Protis clinical decision support software

Digitalizing result interpretation in protein testing

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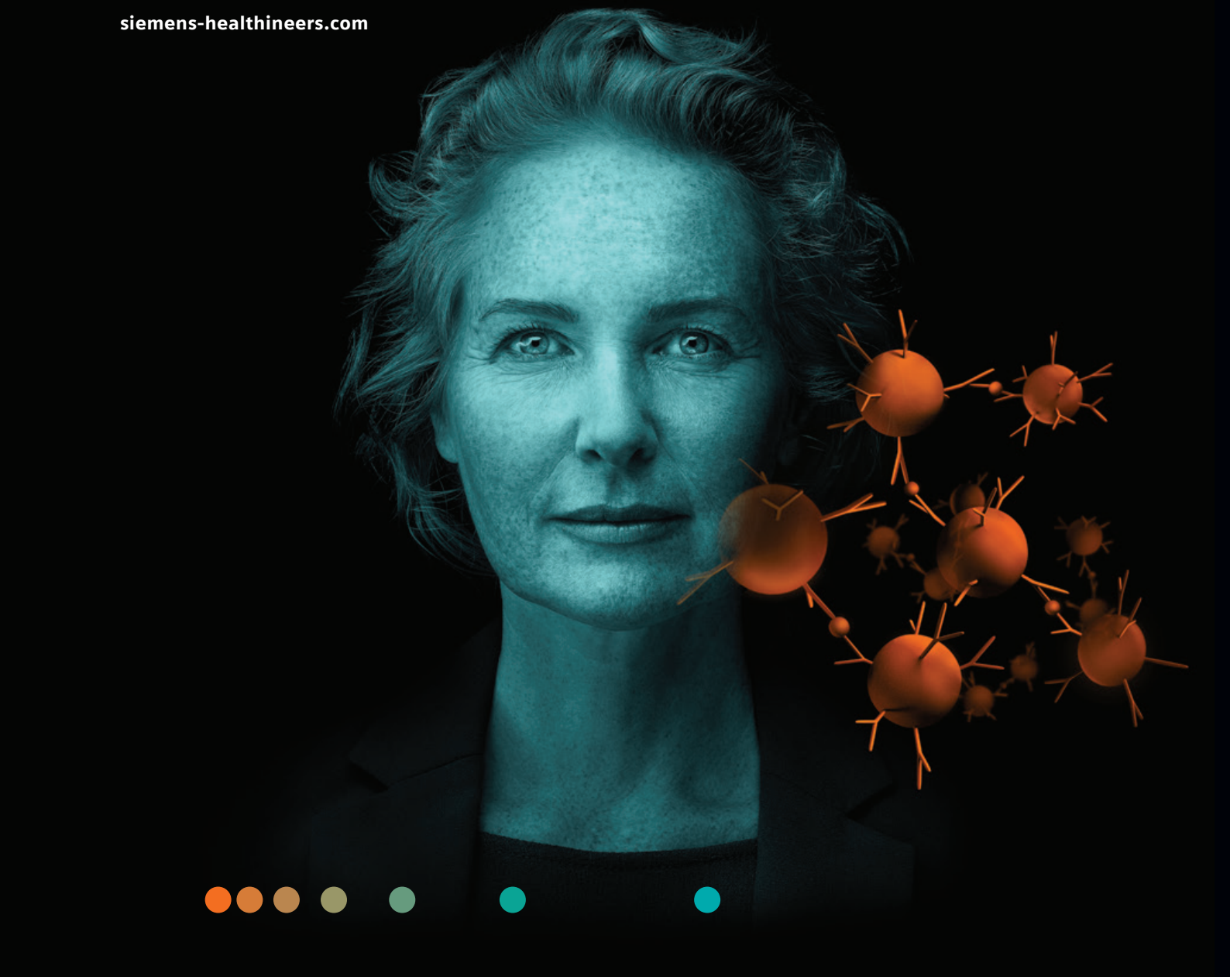

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A software solution that offers assistance where lab testing ends

Physicians require a fast, complete overview of individual patients' results to quickly and confidently diagnose patients' conditions.

