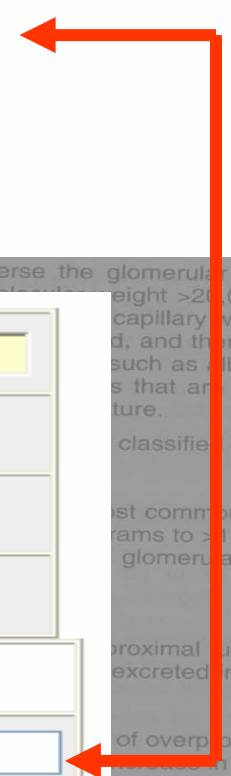
Rank Order Correlation: WCC vs TLC

n	r_s	t	df
178	0.2123	2.88	176
P	one-tailed	0.002236	
	two-tailed	0.004471	

N = 178 **r = 0.2406**

t **df**
 3.289 176
Probability
 directional 0.000608
 non-directional 0.001216

37 times



*Hematuria that occurs in the patient with an elevated PT therapy or a bleeding disorder. However, an underlying †Sickle cell trait/disease may be the sole cause of hematuria of exclusion.

HEMATURIA

PROTEINURIA

Example 4

MULTIPLE LINEAR REGRESSION

Use this for multiparameter modelling eg Ionised Ca

	A	B	C	D	E	F	G	H	I
1	Ca2+	Tca	Alb	Glob	Bic	AG	Phos		
2	1.29	2.58	44	46	31	14	1.33		
3	1.38	2.71	45	24	29	11	1.1		
4	1.33	2.71	44	27	32	12	1.11		
5	1.33	2.53	37	31	15	19	1.46		
6	1.34	2.73	42	27	31	15	1.12		
7	1.3	2.6	42	45	29	11	1.61		
8	1.21	2.42	48	38	27	15	0.94		
9	1.36	2.63	43	33	27	15	1.04		
10	1.23	2.43	43	33	27	15	1.04		
11	1.26	2.45	43	33	27	15	1.04		
12	1.28	2.34	43	33	27	15	1.04		
13	1.22	2.54	43	33	27	15	1.04		
14	1.22	2.39	43	33	27	15	1.04		
15	1.22	2.42	43	33	27	15	1.04		
16	1.42	2.81	43	33	27	15	1.04		
17	1.21	2.24	43	33	27	15	1.04		
18	1.19	2.33	43	33	27	15	1.04		
19	1.24	2.58	43	33	27	15	1.04		
20	1.2	2.41	43	33	27	15	1.04		
21	1.22	2.35	43	33	27	15	1.04		
22	1.18	2.3	43	33	27	15	1.04		
23	1.47	2.77	43	33	27	15	1.04		
24	1.25	2.29	43	33	27	15	1.04		
25	1.18	2.3	43	33	27	15	1.04		
26	1.22	2.36	43	33	27	15	1.04		
27	1.27	2.52	43	33	27	15	1.04		
28	1.29	2.58	43	33	27	15	1.04		
29	1.23	2.3	43	33	27	15	1.04		
30	1.2	2.35	43	28	31	13	0.98		
31	1.22	2.34	42	31	29	12	1.09		

Regression ✖

Input

Input Y Range:

Input X Range:

Labels Constant is Zero

Confidence Level: %

Output options

Output Range:

New Worksheet Ply:

New Workbook

Residuals

Residuals Residual Plots

Standardized Residuals Line Fit Plots

Normal Probability

Normal Probability Plots

It is important not to ignore proteinuria. While it is true that proteinuria may represent a benign finding, it may also indicate the presence of serious underlying renal or systemic disease.

How Much Protein Is Excreted Over a 24-Hour Period in the Normal Individual?

Normally, the glomerular basement membrane (GBM) allows only small amounts of protein to pass into the urine over a 24-hour period.

Protein Normally Excreted

Proteinuria is defined as an abnormal amount of protein in the urine. The normal range for protein excretion in the urine is less than 300 mg per day. Plasma proteins are the major constituent of proteinuria. The most common proteinuria is albuminuria, which is secreted by the glomerular epithelium of Henle and the distal tubule.

PROTEINURIA

Proteinuria is defined as an abnormal amount of protein in the urine. The normal range for protein excretion in the urine is less than 300 mg per day. Plasma proteins are the major constituent of proteinuria. The most common proteinuria is albuminuria, which is secreted by the glomerular epithelium of Henle and the distal tubule.

Why?

The glomerular basement membrane (GBM) acts as a barrier to enter the urine. In normal individuals, proteins less than 100 daltons have considerable difficulty in passing through the GBM. The glomerular basement membrane (GBM) acts as a barrier to enter the urine. In normal individuals, proteins less than 100 daltons have considerable difficulty in passing through the GBM. The glomerular basement membrane (GBM) acts as a barrier to enter the urine. In normal individuals, proteins less than 100 daltons have considerable difficulty in passing through the GBM.

As follows.

Proteinuria is defined as an abnormal amount of protein in the urine. The normal range for protein excretion in the urine is less than 300 mg per day. Plasma proteins are the major constituent of proteinuria. The most common proteinuria is albuminuria, which is secreted by the glomerular epithelium of Henle and the distal tubule.

Proteinuria is defined as an abnormal amount of protein in the urine. The normal range for protein excretion in the urine is less than 300 mg per day. Plasma proteins are the major constituent of proteinuria. The most common proteinuria is albuminuria, which is secreted by the glomerular epithelium of Henle and the distal tubule.

Proteinuria is defined as an abnormal amount of protein in the urine. The normal range for protein excretion in the urine is less than 300 mg per day. Plasma proteins are the major constituent of proteinuria. The most common proteinuria is albuminuria, which is secreted by the glomerular epithelium of Henle and the distal tubule.

*Hematuria that occurs in the patient with a bleeding disorder or on anticoagulant therapy or a bleeding disorder. How much proteinuria is present? Sick cell trait/disease may be the cause of exclusion.

MULTIPLE LINEAR REGRESSION

	A	B	C	D	E
1	SUMMARY OUTPUT				
2					
3	Regression Statistics				
4	Multiple R	0.9687			
5	R Square	0.9383			
6	Adjusted R Square	0.9315			
7	Standard Error	0.0188			
8	Observations	61			
9					
10	ANOVA				
11		df	SS	MS	F
12	Regression	6	0.291137098	0.04852285	136.9104006
13	Residual	54	0.019138311	0.000354413	
14	Total	60	0.31027541		
15					
16		Coefficients	Standard Error	t Stat	P-value
17	Intercept	0.72856	0.05172	14.1	0.0000
18	Tca	0.42451	0.01715	24.7	0.0000
19	Alb	-0.00565	0.00093	-6.1	0.0000
20	Glob	-0.00174	0.00055	-3.2	0.0025
21	Bic	-0.00445	0.00075	-6.0	0.0000
22	AG	-0.00528	0.00111	-4.7	0.0000
23	Phos	-0.02662	0.01235	-2.2	0.0357
24					

$\text{Ionised Ca} = 0.425 \text{ TCa} + 0.728 - 0.00565$
 $\text{Alb} - 0.00174 \text{ Glob} - 0.00445 \text{ Bic} -$
 $0.00528 \text{ AG} - 0.027 \text{ Phos}$

TOPIC 2 : BAYESIAN NETWORK ANALYSIS

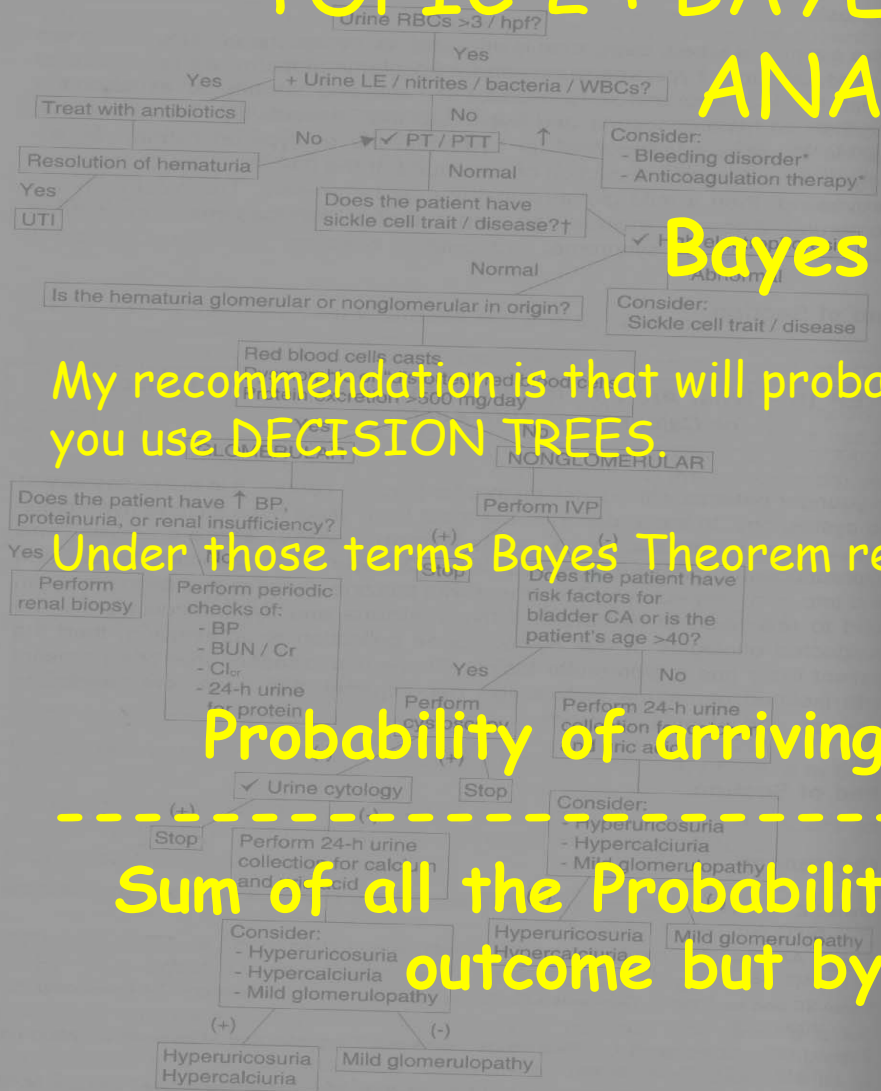
Bayes Theorem

My recommendation is that will probably find Bayes Theorem easier to apply if you use DECISION TREES.

Under those terms Bayes Theorem reads as :

Probability of arriving at your Target Outcome

Sum of all the Probabilities of arriving at the SAME outcome but by all possible routes



It is important not to ignore proteinuria. While it is true that proteinuria may represent a benign finding, it may also indicate the presence of serious underlying renal or systemic disease.

How Much Protein Is Excreted Over a 24-Hour Period in the Normal Individual?

Normally, there is <150 mg of protein excreted in the urine over a 24-hour period.

What Types of Protein Are Normally Excreted in the Urine?

Excreted protein comes from plasma and the urinary tract. Plasma proteins include albumin and a globulin fraction. The major constituents of protein in the normal urinary tract are the amino acids and peptides secreted by the cells of the ascending limb of the loop of Henle and the distal tubule.

CONSTITUENTS OF NORMAL URINE PROTEIN	
ALBUMIN	30%
GLOBULINS	30%
TAMM-HORSFALL PROTEIN	40%

How Is Protein Handled by the Kidneys?

