HOW TO INTERPRET YOUR BLOODWORK

Saturday, April 18, 2020

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London Health Sciences Centre

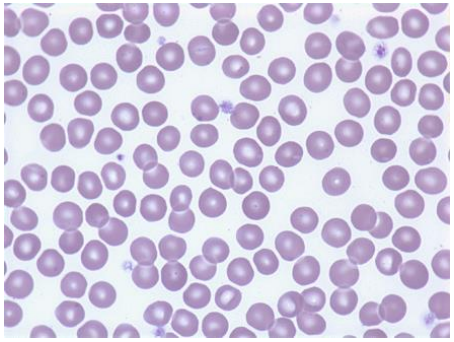
WELCOME

- Presenting from London, Ontario

London
CANADA

OBJECTIVES

- Outline of presentation: The end of the presentation, the audience will be able to..
  - Describe and evaluate the parts of a complete blood count (CBC)
  - Describe myelodysplastic syndromes (MDS)
  - *COVID-19 & MDS
  - Discuss questions on blood tests and what their results mean



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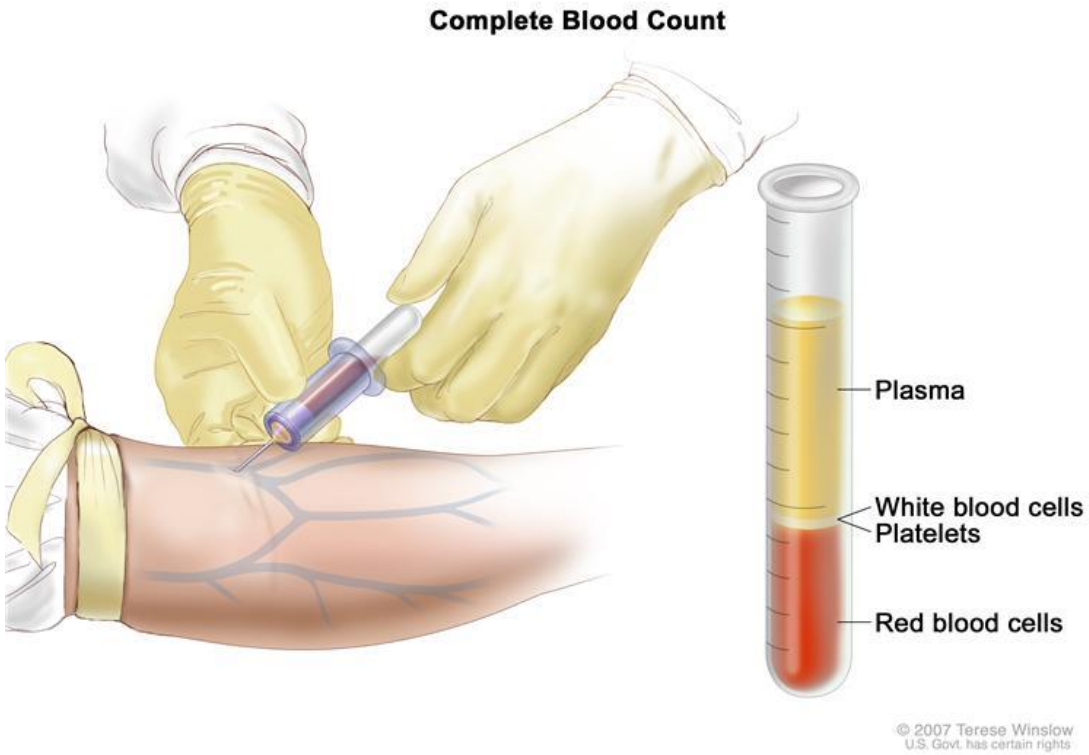
SOME BASICS: BLOOD CELLS AND WHERE THEY COME FROM

Our bodies are made of cells and more cells..



BLOOD CELLS

The easiest way to collect a sample of your blood cells is to take a blood sample.