Results for one patient are often coming from different sources and are documented in separate reports. As the complexity of tests continues to increase, correct interpretation of results also becomes more and more challenging.[1] Also, much of the new clinical data generated by lab tests can require a high level of interpretative skills, knowledge of specific algorithms and clinical pathways. In fact, studies have indicated that about 5% of medical errors are related to misinterpretation of laboratory results.

Interaction between physicians, biologists and laboratory can be required in interpreting patient results, particularly when results from multiple sources need to be integrated, analyzed, and considered. Responding to such requests requires the time of lab personnel and, increasingly, the expertise of specialists.

Protis clinical decision support software enables consolidated result reporting and clinical decision support

- Integrates results from different platforms into one report
- Presents data in an easy-to-follow graphical format
- Provides a fast, consolidated overview of results for a single patient and for different indications

Consolidate result reporting

The Protis clinical decision support software* automatically consolidates test results based primarily on plasma protein determinations and obtained from a variety of Siemens Healthineers platforms into one, easy-to-understand report for an individual patient.

Confidently interpret results

Protis Software Assessment Kits employ standardized rules established by experts to assist with result interpretation and improve the quality of physicians' diagnoses. They support a wide range of clinical indications and help laboratories and physicians to diagnose and treat patients more effectively.

**Product availability varies by country.*

Expand high-quality decision support to physicians without adding resources

Using Protis Software helps laboratories and physicians to diagnose and treat patients more effectively. Protis Software Assessment Kits support a wide range of clinical indications:

CSF testing

For diagnosis of blood-CSF-barrier dysfunction and detection of intrathecal immunoglobulin synthesis using Reiber diagrams

Kidney disease

For evaluation of kidney function by estimating the glomerular filtration rate and for differential diagnosis of proteinuria

Nutritional assessment

Evaluates the nutritional status of the patient and, if indicated, provides recommendations for supplementation therapy and patient monitoring

Customizable, value-added reporting

- All results at a glance on a single page report
- Provides recommendations for patient management, if appropriate
- Provides easy-to-follow graphical results (e.g., Reiber diagrams)
- Assessments are designed to be activated and used individually.

Focuses on relevant determinations

Inappropriate or unnecessary testing contributes significantly to the escalating cost of healthcare. Protis Software Assessment Kits helps physicians order the correct tests by requiring that specific assay panels be ordered for each assessment.

This requirement encourages more targeted ordering of tests and helps reduce inappropriate and unnecessary testing. In addition, the patient reports generated by each assessment module suggest further testing when necessary to help physicians make more efficient and effective diagnoses.

Builds expertise and competency

Protis Software Assessment Kits helps clinicians and laboratory personnel build expertise in interpreting patient results. The software modules provide all the relevant information required for accurate results interpretation, and they use standardized rules established by experts to automatically evaluate and interpret results.

By comparing testing results with the interpretations generated by the assessment modules, clinicians can recognize patterns of results and associate them with appropriate interpretations and diagnoses.