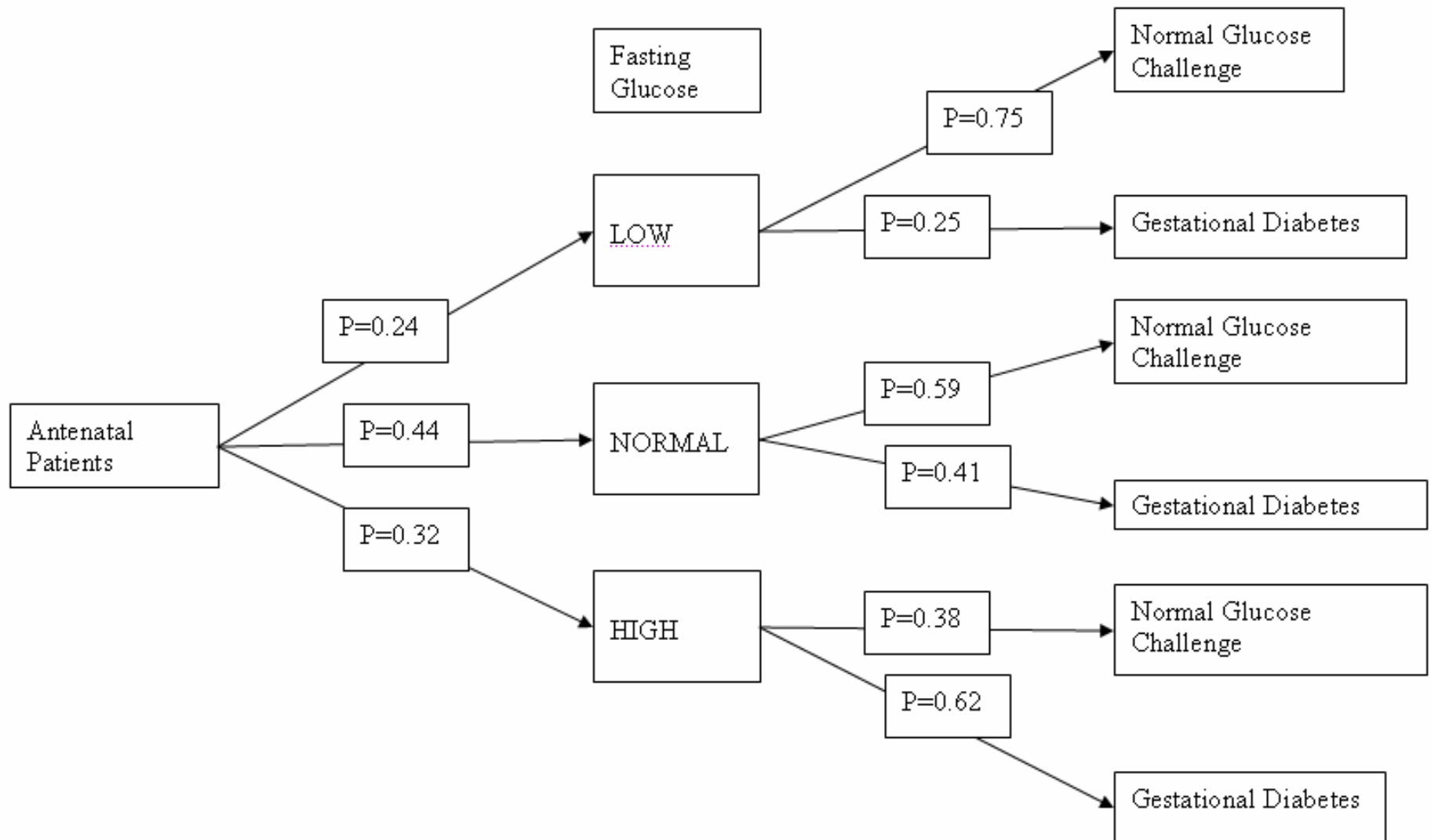
Plasma protein must traverse the glomerular barrier to enter the urine. In general, proteins with a molecular weight <20,000 daltons have considerable difficulty passing through the glomerular barrier. The glomerular basement membrane is also negatively charged, and therefore impedes the passage of negatively charged plasma proteins such as albumin. Filtered protein may be reabsorbed by tubular cells. Proteins that are absorbed by tubular cells are generally low molecular weight in nature.

With this in mind, proteinuria can be classified as follows.

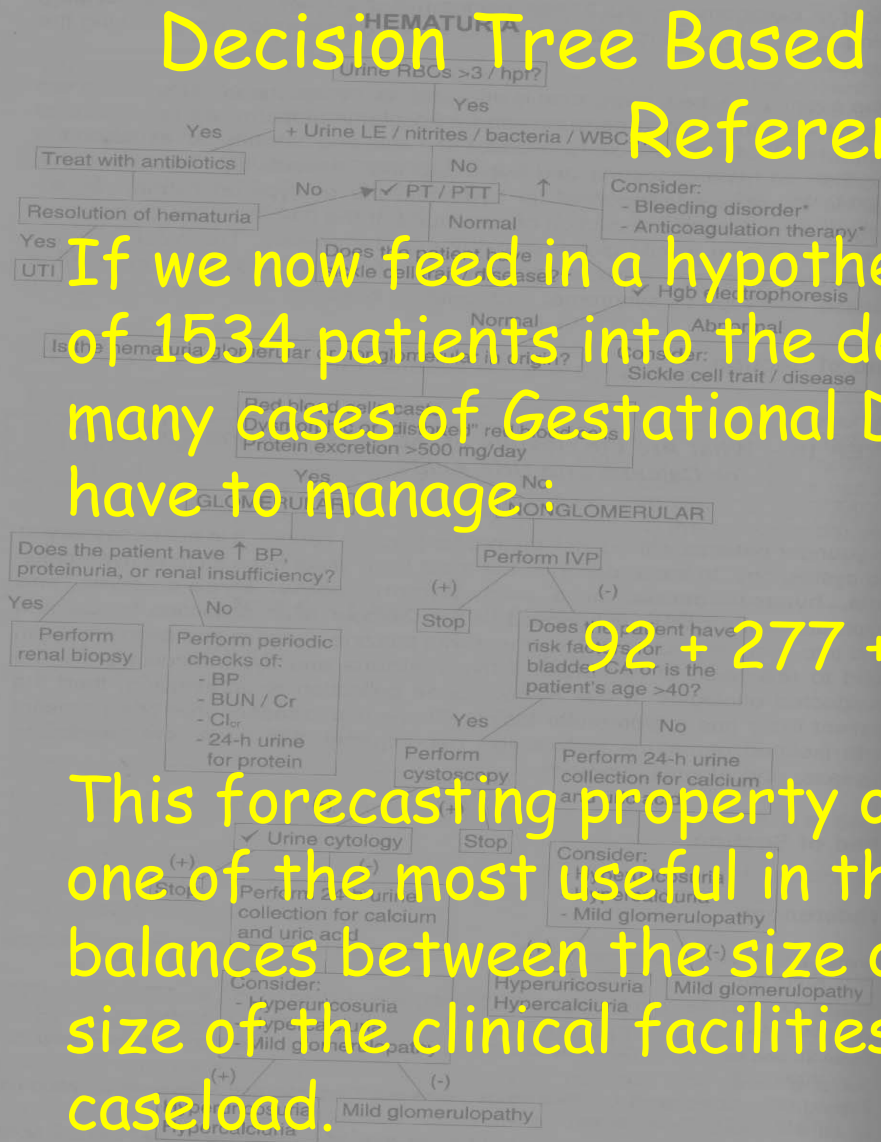
- **Glomerular**
Glomerular proteinuria is the most common type of proteinuria, and may be the result of increased glomerular permeability, which may be due to a variety of processes.
- **Tubular**
Any process that damages the proximal tubular epithelium will allow low molecular weight proteins to be excreted in the urine.
- **Overflow**
Overflow proteinuria is the result of overproduction of a particular protein. This overproduction leads to an increase in plasma protein concentration, which is then filtered at the glomerulus. The increased amount overwhelms the ability of the proximal tubular epithelium to catabolize filtered protein, resulting in urinary excretion of excess protein. In clinical practice, this occurs in multiple myeloma, where immunoglobulin light chains are excreted, or in myelomonocytic leukemia, where excessive lysozyme is excreted.

*Hematuria that occurs in the patient with an elevated PT / PTT may be the result of anticoagulation therapy or a bleeding disorder. However, an underlying structural etiology cannot be excluded.
†Sickle cell trait/disease may be the sole cause of hematuria; however, this diagnosis must be one of exclusion.

Decision Tree Based Upon a Fasting Glucose Reference Study



Decision Tree Based Upon a Fasting Glucose Reference Study



If we now feed in a hypothetical Antenatal Clinic Size of 1534 patients into the decision tree we can see how many cases of Gestational Diabetes they are going to have to manage:

$$92 + 277 + 304 = 673.$$

This forecasting property of our analyses is perhaps one of the most useful in these times of critical balances between the size of clinical caseloads and the size of the clinical facilities available to service that caseload.

PROTEINURIA

It is important not to ignore proteinuria. While it is true that proteinuria may represent a benign finding, it may also indicate the presence of serious underlying renal or systemic disease.

How Much Protein Is Excreted Over a 24-Hour Period in the Normal Individual?

Normally, there is <150 mg of protein excreted in the urine over a 24-hour period.

What Different Types of Protein Are Normally Excreted in the Urine?

Excreted protein comes from plasma and the urinary tract. Plasma proteins in the urine are glomerular in origin. The major constituent of protein excreted in the urinary tract is the Tamm-Horsfall protein, which is secreted by the cells of the ascending limb of the loop of Henle and the distal tubule.

CONSTITUENTS OF NORMAL URINE PROTEIN	
ALBUMIN	30%
GLOBULINS	30%
TAMM-HORSFALL PROTEIN	40%

How Is Protein Handled by the Kidneys?

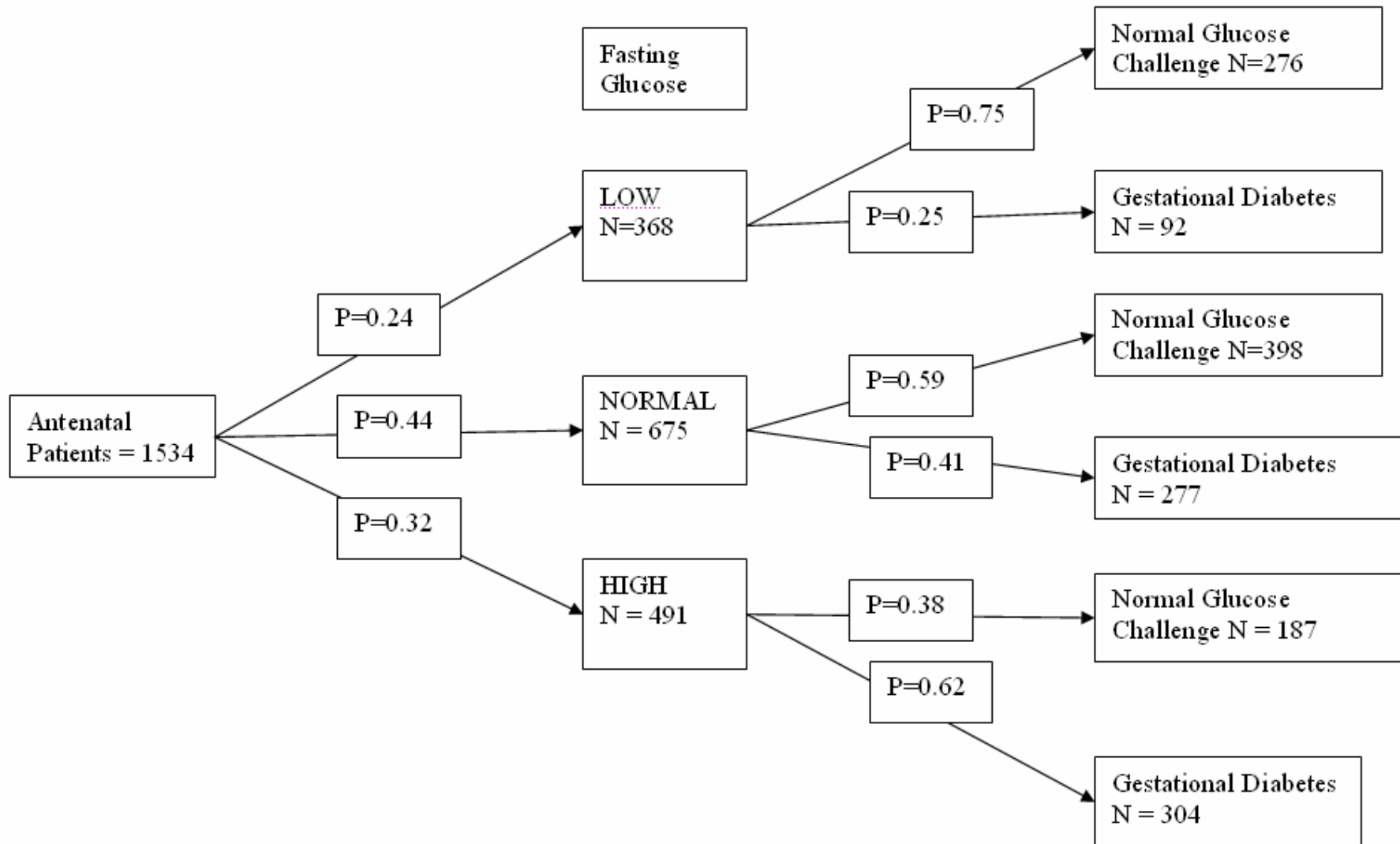
Plasma protein must traverse the glomerular barrier to enter the urine. In general, proteins with a molecular weight >20,000 daltons have considerable difficulty crossing the glomerular barrier. The glomerular basement membrane is so negatively charged and therefore impedes the passage of negatively charged plasma proteins such as albumin. Filtered protein may be reabsorbed by tubular cells. Proteins that are absorbed by tubular cells are generally of a low molecular weight in nature.

With this in mind, proteinuria can be classified as follows:

- **Tubular**
Any process that damages the proximal tubular epithelium will allow low molecular weight proteins to be excreted in the urine.
- **Overflow**
Overflow proteinuria is the result of overproduction of a particular protein. This overproduction leads to an increase in plasma protein concentration, which is then filtered at the glomerulus. The increased amount overwhelms the ability of the proximal tubular epithelium to catabolize filtered protein, resulting in urinary excretion of excess protein. In clinical practice, this occurs in multiple myeloma, where immunoglobulin light chains are excreted, or in myelomonocytic leukemia, where excessive lysozyme is excreted.

