The Basics of Testing: Hematology

Little Mamoru learns that Sysmex's products use "*in vitro* diagnostics" to study blood, urine and other samples. First, the guide and Mamoru go to the hospital together to learn about blood tests.

Mamoru Look! Somebody is getting a shot!

Guide That person is having a blood sample taken, so it can be tested.

Mamoru Blood removed from the body like that is taken to the laboratory to study more closely?

Guide That's right. **Out of all the types of testing that use instruments, hematology is one of the most fundamental.** Hematology analyzes the number and size of red and white blood cells, as well as platelets.

Mamoru Why would you need to study red and white blood cells?

Guide Well, blood flows throughout the body, right? When your body's condition changes, changes appear in the red and white blood cells, too. **Hematology checks whether anything is abnormal about the red or white blood cells.**

Mamoru So, it checks whether they are normal or not.

Guide That's right. In the past, lab technologists* used microscopes and counted every red and white blood cell. That took a lot of time and effort.

Mamoru Red and white blood cells are really small, right? That must be really hard!

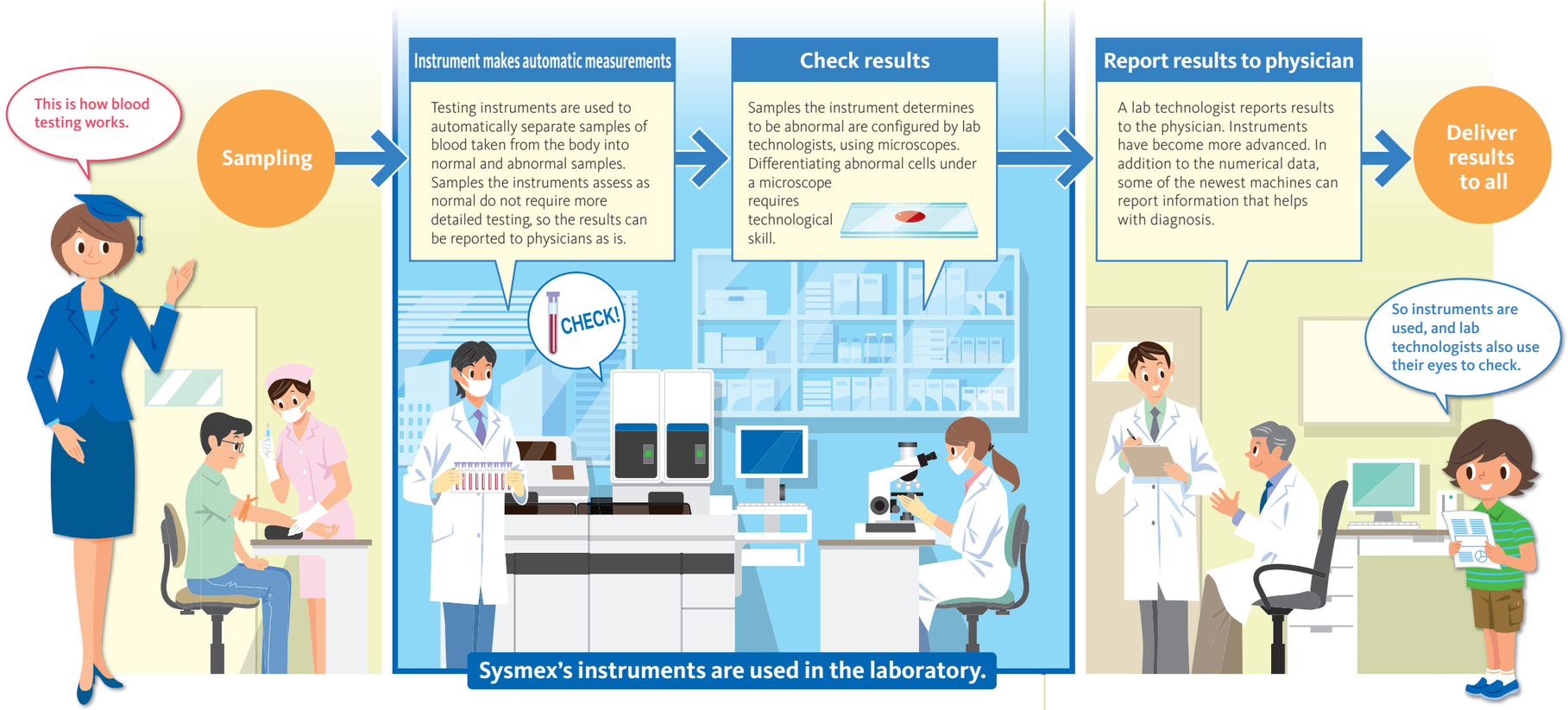
Guide **Now we use testing instruments to perform analysis automatically and accurately.** Measurement speed is faster than for manual operations, so test results are delivered quickly, even in hospitals with many patients.