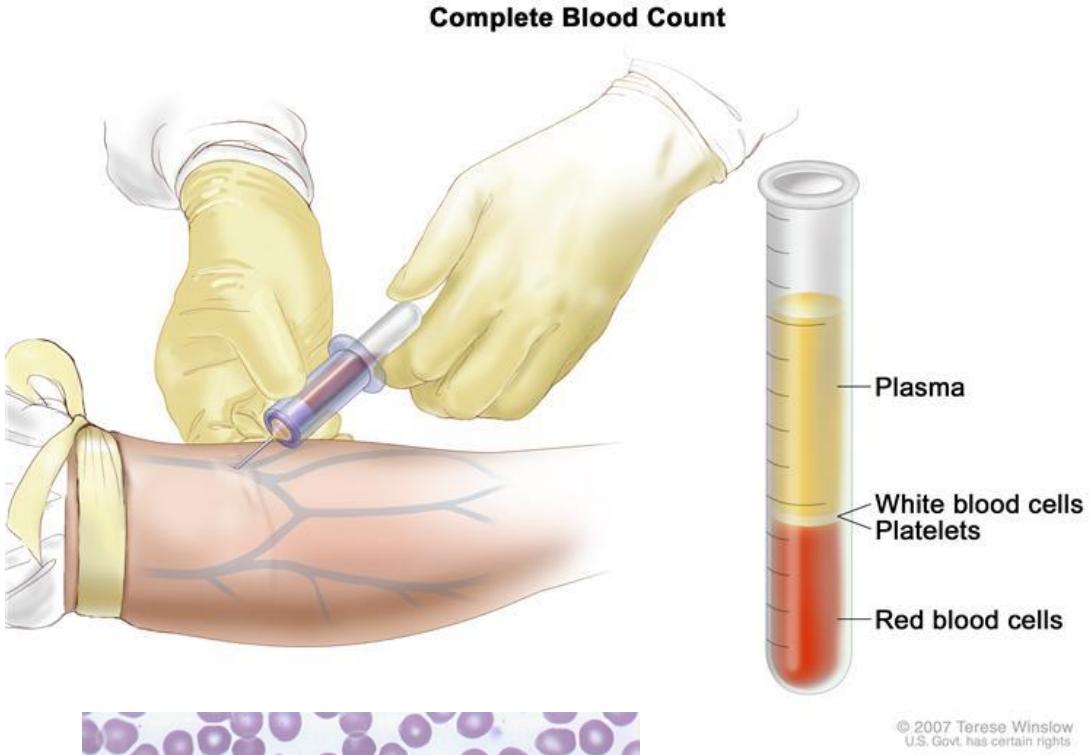
A laboratory technologist (sometimes referred to as a phlebotomist) will draw a blood sample from your arm.

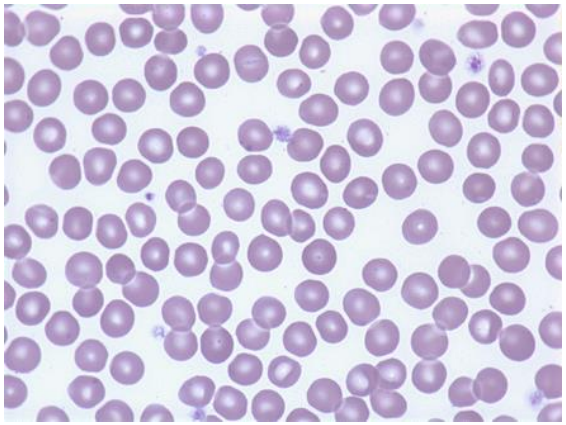
Blood is collected in a test tube and sent to the local laboratory for testing.

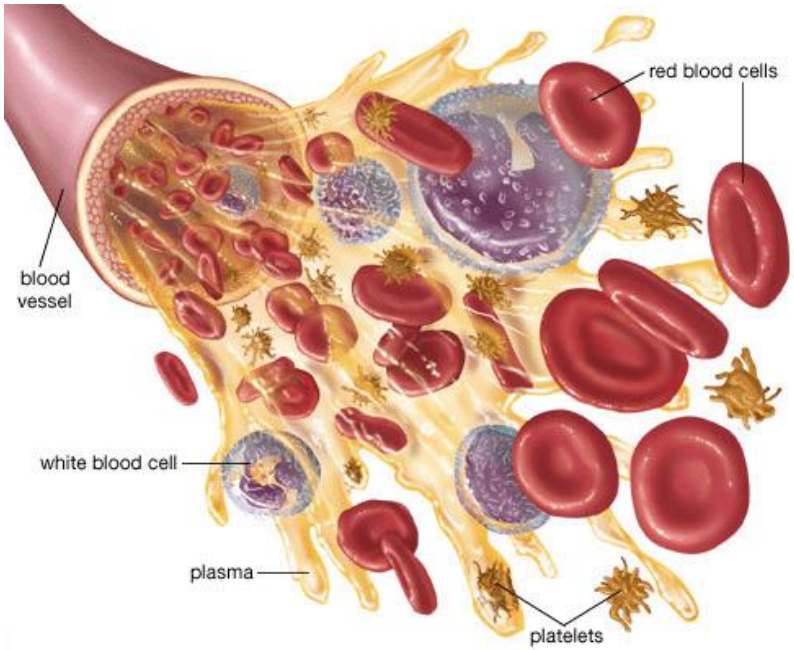
We are going to talk about the complete blood count (CBC)