*Hematuria that occurs in the patient with an elevated PT / PTT may be the result of anticoagulation therapy or a bleeding disorder. However, an underlying structural etiology cannot be excluded.
†Sickle cell trait/disease may be the sole cause of hematuria; however, this diagnosis must be one of exclusion.

Decision Tree Based Upon a Fasting Glucose Reference Study



What Happens When We Search for A Decision Tree in Laboratory Data?

BAYESWARE

- news and events
- corporate profile
- software products
- solutions and services
- support and assistance
- technology and resources
- year 2000 statement
- legal information
- site map



knowledge discovery by bayesian networks

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August 5, 2009

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[Take the Tour!](#)
Do not take our word for it! Watch it yourself on the Visual Tour of Bayesware Discoverer 1.0 Professional Edition, starting... [here](#).



www.bayesware.com

PROTEINURIA

It is important not to... proteinuria. While it is true that proteinuria may represent a benign finding, it may also indicate the presence of serious underlying renal or systemic disease.

How Much Protein is Excreted Over a 24-Hour Period in the Normal Individual?

Normally, there is <150 mg of protein excreted in the urine over a 24-hour period.

Normally Excreted

tract. Plasma proteins constituent of protein... which is secreted... and the distal tubule.

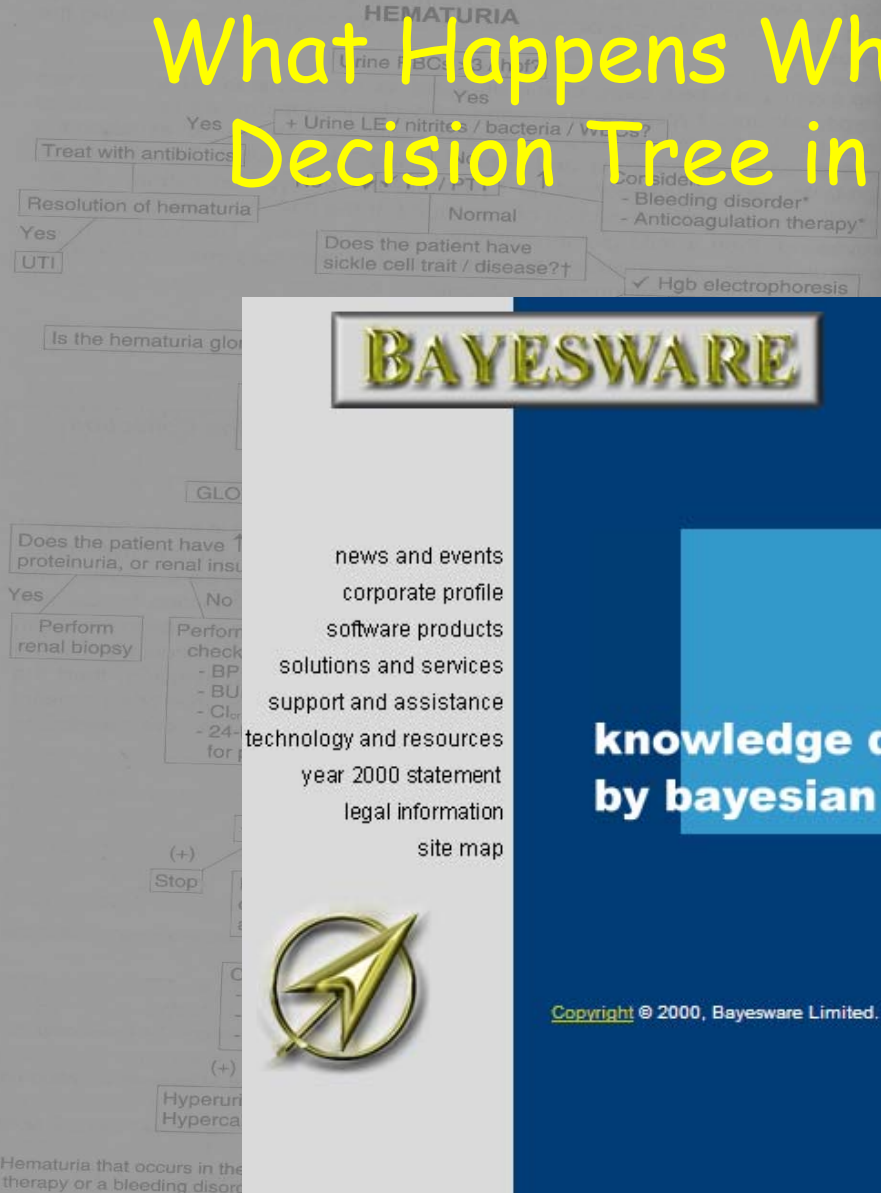
PROTEIN

to enter the urine. In... have considerable... the glomerular basement... impedes the passage of... filtered protein may be... by tubular cells are

of proteinuria, and may... of protein per day. It... ability, which may be

ithelium will allow low... ne.

Overflow proteinuria is the result of overproduction of a particular protein. This overproduction leads to an increase in plasma protein concentration, which is then filtered at the glomerulus. The increased amount overwhelms the ability of the proximal tubular epithelium to catabolize filtered protein, resulting in urinary excretion of excess protein. In clinical practice, this occurs in multiple myeloma, where immunoglobulin light chains are excreted, or in myelomonocytic leukemia, where excessive lysozyme is excreted.



*Hematuria that occurs in the... therapy or a bleeding disorder.
†Sickle cell trait/disease may be the sole cause of hematuria; however, this diagnosis must be one of exclusion.

Can It Find Relationships We Would Expect and Others Which Are Unexpected.

We have 'mined' two sets of data

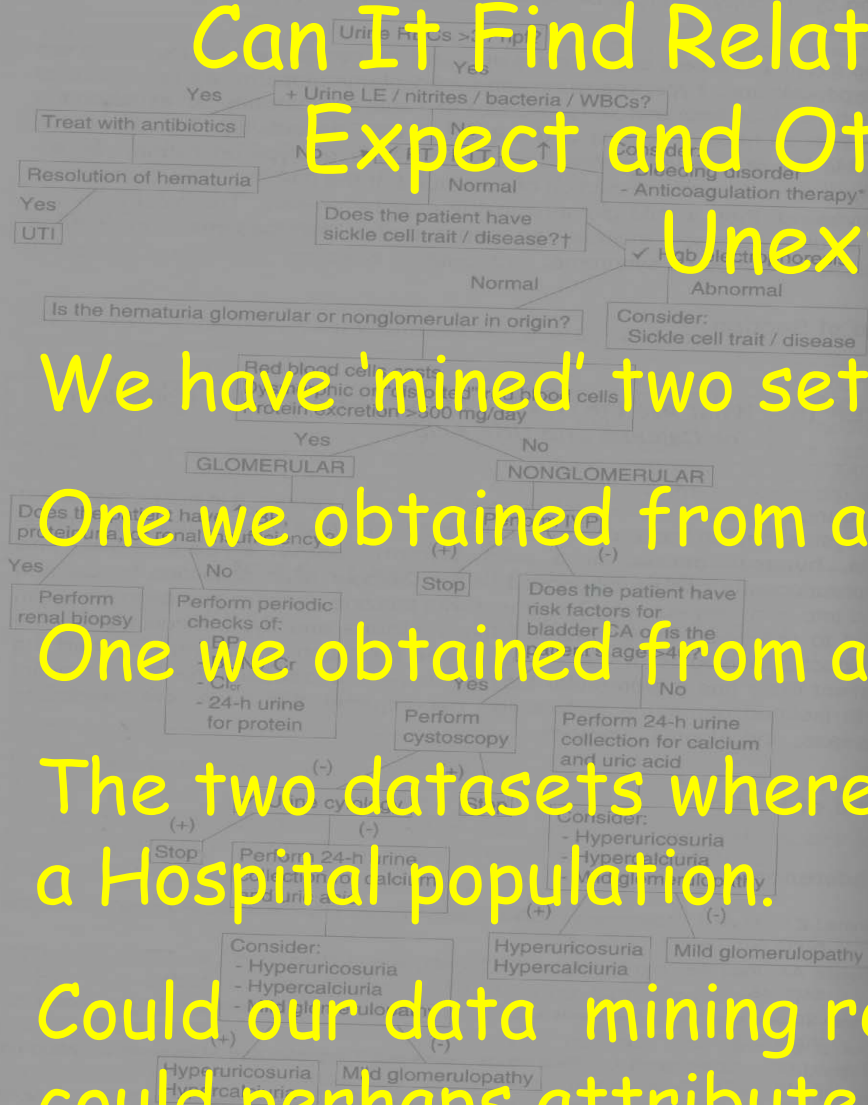
One we obtained from a Vitros 950 Analyzer

One we obtained from a Abbott Architect Analyzer

The two datasets where obtained a year apart from a Hospital population.

Could our data mining reveal differences that we could perhaps attribute to the changeover from the Vitros Analyzer to the Architect?

HEMATURIA



PROTEINURIA

It is important not to overreact to proteinuria. While it is true that proteinuria may be a sign of renal insufficiency, it may also indicate the presence of serious underlying renal or systemic disease.

How Much Protein is Excreted Over a 24-Hour Period in the Normal Individual?

Normally, there is <150 mg of protein excreted in the urine over a 24-hour period.

What Different Types of Protein Are Normally Excreted in the Urine?

Excreted protein comes from plasma and the urinary tract. Plasma proteins include albumin and a globulin fraction. The major constituent of protein derived from the urinary tract is the Tamm-Horsfall protein, which is secreted by the cells of the ascending limb of the loop of Henle and the distal tubule.

CONSTITUENTS OF NORMAL URINE PROTEIN	
ALBUMIN	30%
GLOBULINS	30%
TAMM-HORSFALL PROTEIN	40%

How is Protein Handled by the Kidneys?

Plasma protein must traverse the glomerular barrier to enter the urine. In general, proteins with a molecular weight >20,000 daltons have considerable difficulty passing through glomerular capillary walls. The glomerular basement membrane selectively reabsorbs the protein that has passed through the glomerular barrier. Plasma proteins with a molecular weight <20,000 daltons are filtered. Filtered protein may be reabsorbed by tubular cells. Proteins that are absorbed by tubular cells are generally low molecular weight in nature.

With this in mind, proteinuria can be classified as follows.

- **Glomerular**
Glomerular proteinuria is the most common type of proteinuria, and may vary from several hundred milligrams to >100 grams of protein per day. It occurs as a result of increased glomerular permeability and may be due to a variety of processes.
- **Tubular**
Any process that damages the proximal tubule epithelium will allow low molecular weight protein to be excreted in the urine.
- **Overflow**
Overflow proteinuria is the result of overproduction of a particular protein. This overproduction leads to an increase in plasma protein concentration, which is then filtered at the glomerulus. The increased amount overwhelms the ability of the proximal tubular epithelium to catabolize filtered protein, resulting in urinary excretion of excess protein. In clinical practice, this occurs in multiple myeloma, where immunoglobulin light chains are excreted, or in myelomonocytic leukemia, where excessive lysozyme is excreted.

*Hematuria that occurs in the patient with an elevated PT / PTT may be the result of anticoagulation therapy or a bleeding disorder. However, an underlying structural etiology cannot be excluded.
†Sickle cell trait may cause the blood to appear abnormal. However, this diagnosis must be confirmed by examination.

The Electrolytes Dataset

N = 286 Vitros results + 349 Architect results = 635

Results were scored as L, N or H according to the ref ranges in use at the time.

	A	B	C	D	E	F
342	142	4	23	8.7	74	Vitros
343	141	4.4	50	9.8	74	Vitros
344	141	5	42	13.3	74	Vitros
345	137	4.5	26	3	75	Vitros
346	140	3.9	26	3.5	75	Vitros
347	142	4	25	3.9	75	Vitros
348	140	3.8	30	4.3	75	Vitros
349	142	4	30	4.3	75	Vitros
350	139	4.1	25	2	36	Archie
351	142	4.1	24	3	43	Archie
352	132	3.6	30	4.8	43	Archie
353	145	4.4	26	4.9	43	Archie
354	139	3.2	20	1.1	44	Archie
355	140	3.3	23	3.4	44	Archie
356	142	3.8	22	3.9	44	Archie
357	136	3.5	27	3.9	46	Archie
358	133	4.6	20	5.2	47	Archie
359	142	3.9	22	2.6	48	Archie

Raw Data

Transformed Data

It is important not to ignore proteinuria. While it is true that proteinuria may represent a benign finding, it also indicates the presence of serious underlying renal or systemic disease.

How Much Protein Is Excreted Over a 24-Hour Period in Normal Urine?