Mamoru Wow! That must be a big help for lab technologists. But what happens if the instrument's analysis shows abnormal red or white blood cells?

Guide Then a lab technologist looks into a microscope to study the sample in more detail. Instruments separate out samples that are normal from those that are not, so **the lab technologist can focus on the abnormal samples.**

Mamoru So people use their eyes to confirm the important parts.

Guide We can still learn many things from the blood. Next, let's look at blood testing other than hematology.



Sysmex's instruments are used in the laboratory.

*Lab technologist (clinical laboratory technologist): Technologist who performs a hot of clinical tests at hospitals and medical institutions

Point 1

The Most Fundamental Tests for Determining Physical Condition

Hematology, which provides health information about the entire body, is essential for disease diagnosis and treatment. For this reason, it is a routine part of medical checkups and is performed at many hospitals. Depending on their type, in addition to the number and size of blood cells, testing instruments may be used to automatically obtain a variety of information, such as hemoglobin concentration and white blood cell types. This testing is also used as a reference for determining the presence of infections such as HIV/AIDS or the novel coronavirus.

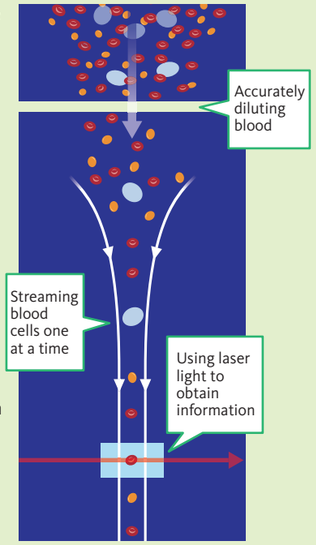
■ Examples of Hematology Parameters Used for Diagnosing Disease

Disease	Abnormalities that test parameters make apparent	
Anemia	Red blood cell count Hemoglobin concentration	⬇Low ⬇Low
Leukemia	White blood cell count Hemoglobin concentration Platelet count	⬆High (May also be ⬇Low) ⬇Low ⬇Low
Thrombocytopenia	Platelet count	⬇Low

Point 2

Combining Advanced Technologies to Make an Accurate and Detailed Analysis of the Micro World

Sysmex's testing instruments utilize a host of technologies to analyze red and white blood cells—several thousand to several million of which are present in a single microliter* of blood. Over long years of R&D, Sysmex has developed unique technologies to enable accurate analysis. These include technologies using reagents to dilute blood to optimal concentrations, technologies for streaming blood cells in single row and technologies for using laser light to obtain a host of information from blood cells.



*Microliter: 1/1,000th of a milliliter

What Blood Tests Show

Little Mamoru has learned about hematology, one of the most fundamental tests. What else can we find by studying the blood?

Mamoru Blood tests are used to study red and white blood cells. What other things can they tell us?

Guide The blood works in many ways to keep the body healthy.

Mamoru Like how?

Guide In winter, more people catch colds, right? To keep you from getting such diseases, the blood kills pathogens that enter the body.

Mamoru The blood can do that?

Guide Yes, it can. **Organisms (called antibodies) are developed to fight pathogens in the blood, helping to protect the body.** Looking at whether and how many of these organisms are in the blood helps us know the type and status of disease.

Mamoru I see.

Guide The blood also helps to get nutrients to all corners of the body.

Mamoru The blood carries nutrients in the food I eat throughout the body?

Guide That's right. And the blood connects many other organs (like the liver, pancreas and kidneys) that help with breaking down nutrients and then getting rid of them after their energy has been used up. **By studying the parts of the blood, we can tell whether these organs are working properly.**

Mamoru When I hurt myself and bleed, the blood clots naturally. Why is that?

Guide Well, if the blood didn't clot, you'd keep on bleeding, right? That's why sometimes before an operation, **a patient might be tested to make sure their blood will clot so they don't bleed too much during surgery.**

Mamoru Studying the blood really tells you lots about the body, doesn't it. I think I'm beginning to understand how important blood tests are.