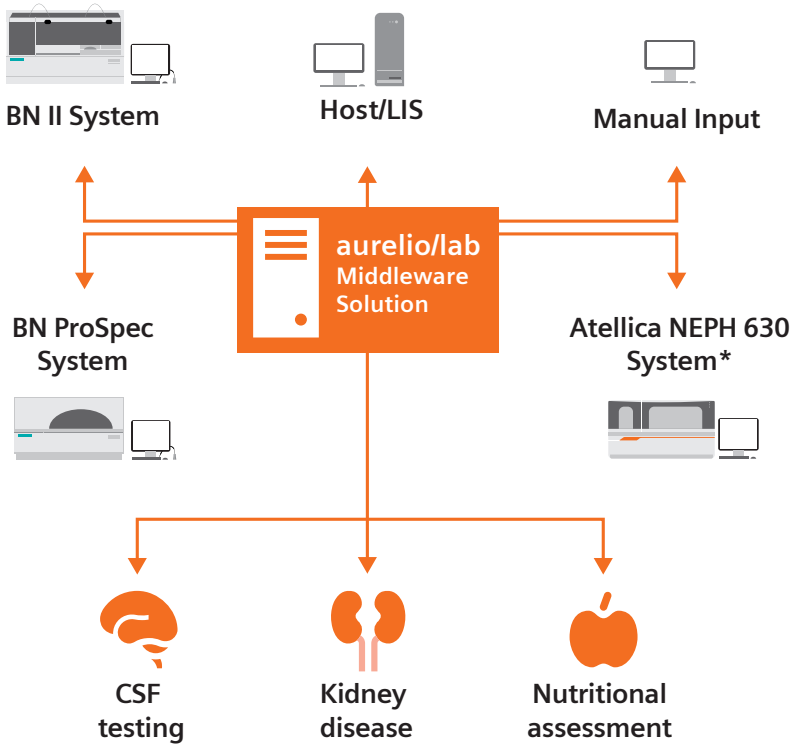
Digitalizing healthcare by enabling consolidated data and analysis

The Protis IT solution software is based on aurelio/lab, and the clinical assessment kits. Aurelio/lab is a powerful and flexible laboratory middleware solution providing extensive connectivity, data management and workflow support features for making lab processes more efficient. It is designed to work seamlessly with Protis Software Assessment Kits, dedicated modules that provide automated, expert interpretation of individual patient results for a variety of tests.

When used with the Protis Assessment Software, the aurelio/lab Management System produces patient assessment reports that include consolidated test results presented in both tabular and graphic formats supplemented with guidance on interpreting the results.

To even better meet the needs of today's labs, the latest software version offers an improved usability and simplified interface, a complete audit trail, database and backup encryption options, and latest cybersecurity measures.

The aurelio/lab middleware is instrument independent and can manage results released from a wide range of diagnostic analyzers from Siemens Healthineers and other sources.



**Product availability varies by country.*

Benefit from extensive connectivity, data management and workflow support features for efficient lab processes

Simple, convenient data management

- Single interface between multiple platforms and LIS (laboratory information system)
- Patient data and sample administration
- Centralized, long-term storage of patient history data
- Flexible release management of patient sample results
- Reports can be printed or exported as PDF files
- Audit trail, database and backup encryption options offer a high level of data privacy and security

Economic testing and result interpretation

- Reduces manual work and staff labor costs through automatic generation of result interpretation suggestions and standardized reporting
- Automatically calculates assessment-specific algorithms (e.g., GFR† estimation for kidney function assessment)
- Helps reduce requests from physicians for result interpretation assistance

Easy-to-use software and user interface

- Intuitive graphical user interface
- Runs on Microsoft Windows 10 operating system
- Online data transfer between connected platforms and LIS
- Allows manual data input
- Flexible configuration options of assessment kits
- Software available in multiple languages

Improved workflow

- Automated job list management between connected platforms and LIS
- Connects to the following Siemens Healthineers platforms: Atellica® NEPH 630*, BN ProSpec® and BN II™ Systems
- ASTM protocol enables additional connections
- Direct communication with Atellica NEPH 630* and BN Systems for assay result import, automated ordering of additional tests, or sample retesting

†GFR: glomerular filtration rate

Intuitively assess inflammatory processes in the central nervous system through sophisticated algorithms

The Protis Cerebrospinal Fluid (CSF) Assessment software is based on the concept developed and published by Professor Hansotto Reiber. His CSF/serum quotient graphs are considered to be the "gold standard" for CSF assessment. Reiber diagrams analyze in an integrated way both the function of the CSF-blood barrier and the presence of intrathecal immunoglobulin synthesis. They have initially been established to evaluate intrathecal synthesis of immunoglobulins, and have been recently transferred for assessment of multiple sclerosis by using free light chain assays.[2]