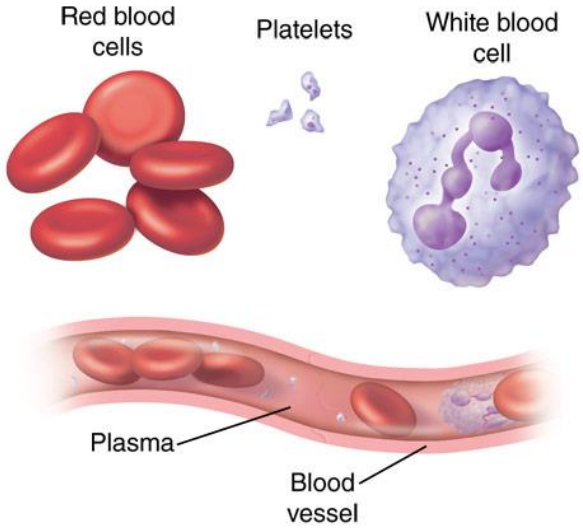
CBC

The complete blood count



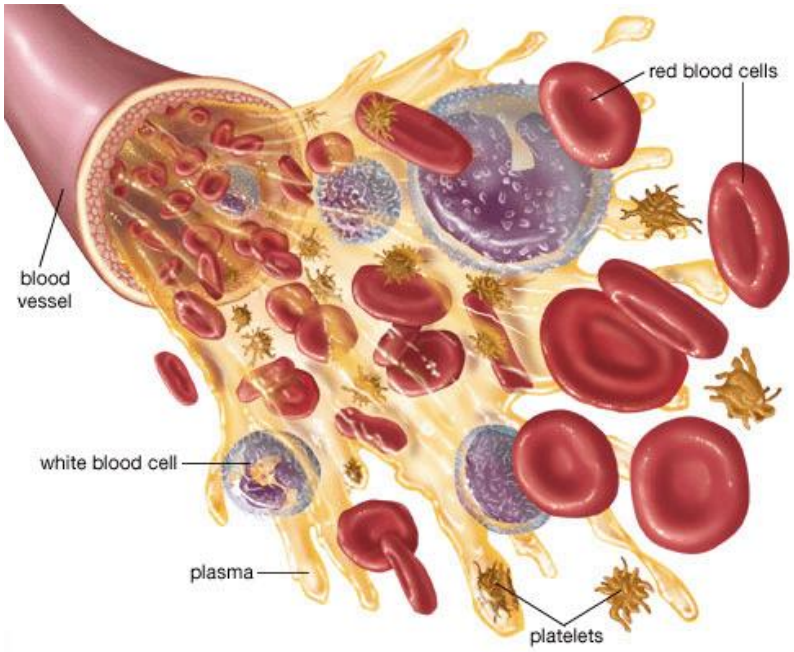






BLOOD

What is blood made of?



BLOODWORK

This is an example of a complete blood count (CBC) and a white cell differential

Event	Result	Ref. Range	Status
LKC	L 0.9	(4.0 - 10.0)	
ERC	L 2.87	(4.50 - 6.50)	
Hemoglobin	L 83	(135 - 170)	
HCT	L 0.25	(0.40 - 0.51)	
MCV	86.2	(79.0 - 97.0)	
RDW	14.1	(12.0 - 15.0)	
MPV	9.8	(7.1 - 11.1)	
Thrombocytes	* C <10	(150 - 400)	
Neutrophil	* C 0.3	(2.0 - 7.5)	
Lymphs	L 0.5	(1.5 - 4.0)	
Monocyte	L 0.1	(0.2 - 0.8)	
Eosinophil	0.0	(0.0 - 0.4)	
Basophil	0.0	(0.0 - 0.1)	

This is the CBC

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IS IT COMPLETE?

The complete blood count doesn't measure everything.

Notice that it does not contain other tests of the blood such as iron levels, kidney function, liver function, thyroid function, sugar levels, cholesterol, calcium, electrolytes..

These other tests are for another discussion and followed by various physicians.

REF. RANGE

What is a reference range?

How do we come up with this?