Mini Lesson

Why take blood early in the morning and on an empty stomach?

Have you ever been told not to eat after 9pm at the night before taking a blood test the next day? This is because the standard values for testing are based on blood sampled "early in the morning and on an early stomach." This is because blood sugar and cholesterol levels temporarily increase after you eat, requiring extra caution.

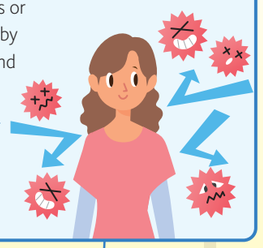
Note: Depending on the test, it may not be necessary to follow the "early in the morning and on an empty stomach" guidelines.

Immunochemistry

Testing to determine the status of action (immunity) to remove viruses, cancer cells or other foreign matter from the body, thereby determining causes and types of illness and symptomatic states.

<Main diseases found through testing>

- Infectious diseases (such as COVID-19)
- Cancer
- Atopic dermatitis
- Hepatitis, etc.



Hemostasis

Testing to determine the activity of blood clotting at a wound entrance and dissolving thrombus. These are important indicators for surgery and drug administration.

<Main diseases found through testing>

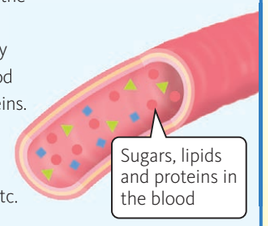
- Thrombosis
- Thrombotic disease (myocardial infarction, cerebral infarction)
- Hemophilia, etc.

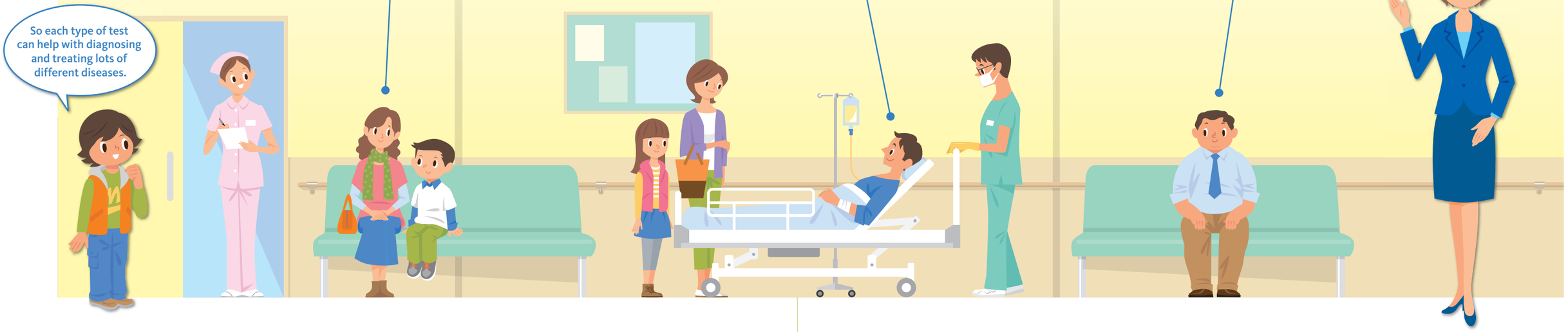
Clinical chemistry

Determining the status of organs involved in the digestion and absorption of nutrients and elimination of waste material (metabolism) by testing to determine the presence in the blood of substances such as sugars, lipids and proteins.

<Main diseases found through testing>

- Diabetes
- Liver dysfunction
- Arteriosclerosis
- Kidney dysfunction, etc.





Immunochemistry

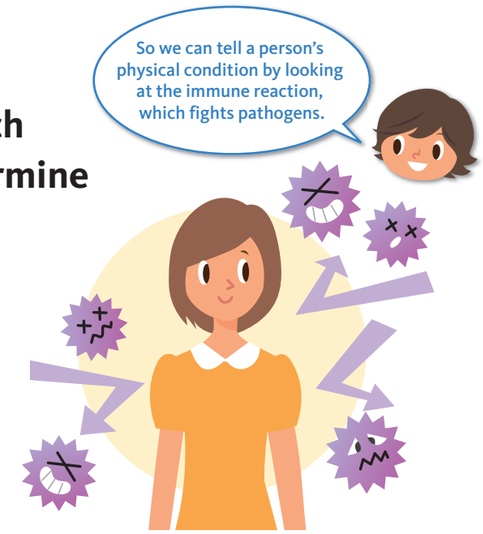
This section introduces the field of immunochemistry. Of all the various areas of testing, Sysmex is currently focusing in particular on market cultivation and R&D in this field.