Diagnostic assessment support

- Evaluation of results using CSF/serum quotient diagrams
- Assessment of intrathecal immunoglobulin synthesis and CSF-blood barrier function
- Result interpretation based on cell count/cell typing, protein results, and specific antibody indices
- Serological identification of infectious pathogens
- Identification of CSF leakage

Core CSF assessment

- IgG and albumin CSF/serum ratios
- CSF sample information – Place of puncture – Optical appearance – Hemoglobin
- Patient record including date of birth for calculation of age-dependent algorithms and diagrams
- Graphical result presentation in Reiber diagrams
- Result interpretation suggestions

Extended panel for further CSF assessment

- IgA and IgM CSF/serum ratios
- Cell count and differentiation, including a predefined list of cell types
- Determination of intrathecal microorganism-specific immune response – Viruses (e.g., measles, rubella, VZV, HSV I/II, EBV, CMV, HIV) – Bacteria (e.g., Borrelia burgdorferi, Treponema pallidum, Chlamydia) – Protozoa (e.g., Toxoplasma gondii) – Species-specific ratio of IgG, IgA, or IgM in CSF and serum
- Oligoclonal bands considering predefined interpretations
- Inclusion of other biochemical markers – Glucose – Lactate – β-trace protein and other proteins determined in CSF
- Microbiological culture and PCR—predefined list of organisms for culture and PCR results

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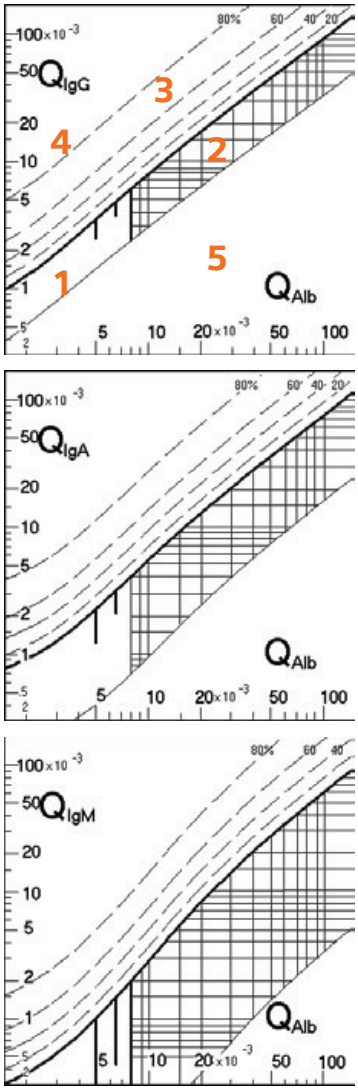
CSF Assessment

Graphical result presentation in Reiber diagrams[2]



1. normal situation
2. pure blood-CSF-barrier dysfunction
3. intrathecal Ig synthesis with reduced CSF turnover
4. intrathecal Ig synthesis without change in CSF turnover
5. implausible result

CSF Assessment Report

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Account

Patient Information Patient ID **20000001**

Name **Patient, Sample CSF** Age **57 Y** Date of birth **7/1/1963** Sex **M**

Samples

		Received date/time	Date of Puncture
CSF	2000000607	7/10/2020	
Serum	2000000601		

Diagnostic Question

Place of Puncture			Visual Inspection	Hemoglobin	Volume (ml)
LP	CP	VP			
			clear	**0**	

Cells

Proteins

	CSF		Serum		Q (CSF/Serum) x 10^{-3}	local Synthesis (IF)
Total Protein						
Albumin	**280**	mg/l	**44**	g/l	**6.4**	
IgG	**60**	mg/l	**11.7**	g/l	**5.1**	**9** %
IgA	**22**	mg/l	**3.4**	g/l	**6.5**	**53** %
IgM	**1.1**	mg/l	**1.4**	g/l	**0.8**	**0** %