Patient Results

Reference Range

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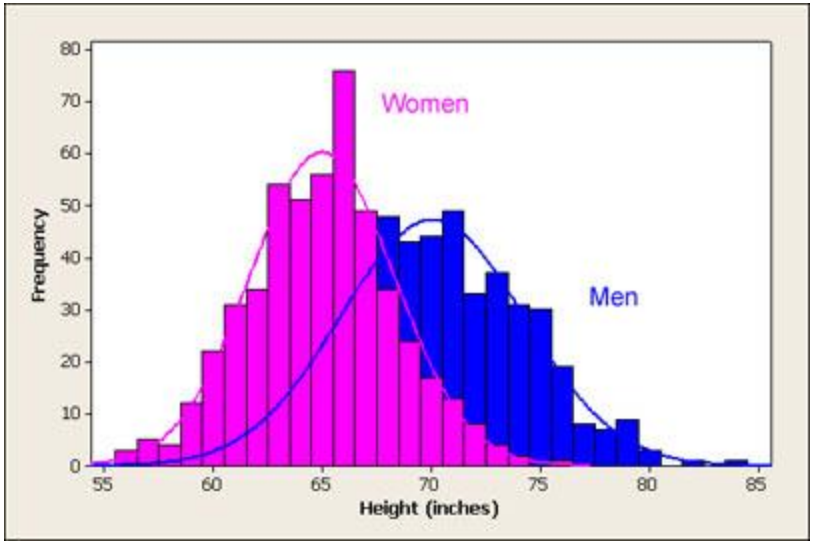

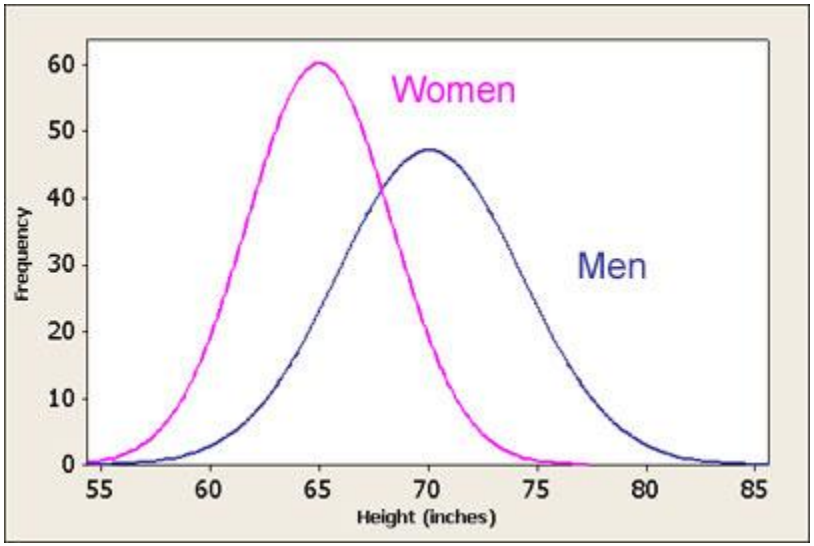

REF. RANGE

Let's talk about height as an example

You have to decide to cut off the range somewhere..

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REF. RANGE

Reference Ranges for each lab value is determined by each individual lab based on their reagents and “normal” controls.

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WHITE BLOOD CELLS

What are white blood cells?

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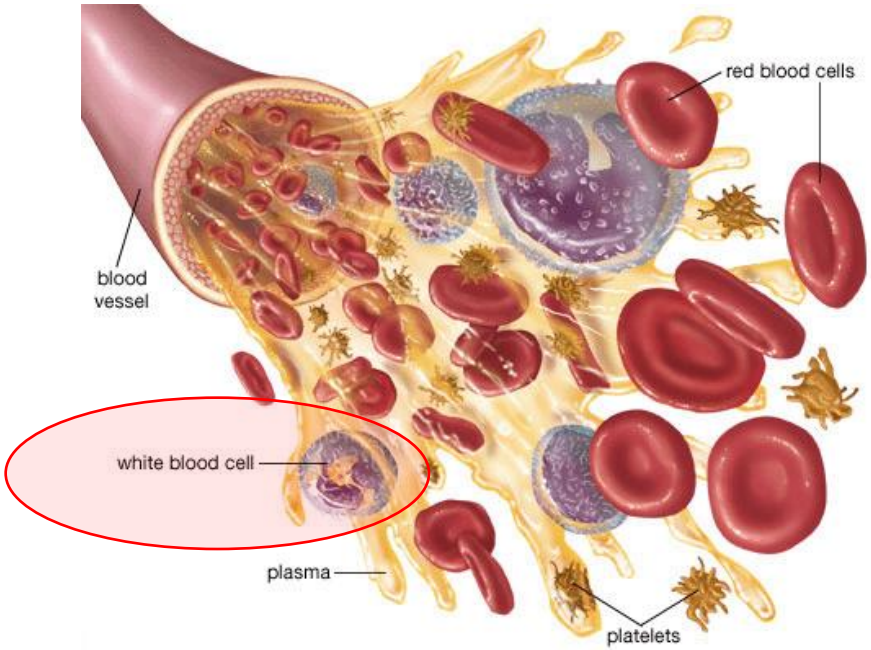