Q What sort of testing?

A The body's immune reaction, which protects the body, is used to determine the type and status of disease.

To keep us from getting sick, our bodies fight viruses and other pathogens that enter the body. When pathogens enter the blood, organisms (antibodies) are created to fight them, protecting the body.

Immunochemistry uses this body-protecting immune reaction to study a person's physical condition. Looking at whether organisms to fight pathogens are present in the blood, and in what quantities, allows us to determine the disease source, type and condition.



Q What sort of diseases are investigated?

A Hepatitis, AIDS and many other diseases can be investigated.

Immunochemistry can be used to study many different diseases. In addition to viruses that enter the body from outside, the body also responds to organisms that cancer cells create inside the body. For this reason, immunochemistry can help in diagnosing infectious diseases caused by viruses and other organisms, as well as in discovering cancer. Immunochemistry can also be used to find the cause of allergies, which occur when the immune system reacts excessively to fight even organisms that are not harmful to the body.

In this way, immunochemistry allows many different diseases to be investigated. Dozens of types of reagents* can be used, depending on the disease to get studied. Organisms in the blood differ depending on the disease, and specialized reagents are available for each.

Major Diseases Investigated through Immunochemistry

Infectious diseases (hepatitis, AIDS, COVID-19, etc.)

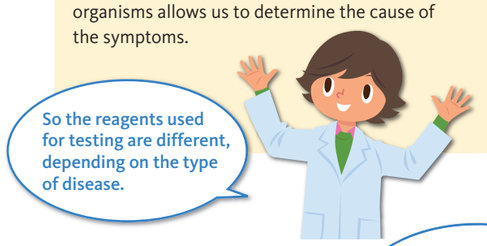
Testing determines the presence in the blood of viruses and other pathogens, as well as the organisms that fight them (antibodies). Some methods can also determine the quantity of a virus.

Cancer

Immunochemistry can study the organisms that cancer creates inside the body, called "tumor markers." As these indicators are used when diagnosing cancer, this sort of testing has an auxiliary use.

Allergies

Pollen, ticks and other allergy-causing organisms can join with specific antibodies and create symptoms. Looking at increases in antibodies that join with certain organisms allows us to determine the cause of the symptoms.



Sysmex's Initiatives

Expanding Our Lineup of Proprietary Reagents to Test for Atopic Dermatitis and Liver Fibrosis Progression

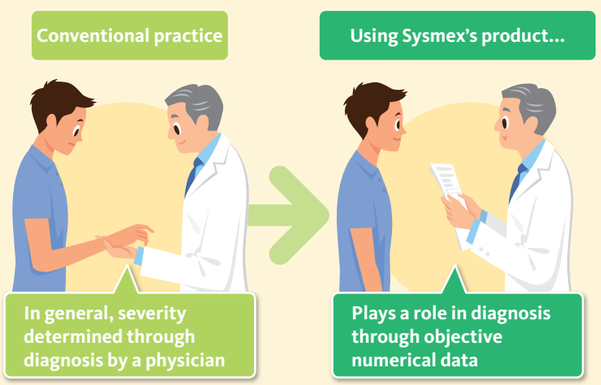
Sysmex is expanding its proprietary reagent lineup in the immunochemistry field to provide higher-value testing to patients and healthcare settings.

For example, physicians check patients' bodies for atopic dermatitis (an allergy) and determine the degree of severity by hearing the subjective symptoms. Instruments are used for testing to obtain objective data used in this diagnosis. **Under conventional methods, testing took more than three hours, which was a problem. Sysmex has developed a reagent that allows testing to be performed in approximately 17 minutes. This development has greatly reduced patient waiting times.**