Oligoclonal IgG

Additional Parameter

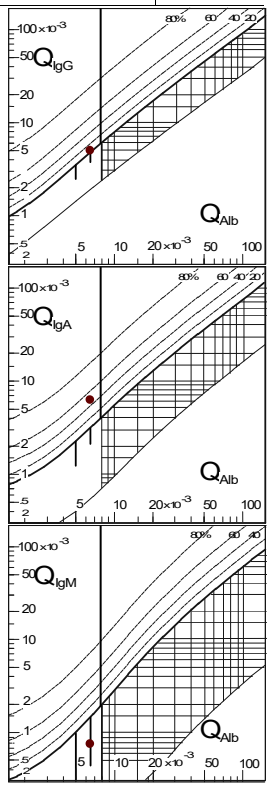
CSF Serum Q (CSF/Serum)

Antibody Indices (Synthesis in CNS: AI ≥ 1.5)

Interpretation

[ ] Normal CSF (Based on Cells, Oligoclonal IgG, AI)	[ ] Normal CSF proteins (Based on Albumin, IgG, IgA, IgM)
[ ] Blood-CSF barrier dysfunction	[ ] Increased cell count
[x] Inflammatory proc. in CNS	[ ] Spec. Ab synthesis in CNS

Comment



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Intelligently assess differential diagnoses of kidney disease

The Protis Kidney Assessment software assists with early detection and diagnosis of renal diseases. It provides estimation of glomerular filtration rate (GFR) using cystatin C- and/or creatinine-based formulas. It also aids in differential diagnosis of proteinuria and hematuria.

Differential diagnosis support

- Glomerular filtration rate
- Glomerular nephropathy
- Tubular nephropathy
- Mixed type nephropathy
- Differential diagnosis of hematuria

Automated basic and sensitive workflows

- Exclusion/differential diagnosis of nephropathy, including:
  - GFR assessment
  - Proteinuria differentiation
  - Hematuria differentiation
- Determination of appropriate sample dilution for marker proteins based on total protein content of urine sample

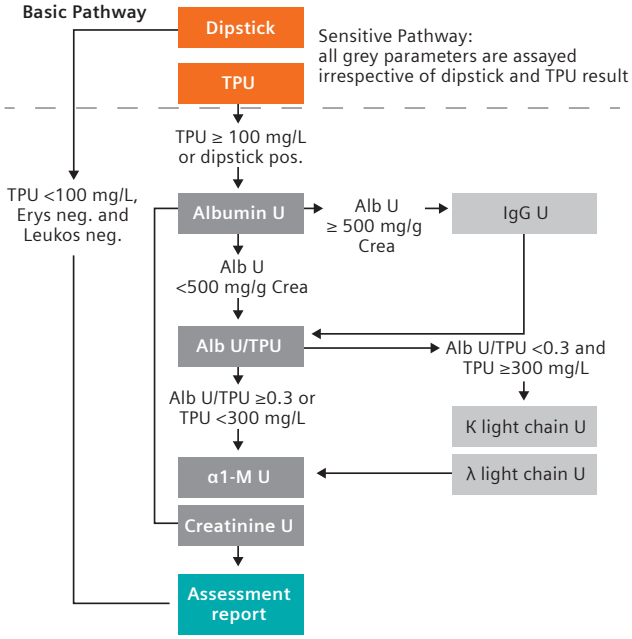
GFR assessment

- Cystatin C in serum
  - Calculation of cystatin C-based GFR, including latest recommended formulas, e.g. KDIGO or CAPA equations
  - Combined creatinine/cystatin C-based equations (KDIGO)
- Creatinine clearance
- Serum creatinine
  - MDRD formula
  - MDRD/IDMS formula
  - Cockcroft-Gault formula
  - Schwartz formula

Differentiation of proteinuria using urine samples:

- Dipstick analysis
- Total protein (TPU)
- Albumin (Alb U)
- Creatinine (Crea)
- α1-Microglobulin (a1-M U)
- α2-Macroglobulin
- IgG (IgG U)
- Ig light chains/kappa and lambda
- Microscopic erythrocytes evaluation