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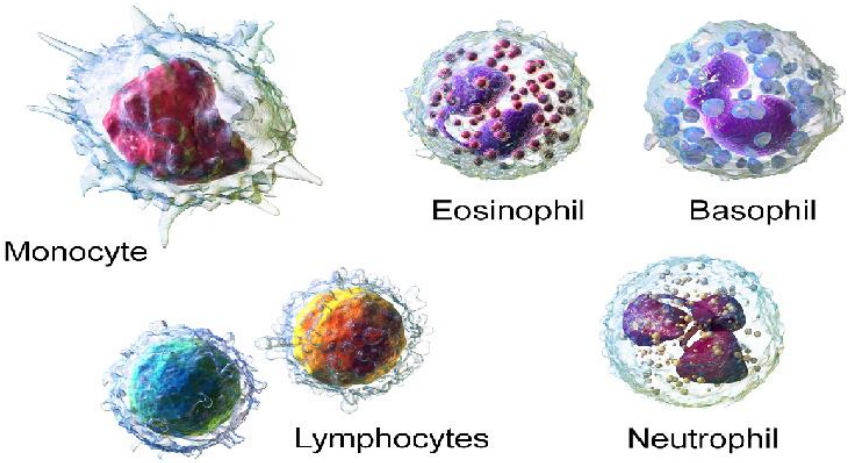
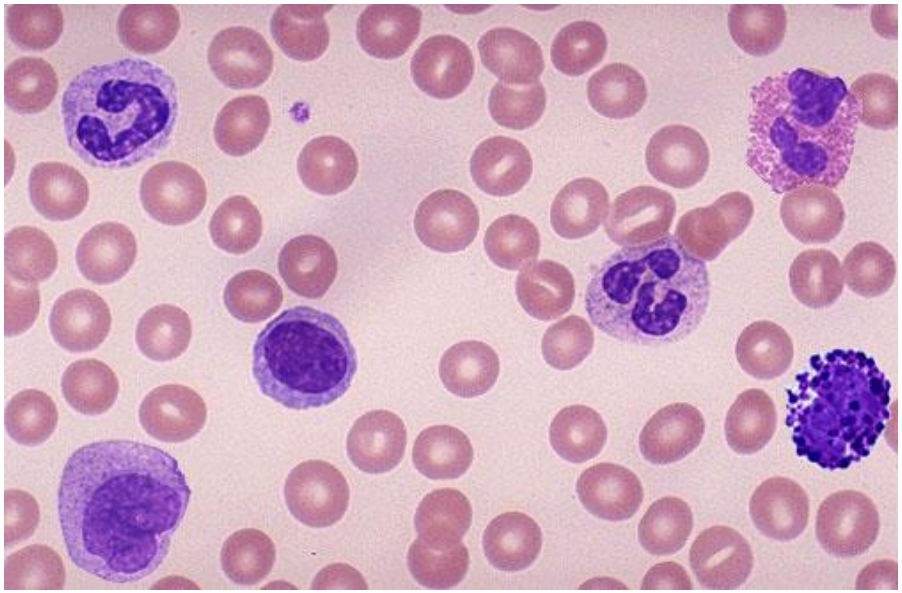
WBC

White blood cells (WBC) are also called leukocytes (LKC).