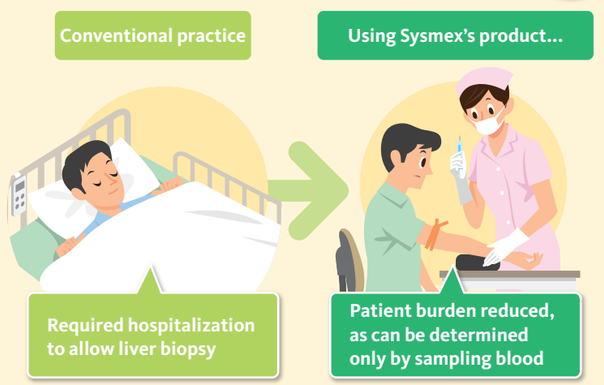
Sysmex was also the first in the world to succeed in the development and practical application of a reagent for testing the degree of hepatic fibrosis, from hepatitis to cirrhosis of the liver, using a glycosylation marker*. Conventional **testing required liver biopsy. Sysmex's reagent allows testing to be performed in a short period of time and through blood testing only, which reduces the physical and economic burden on patients.**

Sysmex is also establishing new measurement technology for achieving advances in immunochemistry and pursuing development toward its practical realization.

For Atopic Dermatitis



Hepatic Fibrosis Progression



*Glycosylation marker: A biomarker that targets structural changes in sugar chains present in glycoproteins

*Reagent: A pharmaceutical product for medical use in *in vitro* diagnostics. To obtain accurate test results, reagents may be used to dilute blood samples or stain blood cells.

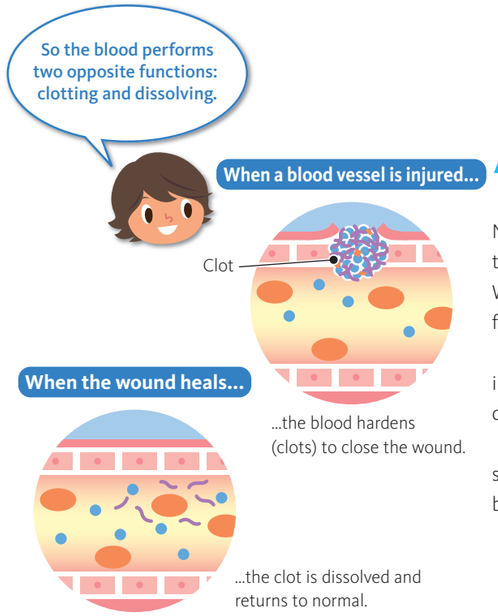
Hemostasis

Of the many different types of testing, this section introduces hemostasis, a field in which Sysmex has a top share* of the global market.

*Sysmex and Siemens Healthineers together hold the top share of the global market

Q What sort of testing?

A This testing determines the ability of the blood to clot or dissolve.



Normally, blood flows inside the blood vessels, which carry it to all corners of the body. However, blood can flow outside the vessels in the case of injury. When this happens, blood naturally clots at the wound to prevent it from flowing out of the body.

At the same time, a balance is maintained to keep blood from clotting inside the vessels. After clotting over a wound, blood also has the ability to dissolve the clot and return to its normal flow once the wound has healed.

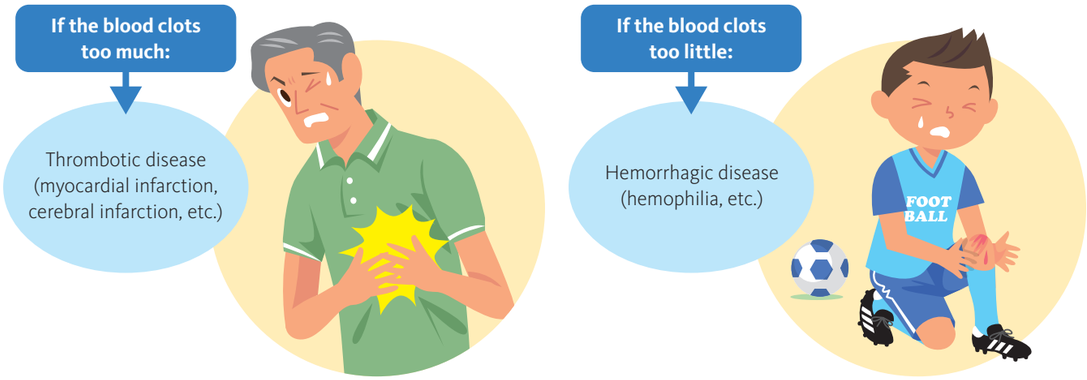
Healthy bodies maintain a good balance between these states. Hemostasis is the type of testing used to see if that balanced degree of clotting in the blood is being maintained.