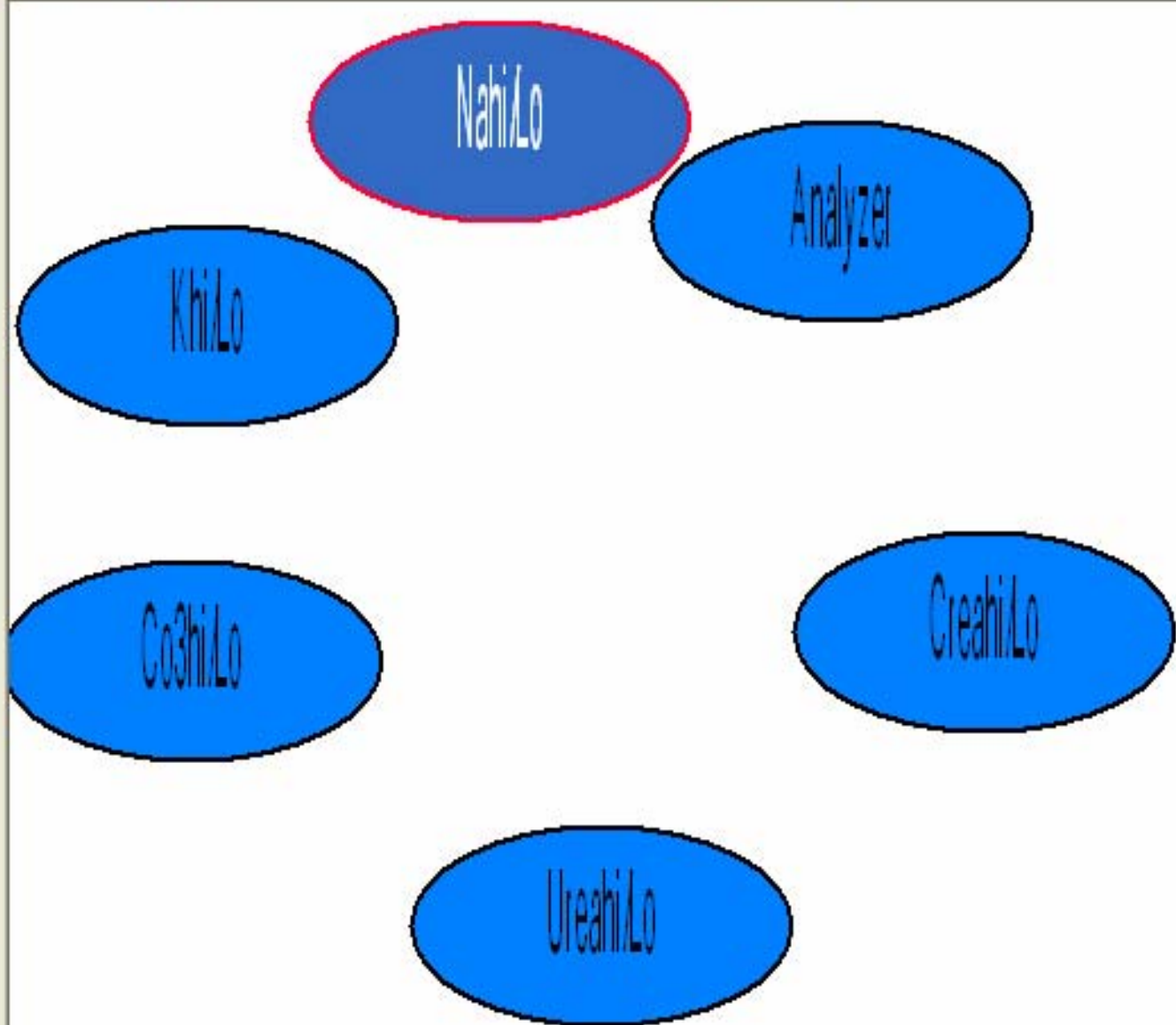
Normally, there is <150 mg of protein excreted in the urine over a 24-hour period.

What Different Types of Protein Are Normally Excreted in the Urine?

	A	B	C	D	E	F
1	Analyzer	NaHi/Lo	KHi/Lo	CO3Hi/Lo	UreaHi/Lo	CreaHi/Lo
2	Vitros	H	H	L	H	H
3	Archie	H	H	L	H	H
4	Vitros	H	H	N	H	H
5	Vitros	H	H	N	H	H
6	Vitros	H	L	H	H	L
7	Vitros	H	L	H	H	L
8	Vitros	H	L	H	N	N
9	Vitros	H	L	L	N	H
10	Vitros	H	L	N	L	N
11	Vitros	H	L	N	H	N
12	Vitros	H	L	N	H	H
13	Vitros	H	L	N	H	H
14	Vitros	H	L	N	N	H
15	Archie	H	L	N	N	N
16	Vitros	H	N	H	H	L
17	Vitros	H	N	H	N	N
18	Vitros	H	N	H	N	N
19	Vitros	H	N	H	H	H
20	Vitros	H	N	L	H	H
21	Archie	H	N	L	N	N
22	Vitros	H	N	N	N	L
23	Vitros	H	N	N	N	L
24	Vitros	H	N	N	H	L
25	Vitros	H	N	N	L	N
26	Vitros	H	N	N	N	N
27	Vitros	H	N	N	H	N