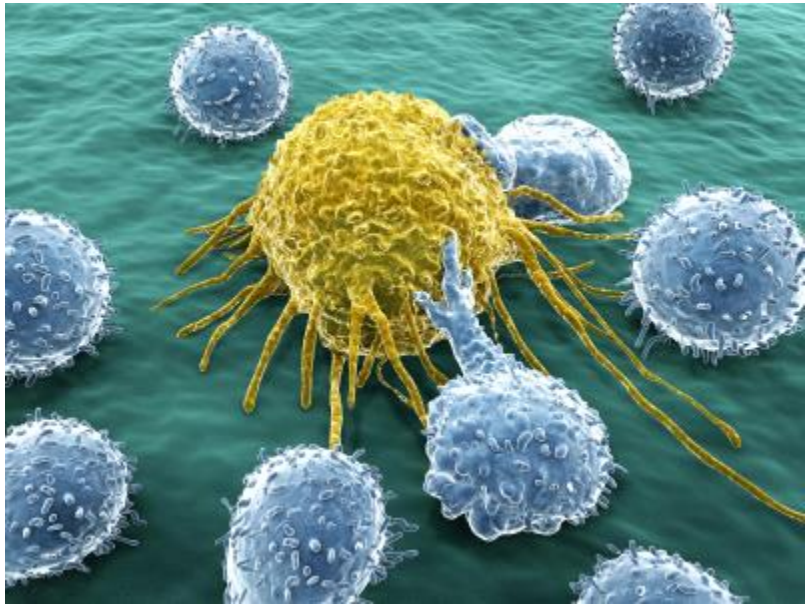
White Blood Cells



BLOOD

White blood cells are also called leukocytes (LKC)

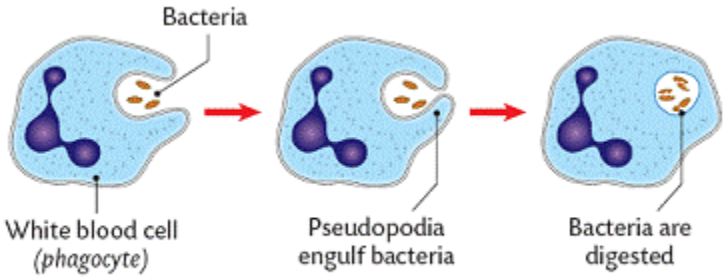
There are many different types of white blood cells that have different functions.



WBC FUNCTION

What do white blood cells do?

These cells are primarily for fighting infections and has a role in inflammation.



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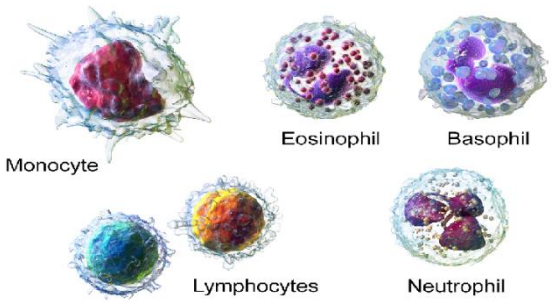
WBC

WBC or LKC is part of the complete blood count (CBC)

WBC is made up of a number of different white blood cells provided in the white cell differential



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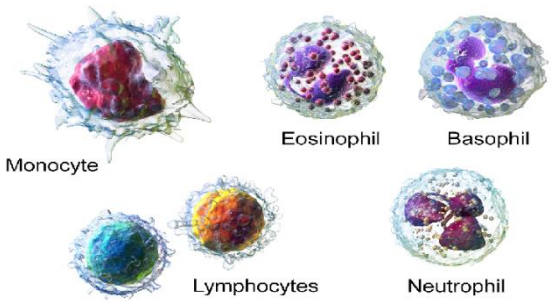
WBC

What do these white cells do?



White Blood Cells

- Neutrophils
  - fight bacteria, fungi
- Lymphocytes
  - fight viruses
- Monocytes
  - help fight infections, can migrate to other tissues to engulf infections and debris
- Eosinophils
  - help fight larger parasites, part of allergic response
- Basophils
  - release histamine, part of inflammatory response

WBC

What do these white cells do?

If these blood cells are too low you can have these problems.

Note: Low neutrophils is called (neutropenia). You may have been told this in clinic that if you have neutropenia to watch for fevers.

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RED BLOOD CELLS

What are red blood cells?