Q What sort of diseases are investigated?

A The main diseases investigated are those in which the blood clots too much or too little.

Diseases occur due to an imbalance in the blood's ability to clot and dissolve—one of these capabilities becoming too strong. If the ability to clot is too strong, blood clots can form inside the vessels (thrombotic disease). On the other hand, if the clotting ability is too weak, blood may fail to clot even in the case of injury (hemorrhagic disease).

Hemostasis is used to diagnose this sort of disease, check medical condition, confirm treatment results and help decide the amount of medication. Hemostasis is also conducted before a surgery to ensure against a major loss of blood during a surgery.



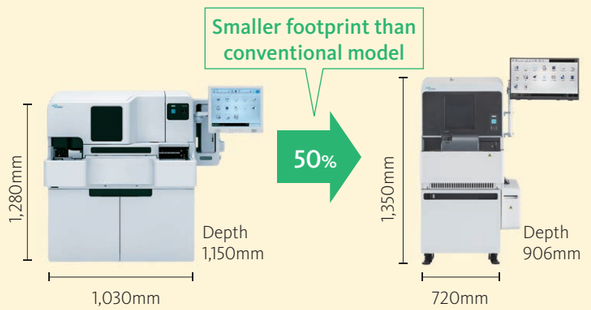
Sysmex's Initiatives

Responding to Increasing Global Testing Demand by Enhancing the Product Lineup to Meet a Wide Variety of Needs

In the past, hemostasis was performed manually, but nowadays this testing has become automated. In many laboratories, a sample is simply placed into an instrument, and testing is performed using fully automated testing instruments and reagents*. In 1995, Sysmex formed an alliance with Siemens Healthineers, which had the world's leading share of the market for reagents used in hemostasis. **The two companies now supply each other with instruments and reagents and hold the leading share of the global market in the hemostasis field.**

Due to changes in eating habits and aging populations in recent years, within the field of hemostasis testing has increased for myocardial infarction, cerebral infarction and other types of thrombotic disease. Treatment for thrombotic disease involves the use of medications that slow the clotting of the blood. Using either too much or too little of such medications inhibits treatment results. As a result, demand is rising for high-quality testing to check that a medication is efficacious and to prudently determine the appropriate amount.

This demand is growing around the world, including in emerging markets. **Sysmex is expanding its product lineup in response to a variety of testing needs.** In addition to its conventional focus on high-performance models, Sysmex is developing and selling environmentally considerate products that offer better processing performance, as well as saving space and using less electricity.



***Reagent:** A pharmaceutical product for medical use in *in vitro* diagnostics. To obtain accurate test results, reagents may be used to dilute blood samples or stain blood cells.

Urinalysis

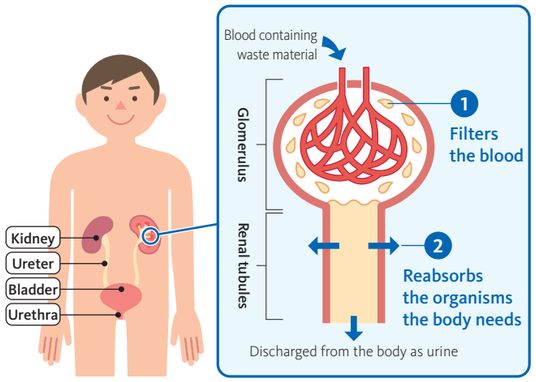
Of the many different types of testing, this section introduces urinalysis, which is used as a first step for early detection and treatment of disease.

Q Why study urine?

A Urinalysis provides a host of information about a person's physical condition.

Urine is produced in the kidneys. Kidneys have the role of removing waste material from the blood, acting as blood's "filters" and producing urine as waste. However, if the kidneys were to simply act as filters, they would also remove substances the body needs, such as glucose and proteins. For this reason, after filtering, the kidney then reabsorbs substances the body needs.

When kidneys are working normally, urine contains almost no glucose or proteins. But if abnormalities occur in the kidneys or other organs in the urinary system, urine may contain substances that are not usually present. Also, diseases and other abnormalities in the body are quickly apparent in the urine. Urine thus allows us to obtain a host of information about the body.