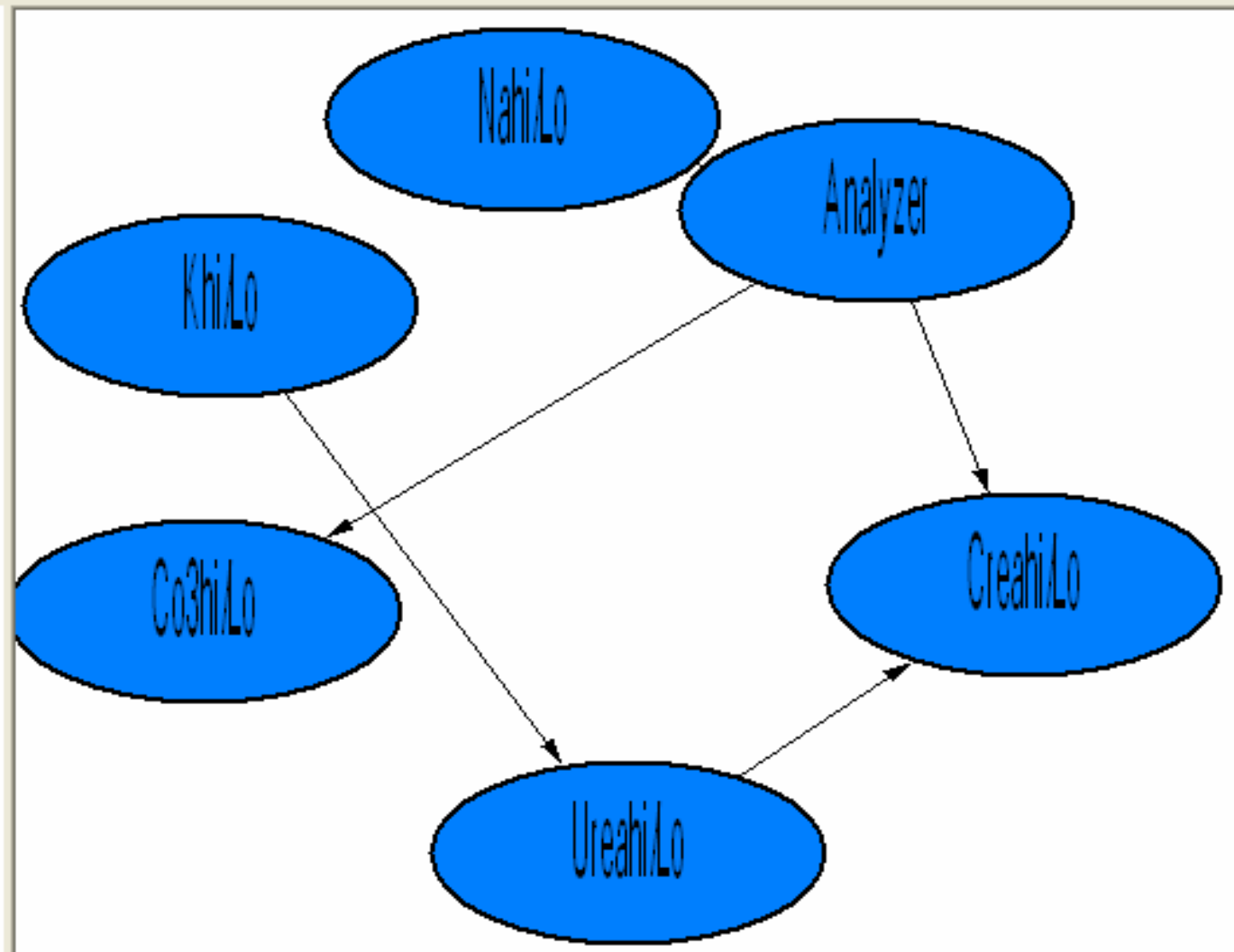


- Analyzer
- Nahi/Lo
- Khi/Lo
- Co3hi/Lo
- Ureahi/Lo
- Creahi/Lo

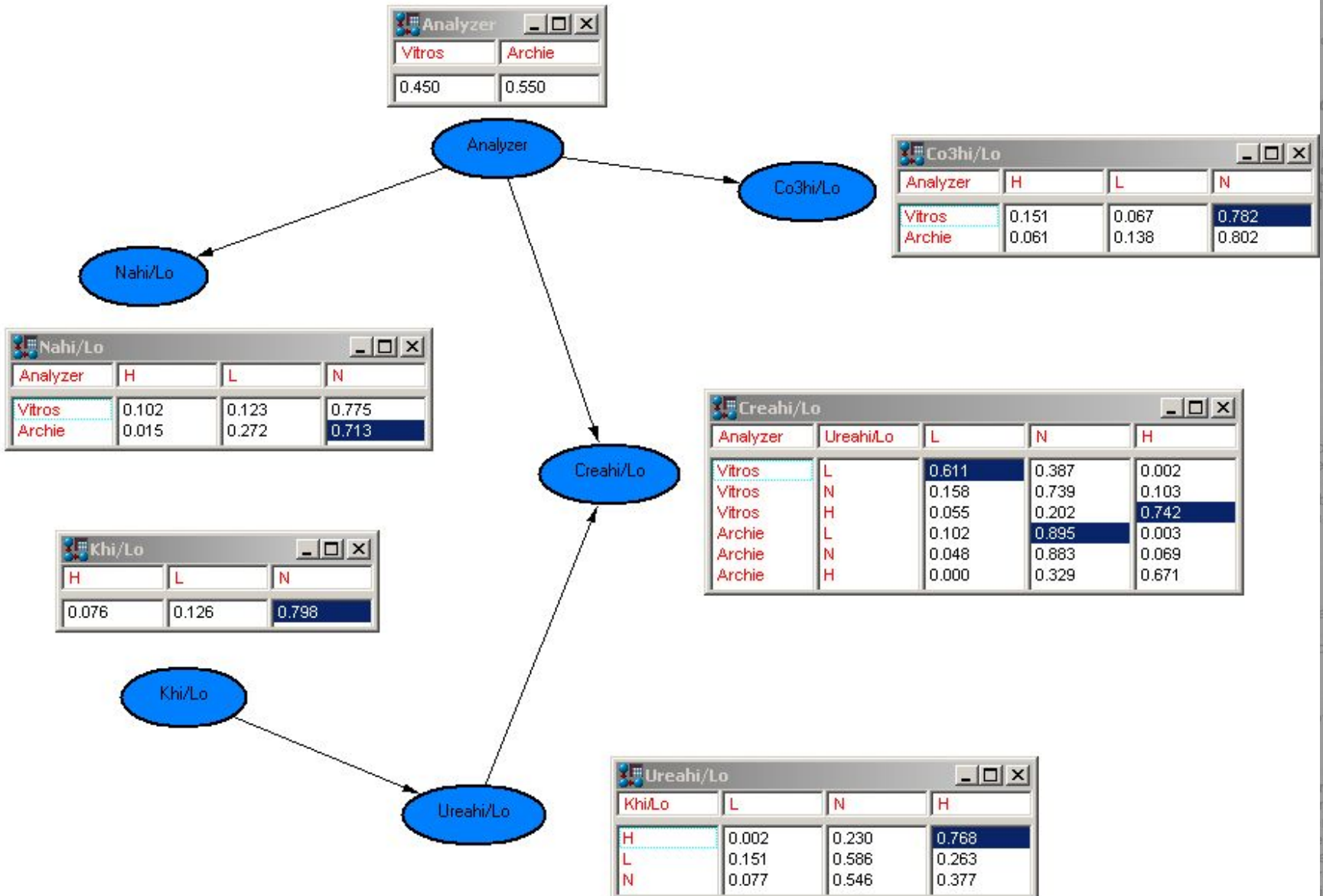




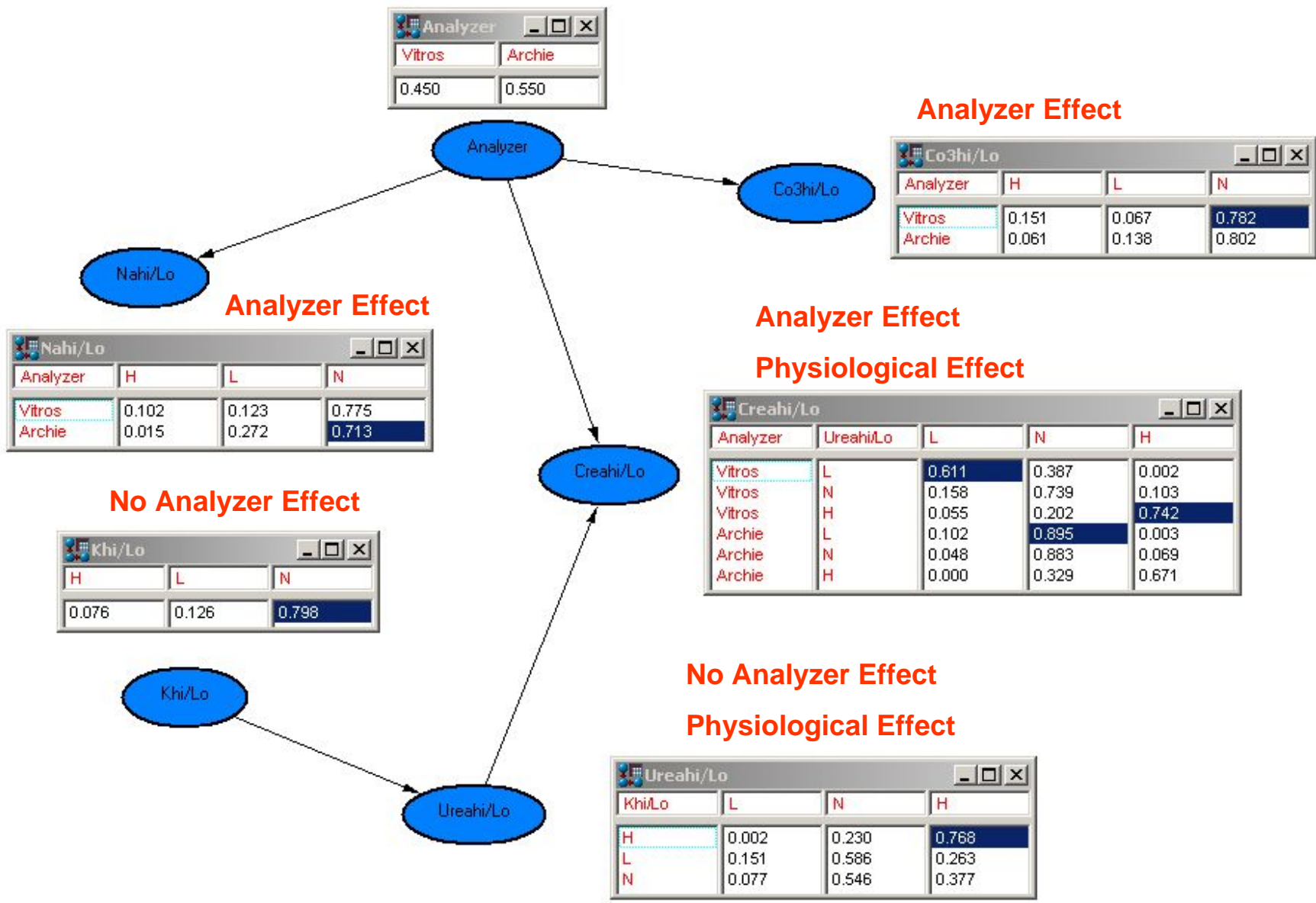
Analyzer		
	0.450	Vitros
	0.550	Archie
Nahi/Lo		
	0.054	H
	0.205	L
	0.741	N
Khi/Lo		
	0.076	H
	0.126	L
	0.798	N
Co3hi/Lo		
	0.101	H
	0.106	L
	0.793	N
Ureahi/Lo		
	0.081	L
	0.527	N
	0.392	H
Creahi/Lo		
	0.088	L
	0.592	N
	0.320	H



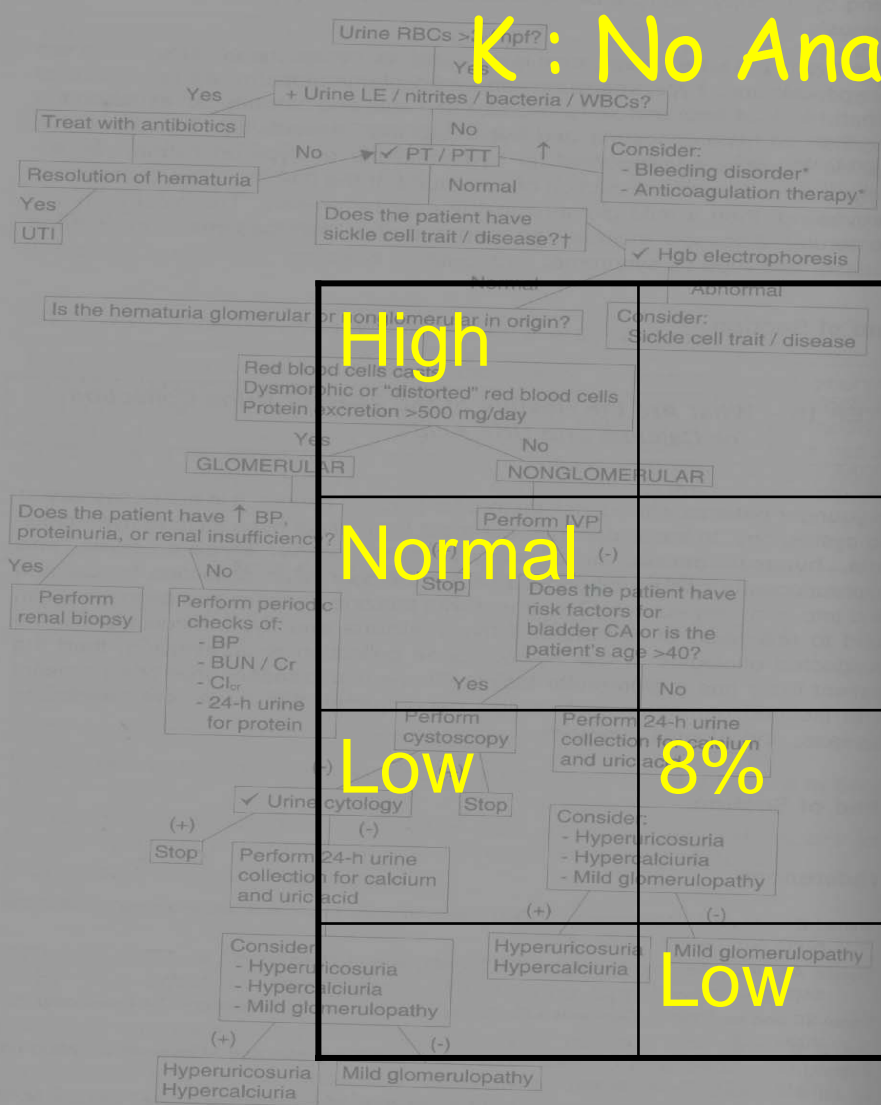
Electrolytes Network : Na, K, HCO₃, Urea, Creat



Electrolytes Network : Na, K, HCO₃, Urea, Creat



HEMATURIA



High

Normal

Low

8%

Low

PROTEINURIA

It is important not to ignore proteinuria. While it is true that proteinuria may present a benign finding, it may also indicate the presence of serious underlying renal or systemic disease.

How Much Protein Is Excreted Over a 24-Hour Period in the Normal Individual?

Normally, there is <150 mg of protein excreted in the urine over a 24-hour period.

What Different Types of Protein Are Normally Excreted in the Urine?

Excreted protein comes from plasma and the urinary tract. Plasma proteins include albumin and a globulin fraction. The major constituent of protein derived from the urinary tract is the Tamm-Horsfall protein, which is secreted by the cells of the ascending limb of the loop of Henle and the distal tubule.

CONSTITUENTS OF NORMAL URINE PROTEIN	
ALBUMIN	30%
GLOBULINS	30%
TAMM-HORSFALL PROTEIN	40%

13%

80%

How Is Protein Handled by the Kidneys?

Plasma protein must traverse the glomerular barrier to enter the urine. In general, proteins with a molecular weight >20,000 daltons have considerable difficulty passing through glomerular capillary walls. The glomerular basement membrane is also negatively charged, and therefore impedes the passage of negatively charged plasma proteins such as albumin. Filtered protein may be reabsorbed by tubular cells. Proteins that are absorbed by tubular cells are generally low molecular weight in nature.

With this in mind, proteinuria can be classified as follows.

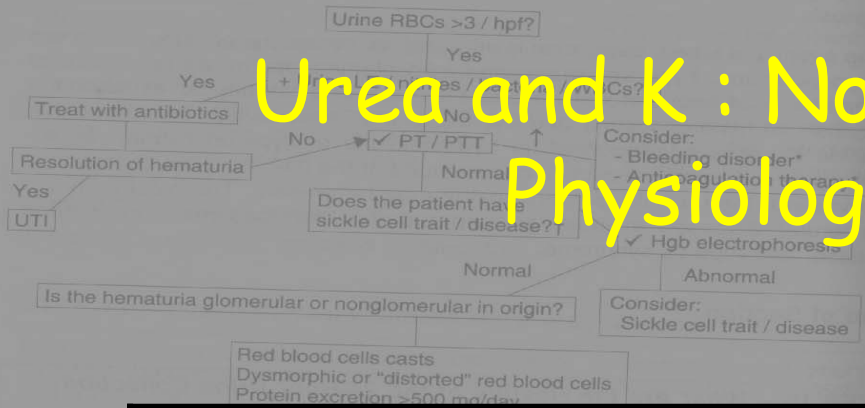
- Glomerular
 - Glomerular proteinuria is the most common type of proteinuria, and may be present in as little as 300 mg to >100 grams of protein per day. It occurs as a result of increased glomerular permeability, which may be due to a variety of processes.
- Tubular

Any process that damages the proximal tubular epithelium will allow low molecular weight proteins to be excreted in the urine.

- Overflow
 - Overflow proteinuria is the result of overproduction of a particular protein. This overproduction leads to an increase in plasma protein concentration, which is then filtered at the glomerulus. The increased amount overwhelms the ability of the proximal tubular epithelium to catabolize filtered protein, resulting in urinary excretion of excess protein. In clinical practice, this occurs in multiple myeloma, where immunoglobulin light chains are excreted, or in myelomonocytic leukemia, where excessive lysozyme is excreted.

*Hematuria that occurs in the patient with an elevated PT / PTT may be the result of anticoagulation therapy or a bleeding disorder. However, an underlying structural etiology cannot be excluded.
 †Sickle cell trait/disease may be the sole cause of hematuria; however, this diagnosis must be one of exclusion.

HEMATURIA



**Urea and K : No Analyzer Effect
Physiological Effect**

PROTEINURIA

It is important not to ignore proteinuria. While it is true that proteinuria may represent a benign finding, it may also indicate the presence of serious underlying renal or systemic disease.

How Much Protein Is Excreted Over a 24-Hour Period in the Normal Individual?

Normally, there is an average of 300 mg of protein excreted in the urine over a 24-hour period.

What Different Types of Protein Are Normally Excreted in the Urine?

Excreted protein comes from plasma and the urinary tract. Plasma proteins include albumin and a globulin fraction. The major constituent of protein derived from the urinary tract is the Tamm-Horsfall protein, which is secreted by the cells of the ascending limb of the loop of Henle and the distal tubule.

COMPOSITIONS OF NORMAL URINE PROTEIN	
ALBUMIN	30%
GLOBULINS	30%
TAMM-HORSFALL PROTEIN	40%

How Is Protein Handled by the Kidneys?

Plasma protein must pass the glomerular barrier to enter the urine. In general, proteins with a molecular weight >20,000 daltons have considerable difficulty passing through glomerular capillary walls. The glomerular basement membrane is also negatively charged, and therefore impedes the passage of negatively charged plasma proteins such as albumin. Filtered protein may be reabsorbed by tubular cells. Proteins that are not reabsorbed by tubular cells are generally low molecular weight in nature.

With this in mind, proteinuria can be classified as follows.

- **Glomerular**
Glomerular proteinuria is the most common type of proteinuria, and may vary on a spectrum from 300 mg to >100 grams of protein per day. It occurs as a result of increased glomerular permeability, which may be due to a variety of processes.
- **Tubular**
Any process that damages the proximal tubular epithelium will allow low molecular weight proteins to be excreted in the urine.
- **Overflow**
Overflow proteinuria is the result of overproduction of a particular protein. This overproduction leads to an increase in plasma protein concentration, which is then filtered at the glomerulus. The increased amount overwhelms the ability of the proximal tubular epithelium to catabolize filtered protein, resulting in urinary excretion of excess protein. In clinical practice, this occurs in multiple myeloma, where immunoglobulin light chains are excreted, or in myelomonocytic leukemia, where excessive lysozyme is excreted.