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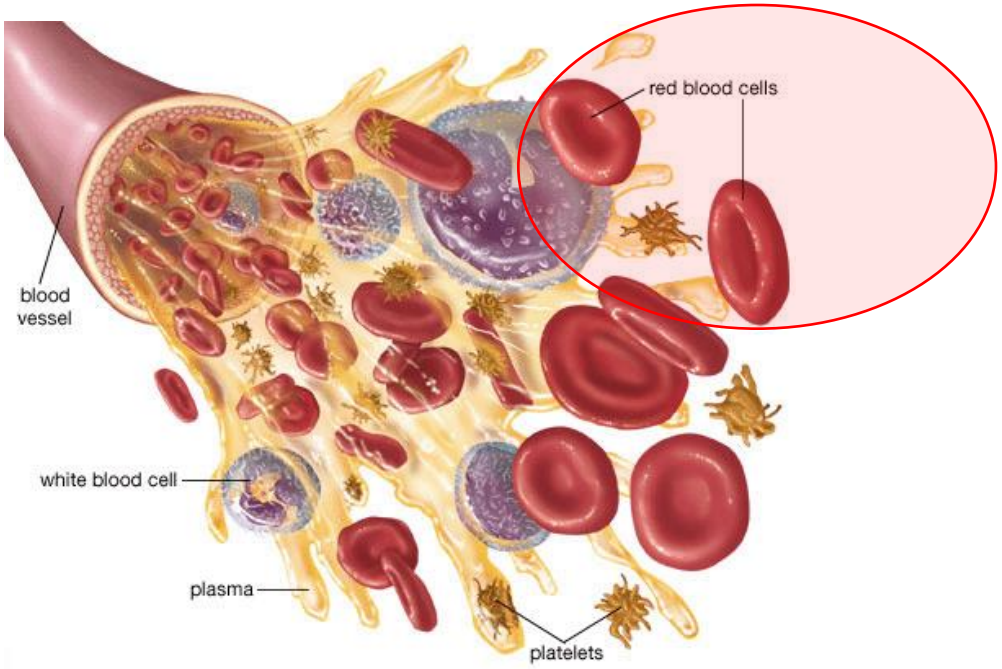

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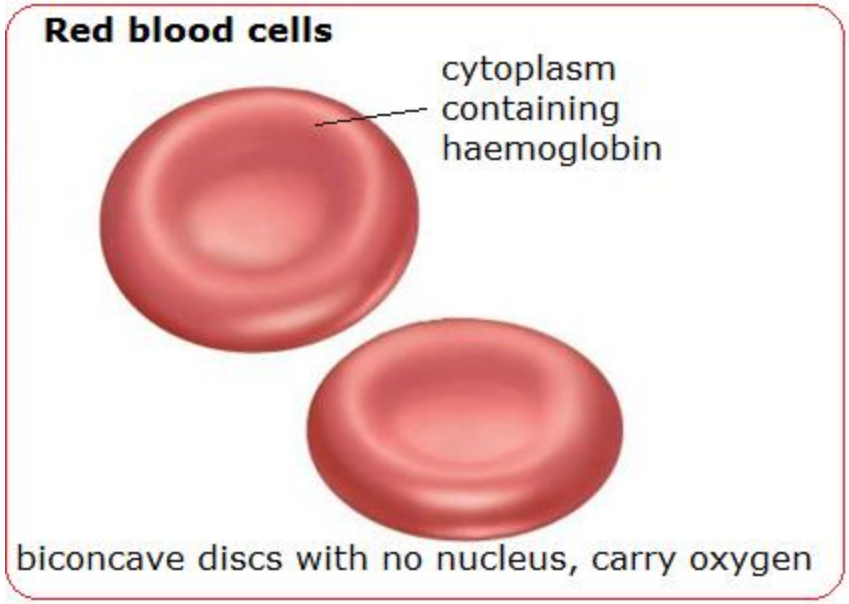
RBC

Red blood cells (RBC) are also called erythrocytes

ERC is the erythrocyte count



RBC

There are different measures that involve red blood cells such as hemoglobin, hematocrit, MCV and RDW.