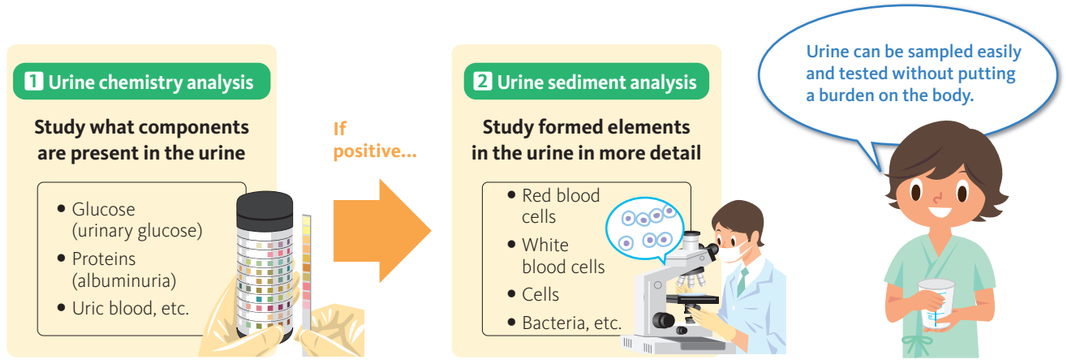


Q What sort of testing is done?

A There are two methods of testing: urine chemistry and urine sediment analysis.

Urinalysis testing is divided into urine chemistry analysis, a primary test, and urine sediment analysis, secondary testing conducted when urine chemistry analysis yields positive results. Urine chemistry analysis involves observing color changes in strips of test paper dipped in urine samples. This testing shows what elements the urine contains. Urine sediment analysis, on the other hand, is used to observe red and white blood cells and other cells that have precipitated into the urine. This analysis checks whether levels are higher than normal and for substances that are not usually present.

Urine sampling is painless and repeatable. For this reason, many hospitals throughout the world routinely use urinalysis as testing that places little burden on patients.



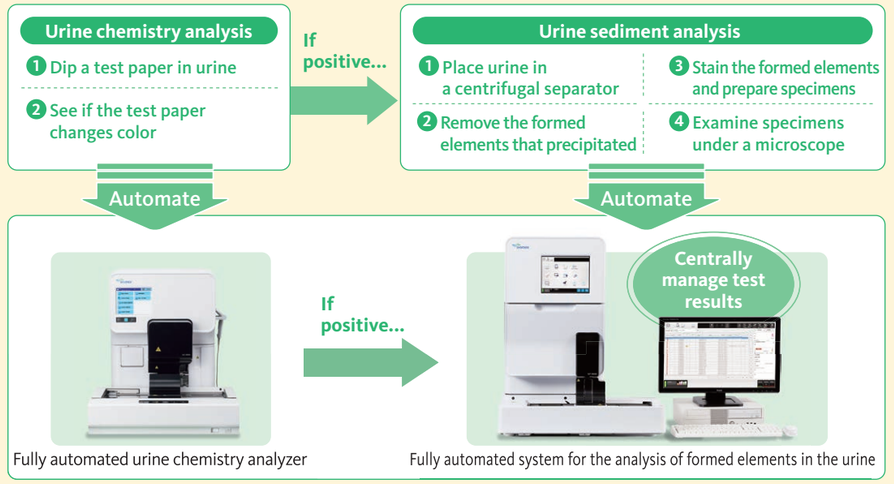
Sysmex's Initiatives

Expanding the Product Lineup

Urinalysis provides information about the whole body and presents little physical or economic burden. As a result, test numbers are growing as healthcare environments are put into place in emerging markets. Furthermore, in developed countries and emerging markets alike, the number of dialysis patients (such as those with diabetic nephropathy) is increasing. For this reason, demand is growing for the use of urinalysis in the early-stage diagnosis of diabetes nephropathy.

Sysmex has developed instruments to automatically analyze formed elements in urine, helping to make urine sediment analysis more efficient and standardized. In 1995, the Group developed the world's first instrument using proprietary technology (applying a specialized laser to analyze urine) to fully automate urine sediment analysis. Sysmex also continues working to create products that allow more parameters to be measured with greater precision.

In urine chemistry analysis, meanwhile, Sysmex has sales tie-ups in place with other companies. A 2020 tie-up with Siemens Healthineers reinforced Sysmex's sales structure in North America. As a result, **the Group can now meet even more diverse customer needs by combining the urine sediment products it has provided in the past with urine chemistry analysis products.**



Fully automated urine chemistry analyzer

Fully automated system for the analysis of formed elements in the urine