Workflows in Kidney Assessment



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Kidney Assessment

Kidney Assessment Report

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Account

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Patient Information

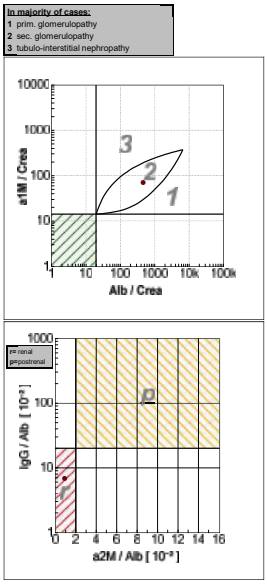
Name	**Kidney Patient, Sample**	Patient ID	**20000014**	Sex	**F**
Height (cm)		Age Weight (kg)	**60 Y**	Date of birth Race	**7/7/1960**

Samples

Urine	2000001902	Volume (ml)
Serum	2000001901	Volume (ml)

Parameter	Result	Reference	Unit	Concentration	
Serum Assays					
Cystatin C	**3.8**	0.62 - 1.11	mg/l		
Glomerular Filtration Rate					
GFR Cystatin C	**12**	>=90	ml/min		
Urine Assays					
Creatinine				**50**	mg/dl
Total Protein	**744.0**	<100	mg/g Crea	**0.372**	g/l
Albumin	**460.0**	<20	mg/g Crea	**230**	mg/l
Immunoglobulin G	**31.6**	<10	mg/g Crea	**15.8**	mg/l
a1-Microglobulin	**70.8**	<14	mg/g Crea	**35.4**	mg/l
a2-Macroglobulin	**4.2**	<10	mg/g Crea	**2.1**	mg/l
Ratios					
IgG/Albumin	**6.9**	%	a1-Microglobulin/Albumin	**15.4**	%
a2-Macroglobulin/Albumin	**0.9**	%	Albumin/Total Protein	**61.8**	%

Dipstick Results		Cell Counts
Erythrocytes a.	++	
Leukocytes a.	0	
Protein a.	++	
Glucose a.	0	



Interpretation

GFR estimation indicates a drastic decrease in glomerular filtration, which is classified as renal failure. (Based on the Cystatin C formula)

Glomerular proteinuria is present. This is classified as significant (presence of macroalbuminuria). Additional, significant tubular proteinuria exists.

This constellation is compatible with glomerulopathy with restricted tubulo-interstitial reabsorption.
The presence of renal hematuria is highly likely; additional erythrocytes from postrenal sources cannot be ruled out.

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Signature

All reports come in a standardized format, but are also adaptable to meet your needs, e.g. adding your clients, assay mix or your own logo.

Combined result interpretation from multiple sources

- Dipstick
- Nephelometer
- Clinical chemistry

Illustration of glomerulopathy/ nephropathy/hematuria status

Detailed clinical interpretation proposal

Lower patient management costs through holistic, nutritional status checks

Protein calorie malnutrition is common in hospitalized patients but often remains undiagnosed. At-risk patients are often among the most severely ill, and failure to recognize malnourished patients can impact patients' health, increase the length of stay, and add to hospital-associated costs.

The Protis Nutritional Assessment software aids in identifying a patient's risk category, provides recommendations for further patient management, and suggests appropriate monitoring of the nutrition status.