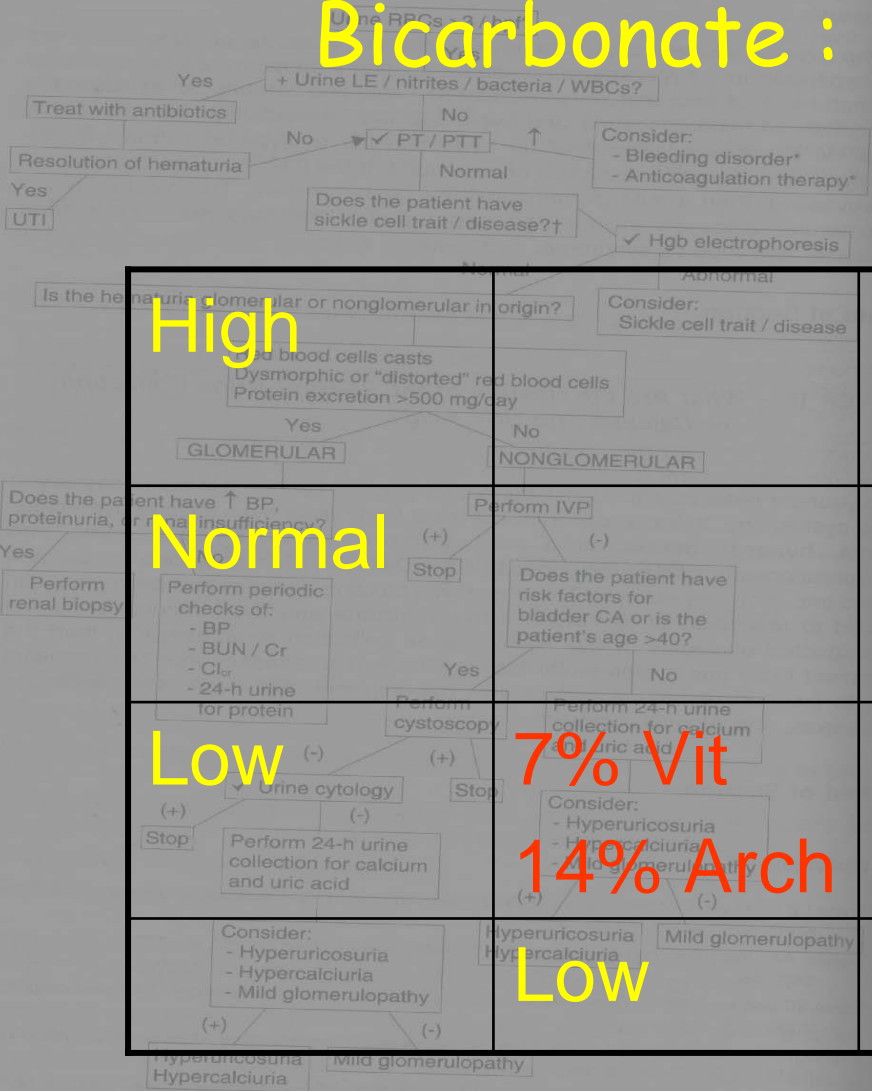
Classification	Percentage	Protein Type
High	26%	38%
Normal	59%	55%
Low	15%	8%
Low		Normal
High		High

POTASSIUM

*Hematuria that occurs in the patient with an elevated PT / PTT may be the result of anticoagulation therapy or a bleeding disorder. However, an underlying structural etiology cannot be excluded.
†Sickle cell trait/disease may be the sole cause of hematuria; however, this diagnosis must be one of exclusion.

Bicarbonate : Analyzer Effect

HEMATURIA



PROTEINURIA

It is important not to ignore proteinuria. While it is true that proteinuria may represent a benign finding, it may also indicate the presence of serious underlying renal or systemic disease.

How Much Protein Is Excreted Over a 24-Hour Period in the Normal Individual?

Normally, there is <150 mg of protein excreted in the urine over a 24-hour period.

What Different Types of Protein Are Normally Excreted in the Urine?

Excreted protein comes from plasma and the urinary tract. Plasma proteins include albumin and a globulin fraction. The major constituent of protein derived from the urinary tract is the Tamm-Horsfall protein, which is secreted by the cells of the ascending limb of the loop of Henle and the distal tubule.

CONSTITUENTS OF NORMAL URINE PROTEIN	
ALBUMIN	30%
GLOBULINS	30%
TAMM-HORSFALL PROTEIN	40%

How Is Protein Handled by the Kidneys?

Plasma protein must traverse the glomerular barrier to enter the urine. In general, proteins with a molecular weight >20,000 daltons have considerable difficulty passing through glomerular capillary walls. The glomerular basement membrane is also negatively charged, and therefore impedes the passage of negatively charged plasma proteins such as albumin. Filtered protein may be reabsorbed by tubular cells. Proteins that are absorbed by tubular cells are generally low molecular weight in nature.

With this in mind, proteinuria can be classified as follows.

- Glomerular
 - Glomerular proteinuria is the most common type of proteinuria, and may vary from several hundred milligrams to >100 grams of protein per day. It occurs as a result of increased glomerular permeability, which may be due to a variety of processes.
- Tubular
 - Any process that damages the proximal tubular epithelium will allow low molecular weight proteins to be excreted in the urine.
- Overflow
 - Overflow proteinuria is the result of overproduction of a particular protein. This overproduction leads to an increase in plasma protein concentration, which is then filtered at the glomerulus. The increased amount overwhelms the ability of the proximal tubular epithelium to catabolize filtered protein, resulting in urinary excretion of excess protein. In clinical practice, this occurs in multiple myeloma, where immunoglobulin light chains are excreted, or in myelomonocytic leukemia, where excessive lysozyme is excreted.

High

Normal

Low

10% Vit
6% Arch

78% Vit
80% Arch

7% Vit
14% Arch

Low
Normal
High

*Hematuria that occurs in the patient with an elevated PT / PTT may be the result of anticoagulation therapy or a bleeding disorder. However, an underlying structural etiology cannot be excluded.
†Sickle cell trait/disease may be the sole cause of hematuria; however, this diagnosis must be one of exclusion.

HEMATURIA

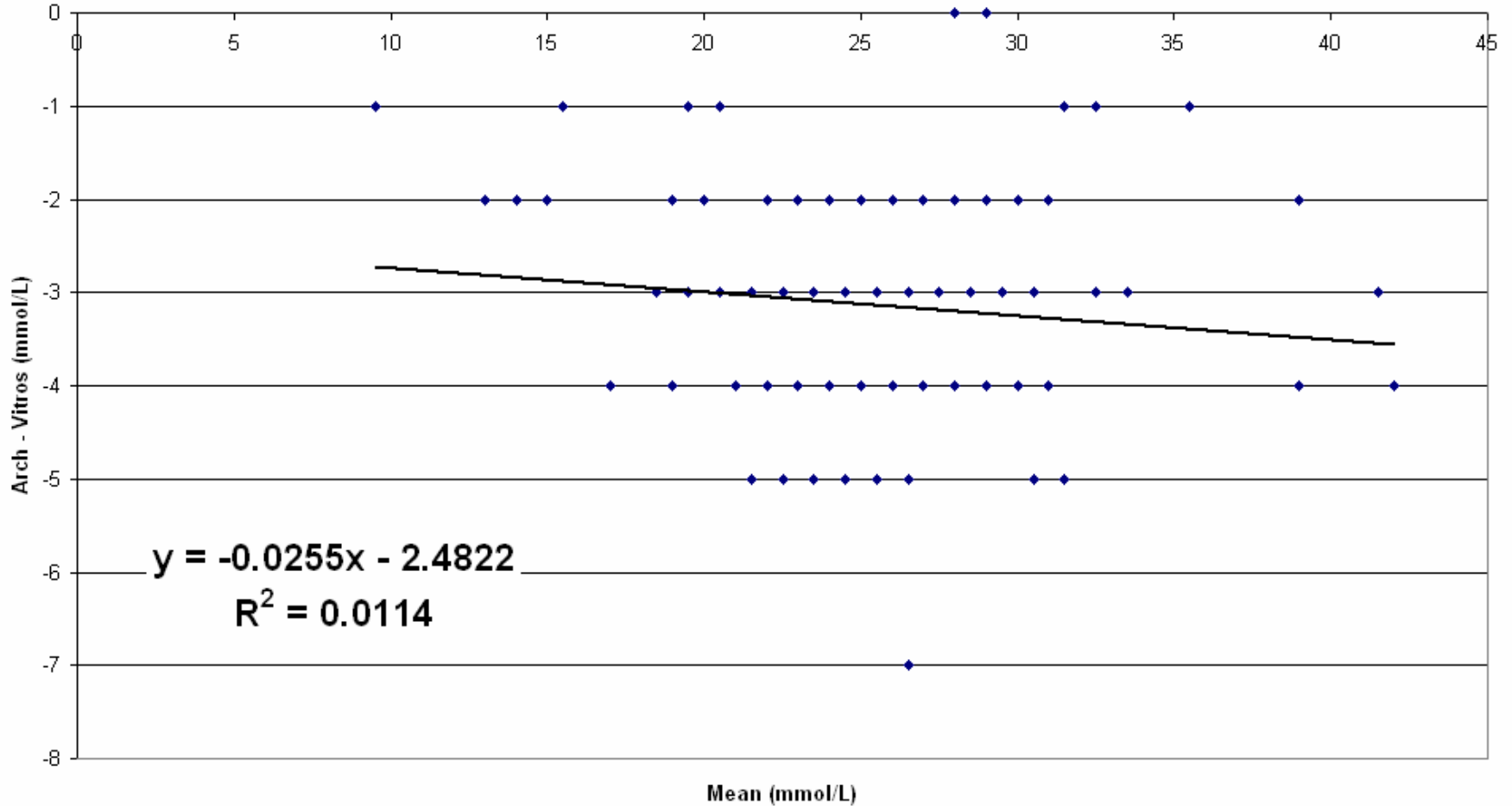
Urine RBCs >3 / hpf?

Yes

PROTEINURIA

It is important not to ignore proteinuria. While it is true that proteinuria may represent a benign finding, it may also indicate the presence of serious underlying renal or systemic disease.

HC03



This overproduction leads to an increase in plasma protein concentration, which is then filtered at the glomerulus. The increased amount overwhelms the ability of the proximal tubular epithelium to catabolize filtered protein, resulting in urinary excretion of excess protein. In clinical practice, this occurs in multiple myeloma, where immunoglobulin light chains are excreted, or in myelomonocytic leukemia, where excessive lysozyme is excreted.

HEMATURIA

PROTEINURIA

Sodium : Analyzer Effect

It is important not to ignore proteinuria. While it is true that proteinuria may represent a benign finding, it may also indicate the presence of serious underlying renal or systemic disease.

How Much Protein Is Excreted Over a 24-Hour Period in the Normal Individual?

Normally, there is <150 mg of protein excreted in the urine over a 24-hour period.

What Different Types of Protein Are Normally Excreted in the Urine?

Excreted protein comes from plasma and the urinary tract. Plasma proteins include albumin and a globulin fraction. The major constituent of protein derived from the urinary tract is the Tamm-Horsfall protein, which is secreted by the cells of the ascending limb of the loop of Henle and the distal tubule.

CONSTITUENTS OF NORMAL URINE PROTEIN	
ALBUMIN	30%
GLOBULINS	30%
TAMM-HORSFALL PROTEIN	40%

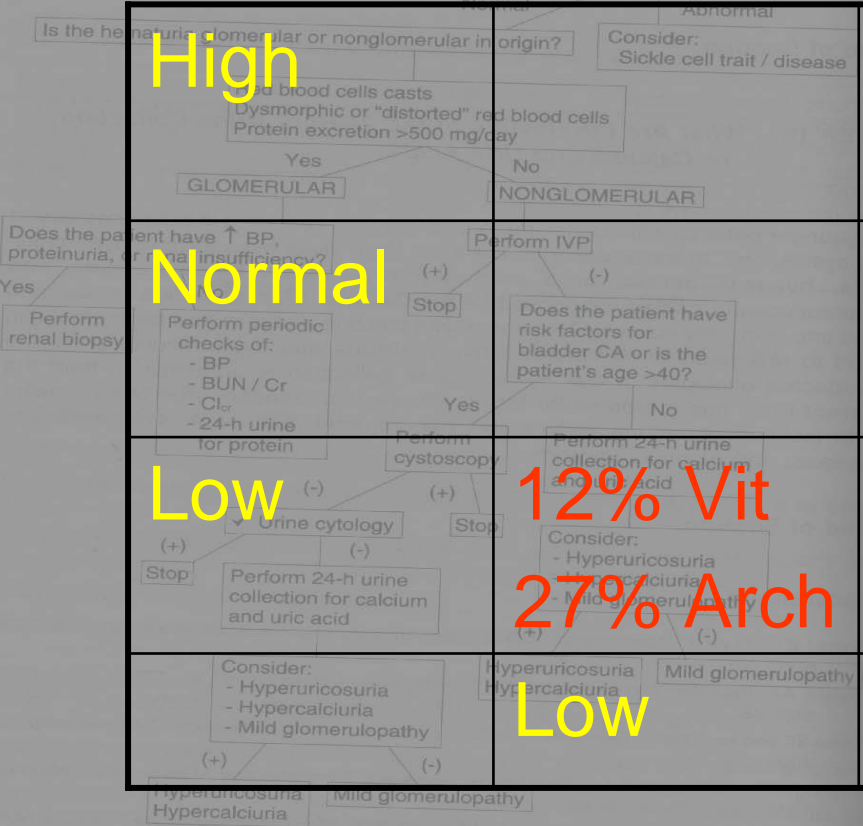
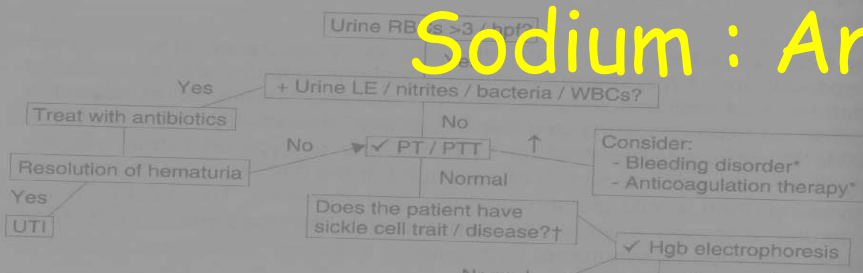
How is Protein Handled by the Kidneys?

Plasma protein must traverse the glomerular barrier to enter the urine. In general, proteins with a molecular weight >20,000 daltons have considerable difficulty passing through glomerular capillary walls. The glomerular basement membrane is also negatively charged, and therefore impedes the passage of negatively charged plasma proteins such as albumin. Filtered protein may be reabsorbed by tubular cells. Proteins that are absorbed by tubular cells are generally low molecular weight in nature.

With this in mind, proteinuria can be classified as follows.

- Glomerular
 - Glomerular proteinuria is the most common type of proteinuria, and may vary from several hundred milligrams to >100 grams of protein per day. It occurs as a result of increased glomerular permeability, which may be due to a variety of processes.
- Tubular
 - Any process that damages the proximal tubular epithelium will allow low molecular weight proteins to be excreted in the urine.
- Overflow

Overflow proteinuria is the result of overproduction of a particular protein. This overproduction leads to an increase in plasma protein concentration, which is then filtered at the glomerulus. The increased amount overwhelms the ability of the proximal tubular epithelium to catabolize filtered protein, resulting in urinary excretion of excess protein. In clinical practice, this occurs in multiple myeloma, where immunoglobulin light chains are excreted, or in myelomonocytic leukemia, where excessive lysozyme is excreted.



High

10% Vit
2% Arch

Normal

78% Vit
71% Arch

Low

12% Vit
27% Arch

Low

Normal High

*Hematuria that occurs in the patient with an elevated PT / PTT may be the result of anticoagulation therapy or a bleeding disorder. However, an underlying structural etiology cannot be excluded.
†Sickle cell trait/disease may be the sole cause of hematuria; however, this diagnosis must be one of exclusion.

HEMATURIA

Urine RBCs >3 / hpf?

Yes

Yes

+ Urine LE / nitrites / bacteria / WBCs?

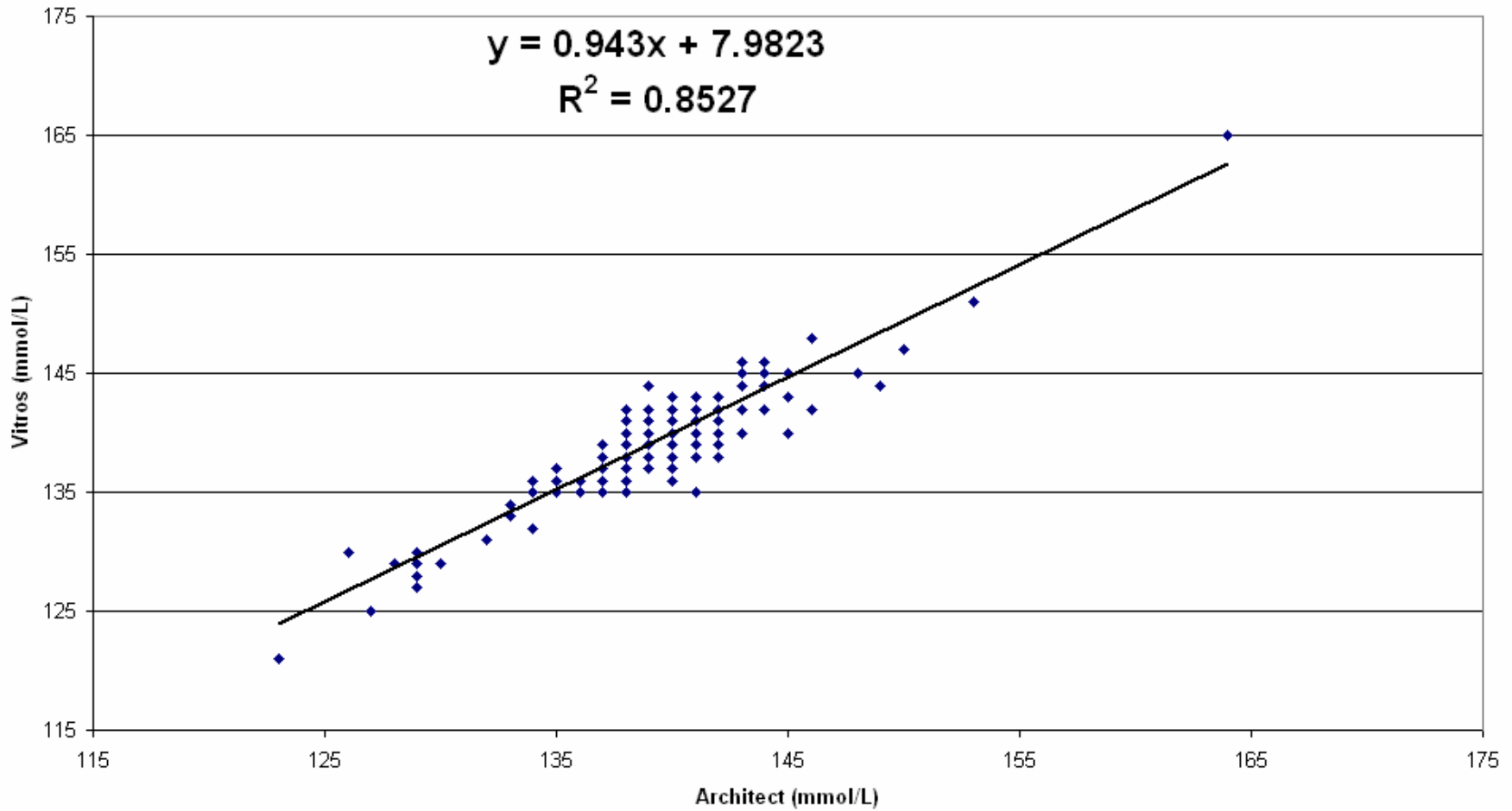
No

Treat with antibiotics

PROTEINURIA

It is important not to ignore proteinuria. While it is true that proteinuria may represent a benign finding, it may also indicate the presence of serious underlying renal or systemic disease.

Na



overwhelms the ability of the proximal tubular epithelium to catabolize filtered protein, resulting in urinary excretion of excess protein. In clinical practice, this occurs in multiple myeloma, where immunoglobulin light chains are excreted, or in myelomonocytic leukemia, where excessive lysozyme is excreted.

Urea and Creat : Analyzer Effect and Physiological Effect

<p>HEMATURIA</p> <p>Urine RBCs >3 / hpf?</p> <p>Yes</p> <p>+ Urine LE / nitrite / heme / WBCs?</p> <p>Yes → Treat with antibiotics</p> <p>No → PT / PTT</p> <p>Normal → Consider: - Bleeding disorder* - Anticoagulation therapy*</p> <p>Abnormal → Consider: Sickle cell trait / disease</p> <p>Does the patient have sickle cell trait / disease?†</p> <p>Normal → Hgb electrophoresis</p> <p>Is the hematuria glomerular or non-glomerular in origin?</p> <p>Red blood cells casts Dysmorphic or "distorted" red blood cells Protein excretion >500 mg/day</p> <p>Yes → GLOMERULAR</p> <p>No → NONGLOMERULAR</p> <p>Does the patient have ↑ BP, proteinuria, or renal insufficiency?</p> <p>Yes → Perform renal biopsy</p> <p>No → Perform periodic checks of: - BP - BUN / Cr - Cl_r - 24-h urine for protein</p>	<p>High</p> <p>0% Vit</p> <p>0% Arch</p>	<p>Normal</p> <p>39% Vit</p> <p>90% Arch</p>	<p>Low</p> <p>61% Vit</p> <p>10% Arch</p>	<p>Normal</p> <p>74% Vit</p> <p>88% Arch</p>
<p>Does the patient have ↑ BP, proteinuria, or renal insufficiency?</p> <p>Yes → Perform renal biopsy</p> <p>No → Perform periodic checks of: - BP - BUN / Cr - Cl_r - 24-h urine for protein</p> <p>Perform cystoscopy</p> <p>Urine cytology</p> <p>Perform 24-h urine collection for calcium and uric acid</p> <p>Consider: - Hyperuricosuria - Hypercalciuria - Mild glomerulopathy</p>	<p>Normal</p> <p>20% Vit</p> <p>33% Arch</p>	<p>Normal</p> <p>74% Vit</p> <p>88% Arch</p>	<p>Normal</p> <p>74% Vit</p> <p>88% Arch</p>	<p>Normal</p> <p>74% Vit</p> <p>88% Arch</p>
<p>Consider: - Hyperuricosuria - Hypercalciuria - Mild glomerulopathy</p> <p>Hyperuricosuria Hypercalciuria</p> <p>Mild glomerulopathy</p>	<p>Low</p> <p>6% Vit</p> <p>0% Arch</p>	<p>Low</p> <p>6% Vit</p> <p>0% Arch</p>	<p>Low</p> <p>6% Vit</p> <p>0% Arch</p>	<p>Low</p> <p>6% Vit</p> <p>0% Arch</p>

CREAT

UREA

PROTEINURIA

It is important not to ignore proteinuria. While it is true that proteinuria may represent a benign finding, it may also indicate the presence of serious underlying renal or systemic disease.

How Much Protein Is Excreted Over a 24-Hour Period in the Normal Individual?

Normally, there is <150 mg of protein excreted in the urine over a 24-hour period.

What Different Types of Protein Are Normally Excreted in the Urine?

Excreted protein comes from plasma and the urinary tract. Plasma proteins include albumin and a globulin fraction. The major constituent of protein derived from the urinary tract is the Tamm-Horsfall protein, which is secreted by the cells of the ascending limb of the loop of Henle and the distal tubule.

CONSTITUENTS OF NORMAL URINARY PROTEIN

ALBUMIN 30%	20% Vit
GLOBULINS 30%	33% Arch
TAMM-HORSFALL PROTEIN	

How Is Protein Handled by the Kidney?

Most plasma protein must traverse the glomerular barrier to enter the urine. In general, proteins with a molecular weight >20,000 daltons have considerable difficulty passing through glomerular capillary walls. The glomerular basement membrane is also negatively charged, and therefore impedes the passage of negatively charged plasma proteins such as albumin. Filtered proteins can be reabsorbed by tubular cells. Proteins that are absorbed by tubular cells are generally low molecular weight in nature.

With this in mind, proteinuria can be classified as follows.

- **Glomerular**
Glomerular proteinuria is the most commonly type of proteinuria, and may vary from several hundred milligrams to >100 grams of protein per day. It occurs as a result of increased glomerular permeability, which may be due to a variety of processes.

- **Tubular**
Any process that damages the proximal tubular epithelium will allow low molecular weight proteins to be excreted in the urine.

- **Overflow**
Overflow proteinuria is the result of overproduction of a particular protein. This overproduction leads to an increase in plasma protein concentration, which is then filtered at the glomerulus. The increased amount overwhelms the ability of the proximal tubular epithelium to catabolize filtered protein, resulting in urinary excretion of excess protein. In clinical practice, this occurs in multiple myeloma, where immunoglobulin light chains are excreted, or in myelomonocytic leukemia, where excessive lysozyme is excreted.

*Hematuria that occurs in the patient with an elevated PT / PTT may be the result of anticoagulation therapy or a bleeding disorder. However, an underlying structural etiology cannot be excluded.
†Sickle cell trait/disease may be the sole cause of hematuria; however, this diagnosis must be one of exclusion.