Consolidated malnutrition risk assessment

- Evaluation of nutritional status based on prealbumin, albumin, and weight-based data
- Integration of anamnestic data (e.g., body mass index [BMI], weight loss)
- Alert feature for underlying conditions that might impact the concentration of nutritional protein markers, such as inflammation, liver disease, or hemoconcentration/hemodilution
- Combined results from multiple analyzers
- Recommendations for further patient monitoring
- Alerts if nutritional supplementation may be indicated
- At-a-glance evaluation of the most relevant nutritional markers
- Calculation of NRI (Nutritional Risk Index)[5] and PINI (Prognostic Inflammatory and Nutritional Index)[6]

Nutritional protein markers

- Core assays for nutritional assessment
  - Prealbumin/Transthyretin
  - Albumin
- Extended protein panel for further characterization
  - Inflammation
  - CRP
  - α1-acid glycoprotein
  - Liver disease
    - Prothrombin time (PT)
    - Hemoconcentration or hemodilution
    - Hematocrit

Nutritional indices

NRI = 1.52 x albumin (g/L) + 41.7 x (actual/usual weight)

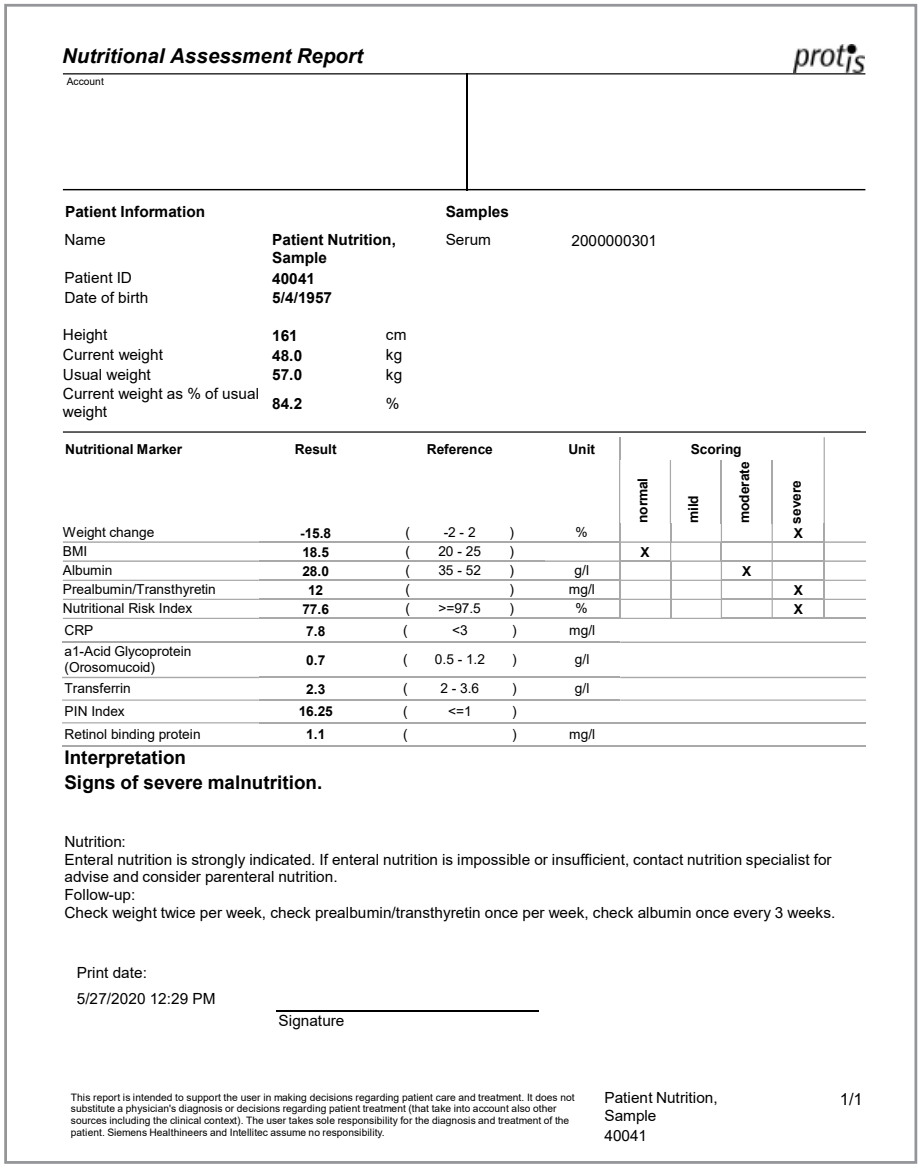
$$\text{PINI} = \frac{\text{CRP (mg/L)} \times \alpha\text{1-acid glycoprotein (mg/L)}}{\text{albumin (g/L)} \times \text{prealbumin (mg/L)}}$$