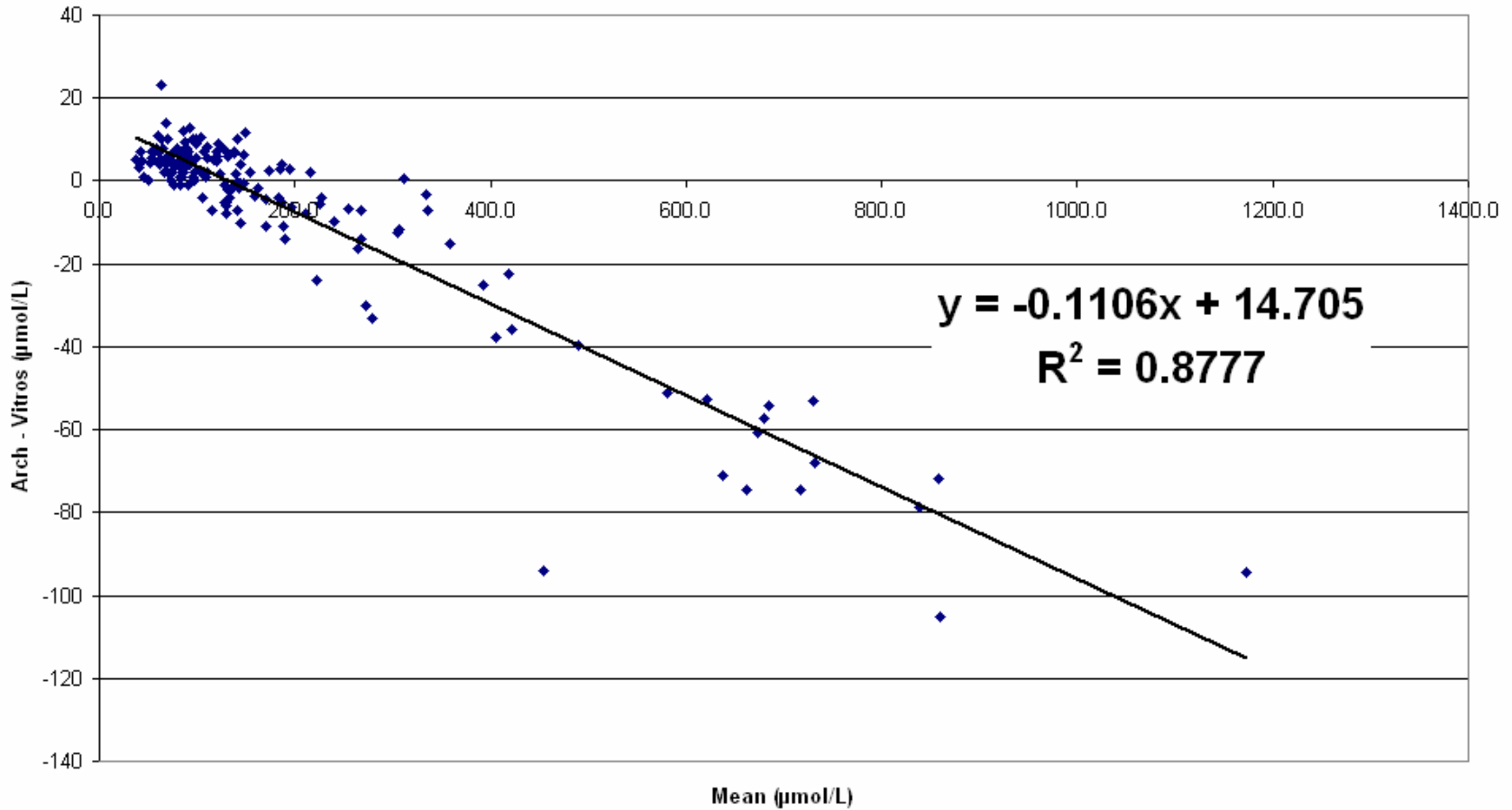
HEMATURIA

Urine RBCs >3 / hpf?

PROTEINURIA

It is important not to ignore proteinuria. While it is true that proteinuria may represent a benign finding, it is also a marker of renal disease.

Creat (Bland & Altman)



Treat

Resolut

Yes

UTI

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Yes

Perfor

renal bic

*Hematuria that occurs in the patient with an elevated PT / PTT may be the result of anticoagulation therapy or a bleeding disorder. However, an underlying structural etiology cannot be excluded.
†Sickle cell trait/disease may be the sole cause of hematuria; however, this diagnosis must be one of exclusion.

- Overflow
- Overflow proteinuria is the result of overproduction of a particular protein. This overproduction leads to an increase in plasma protein concentration, which is then filtered at the glomerulus. The increased amount overwhelms the ability of the proximal tubular epithelium to catabolize filtered protein, resulting in urinary excretion of excess protein. In clinical practice, this occurs in multiple myeloma, where immunoglobulin light chains are excreted, or in myelomonocytic leukemia, where excessive lysozyme is excreted.

HEMATURIA

Urine RBCs >3 / hpf?

Yes

Yes

+ Urine LE / nitrites / bacteria / WBCs?

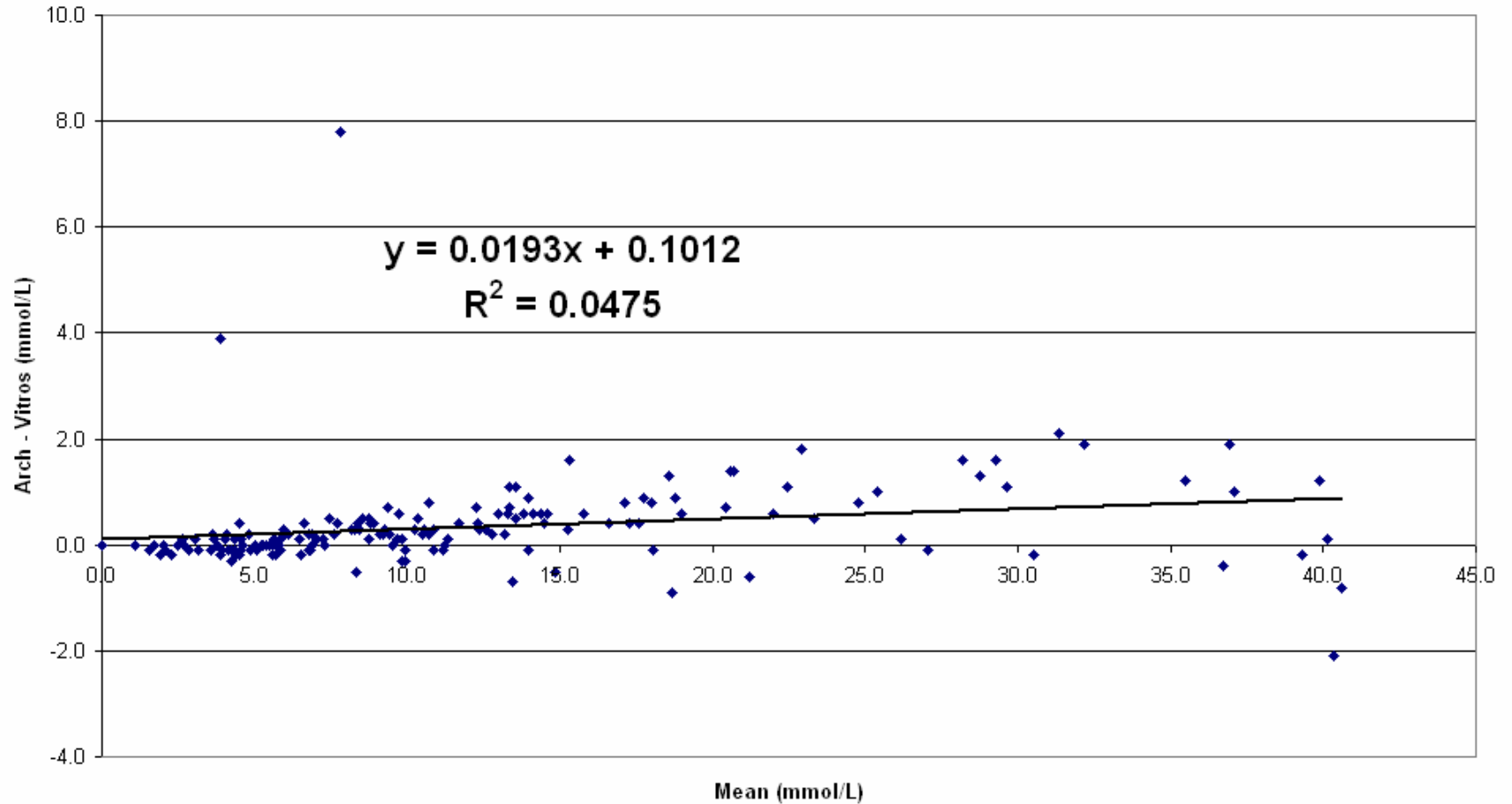
No

Treat with antibiotics

PROTEINURIA

It is important not to ignore proteinuria. While it is true that proteinuria may represent a benign finding, it may also indicate the presence of serious underlying renal or systemic disease.

Urea (Bland)



...production leads to an increase in plasma protein concentration, which is then filtered at the glomerulus. The increased amount overwhelms the ability of the proximal tubular epithelium to catabolize filtered protein, resulting in urinary excretion of excess protein. In clinical practice, this occurs in multiple myeloma, where immunoglobulin light chains are excreted, or in myelomonocytic leukemia, where excessive lysozyme is excreted.

HEMATURIA

Urine RBCs ≥ 3 / hpf

Yes \rightarrow + Urine LE / neut / bacteria / WBCs?

Treat with antibiotics

Resolution of hematuria

Yes

UTI

No \rightarrow Does the patient have sickle cell trait / disease?

Consider: - Radiographic - Anticoagulation therapy*

Abnormal \rightarrow Consider: Sick cell trait / disease

Abnormal

Consider: Sick cell trait / disease

Red blood cells casts
Dysmorphic or "dixied" blood cells
Protein excretion > 100 mg / day

Yes \rightarrow GLOMERULAR

No \rightarrow NON-GLOMERULAR

Does the patient have \uparrow BP, proteinuria, or renal insufficiency?

Yes

Perform renal biopsy

No

Perform periodic checks of:
- BP
- BUN / Cr
- Cl_{cr}
- 24-h urine for protein

Does the patient have risk factors for glomerular disease? (A) or patient's age > 40 ?

(+)

Perform 24-h urine collection for calcium and uric acid

(-)

Perform 24-h urine collection for calcium and uric acid

(+)

Urine cytology

(-)

Stop

Perform 24-h urine collection for calcium and uric acid

(+)

Consider:
- Hyperuricosuria
- Hypercalciuria
- Mild glomerulopathy

(-)

Hyperuricosuria
Hypercalciuria
Mild glomerulopathy

(+)

Hyperuricosuria
Hypercalciuria

(-)

Mild glomerulopathy

Now is an opportune time to expand our use of statistics in the clinical laboratory. We have particularly stable analytical platforms so we should spend more time on the objective examination of the very large amounts of data these systems produce. Within these datasets is a rich resource of knowledge that can only be appreciated after the application of robust and multiparameter statistical tests that go beyond our usual practice.

*Hematuria that occurs in the patient with an elevated PT / PTT may be due to a hemolytic process. The cause is usually a hemolytic anemia, a hemolytic thrombocytopenic purpura, or a disseminated intravascular coagulation. Sickle cell trait/disease may be the sole cause of hematuria; however, this diagnosis must be one of exclusion.

PROTEINURIA

It is important not to ignore proteinuria. Although it is a common finding, proteinuria may represent a benign condition. It may, however, be a harbinger of renal or systemic disease.

www.medlabstats.com

How Much Protein Is Excreted Over a 24-Hour Period in the Normal Individual?

Normally, there is < 150 mg of protein excreted in the urine over a 24-hour period.

What Different Types of Protein Are Normally Excreted in the Urine?

Excreted protein comes from plasma and the urinary tract. Plasma proteins include albumin and a globulin fraction. The major constituent of protein derived from the urinary tract is the Tamm-Horsfall protein, which is secreted by the cells of the ascending limb of the loop of Henle and the distal tubule.

CONSTITUENTS OF NORMAL URINE PROTEIN	
ALBUMIN	30%
GLOBULINS	30%
TAMM-HORSFALL PROTEIN	40%

How Is Protein Handled by the Kidneys?

Plasma protein must traverse the glomerular barrier to enter the urine. In general, proteins with a molecular weight $> 20,000$ daltons have considerable difficulty passing through glomerular capillary walls. The glomerular basement membrane is also negatively charged, and therefore impedes the passage of cationic or negatively charged plasma proteins. In addition, protein may be reabsorbed by tubular cells. Proteins that are absorbed by tubular cells are generally low molecular weight in nature.

With this in mind, proteinuria can be classified as follows.

- Glomerular

Glomerular proteinuria is the most common type of proteinuria, and may vary from several to over 3000 mg of protein per day. It occurs as a result of increased glomerular permeability, which may be due to a variety of processes.

Any process that damages the proximal tubular epithelium will allow low molecular weight proteins to be absorbed in the urine.

Overflow

Overflow proteinuria is the result of overproduction of a particular protein. This overproduction leads to an increase in plasma protein concentration. The amount filtered at the glomerulus, the increased amount overwhelms the ability of the proximal tubular epithelium to catabolize filtered protein. This is seen in multiple myeloma, where immunoglobulin light chains are excreted, or in myelomonocytic leukemia, where excessive lysozyme is excreted.