Classification of nutritional status

Parameter	Levels of malnutrition			
	none	mild	moderate	severe
Prealbumin (g/L)	>0.2	0.11–0.2	0.05–0.11	<0.05
Albumin (g/L)	>35	30–35	20–30	<20 *(<25 for age ≥70 years)*
NRI	>97.5%	90–97.5%	83.5–90%	<83.5%
Weight loss in last 3 months	<2%	2–5%	5–10%	>10%
BMI	—	—	—	<17.0 (≤20.0 for age ≥70 years)

Nutritional parameters			Scoring (example data)			
	result	unit	normal	mild	moderate	severe
Weight loss	3.2	%		●		
BMI	25.4	—	●			
Prealbumin	0.095	g/L			●	
Albumin	31.5	g/L		●		
Nutritional Risk Index	88.2	%			●	

Protis Nutritional Assessment



Nutritional Assessment Report

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Account

Patient Information

Name	**Patient Nutrition, Sample**	
Patient ID	**40041**	
Date of birth	**5/4/1957**	
Height	**161**	cm
Current weight	**48.0**	kg
Usual weight	**57.0**	kg
Current weight as % of usual weight	**84.2**	%

Samples

Serum	2000000301

Nutritional Marker	Result	Reference	Unit	Scoring: normal	mild	moderate	severe
Weight change	**-15.8**	(-2 - 2)	%				X
BMI	**18.5**	(20 - 25)		X			
Albumin	**28.0**	(35 - 52)	g/l			X	
Prealbumin/Transthyretin	**12**	( )	mg/l				X
Nutritional Risk Index	**77.6**	(>=97.5)	%				X
CRP	**7.8**	(<3)	mg/l				
a1-Acid Glycoprotein (Orosomucoid)	**0.7**	(0.5 - 1.2)	g/l				
Transferrin	**2.3**	(2 - 3.6)	g/l				
PIN Index	**16.25**	(<=1)					
Retinol binding protein	**1.1**	( )	mg/l				

Interpretation

Signs of severe malnutrition.

Nutrition:
Enteral nutrition is strongly indicated. If enteral nutrition is impossible or insufficient, contact nutrition specialist for advise and consider parenteral nutrition.
Follow-up:
Check weight twice per week, check prealbumin/transthyretin once per week, check albumin once every 3 weeks.

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Signature

This report is intended to support the user in making decisions regarding patient care and treatment. It does not substitute a physician's diagnosis or decisions regarding patient treatment (that take into account also other sources including the clinical context). The user takes sole responsibility for the diagnosis and treatment of the patient. Siemens Healthineers and Intellitec assume no responsibility.

Patient Nutrition, Sample
40041

1/1

Detailed sample result table with nutritional assessment scoring

Timely, holistic nutritional assessment helps improve patient outcomes and can yield significant cost savings. Elia Mears calculated a direct financial benefit to their hospital of over $600,000 a year, with the majority of this saving due to the decrease in length of stay.[6]

At Siemens Healthineers, our purpose is to enable healthcare providers to increase value by empowering them on their journey toward expanding precision medicine, transforming care delivery, and improving patient experience, all made possible by digitalizing healthcare.

An estimated 5 million patients globally benefit every day from our innovative technologies and services in the areas of diagnostic and therapeutic imaging, laboratory diagnostics, and molecular medicine, as well as digital health and enterprise services.

We are a leading medical technology company with over 120 years of experience and 18,000 patents globally. Through the dedication of more than 50,000 colleagues in 75 countries, we will continue to innovate and shape the future of healthcare.

Product availability may vary from country to country and is subject to varying regulatory requirements. Please contact your local representative for availability.

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