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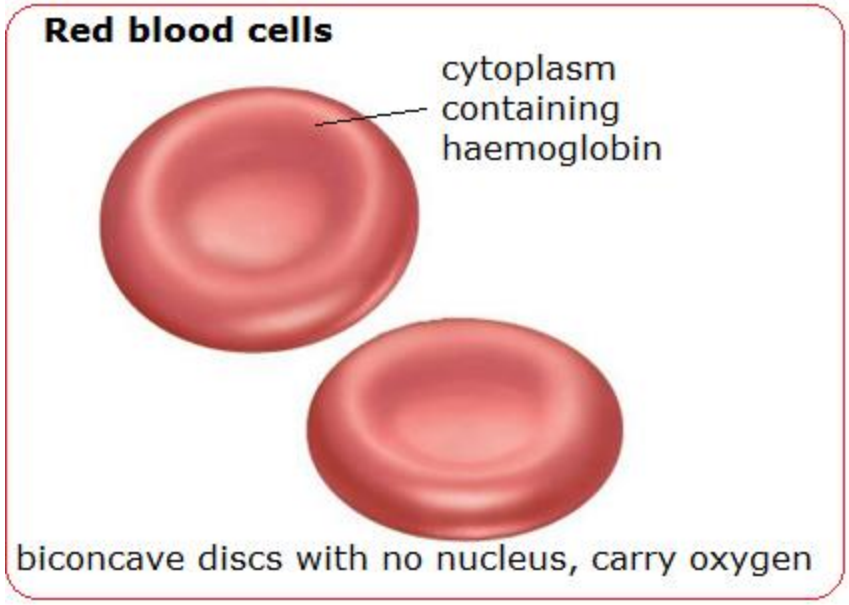
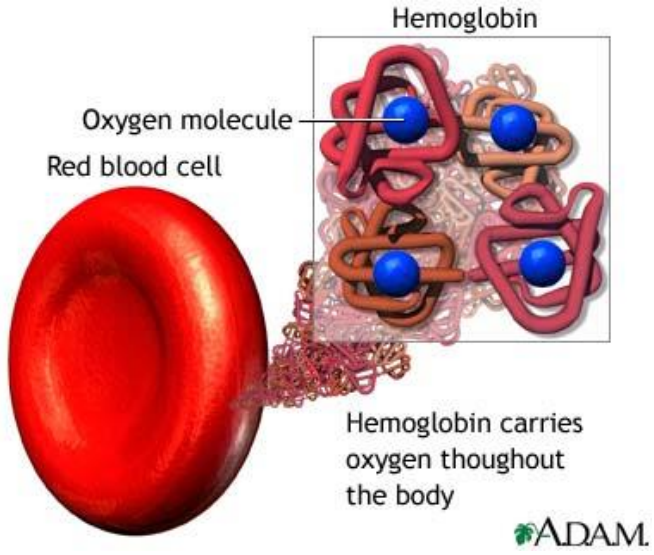
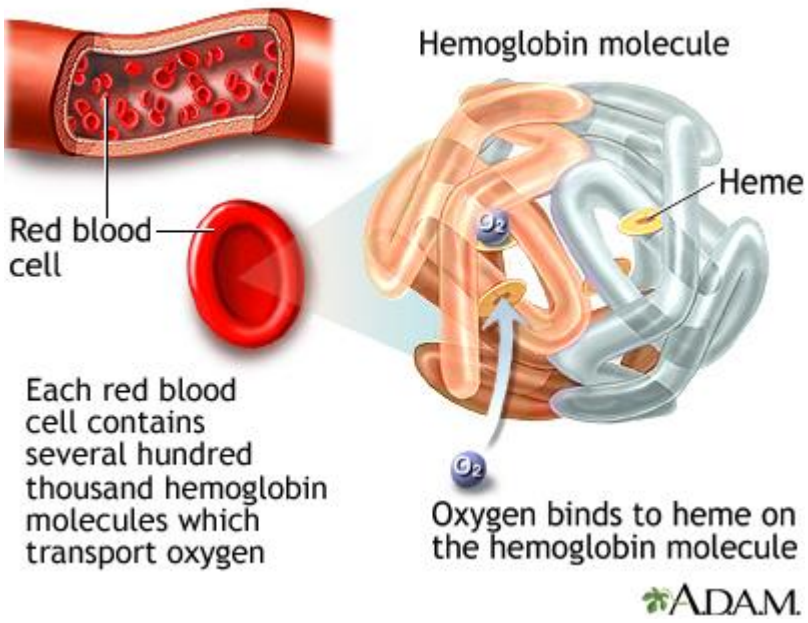




HEMOGLOBIN

Hemoglobin molecules are essential.. They carry oxygen in the red blood cells.



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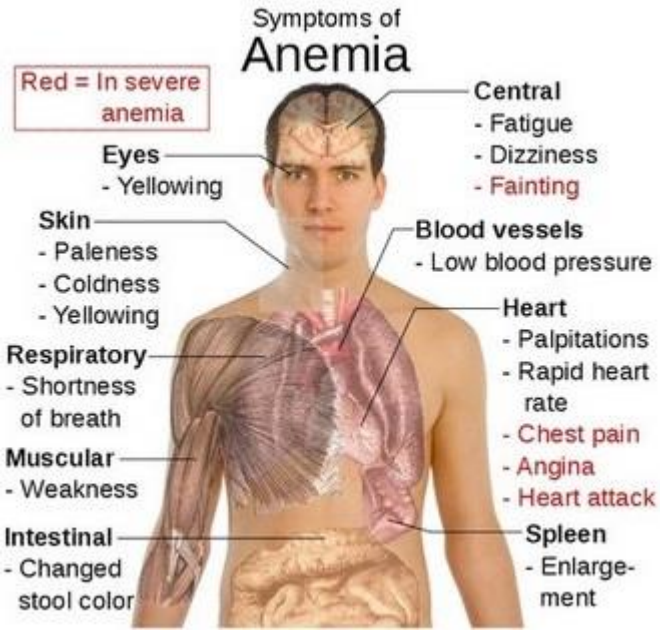

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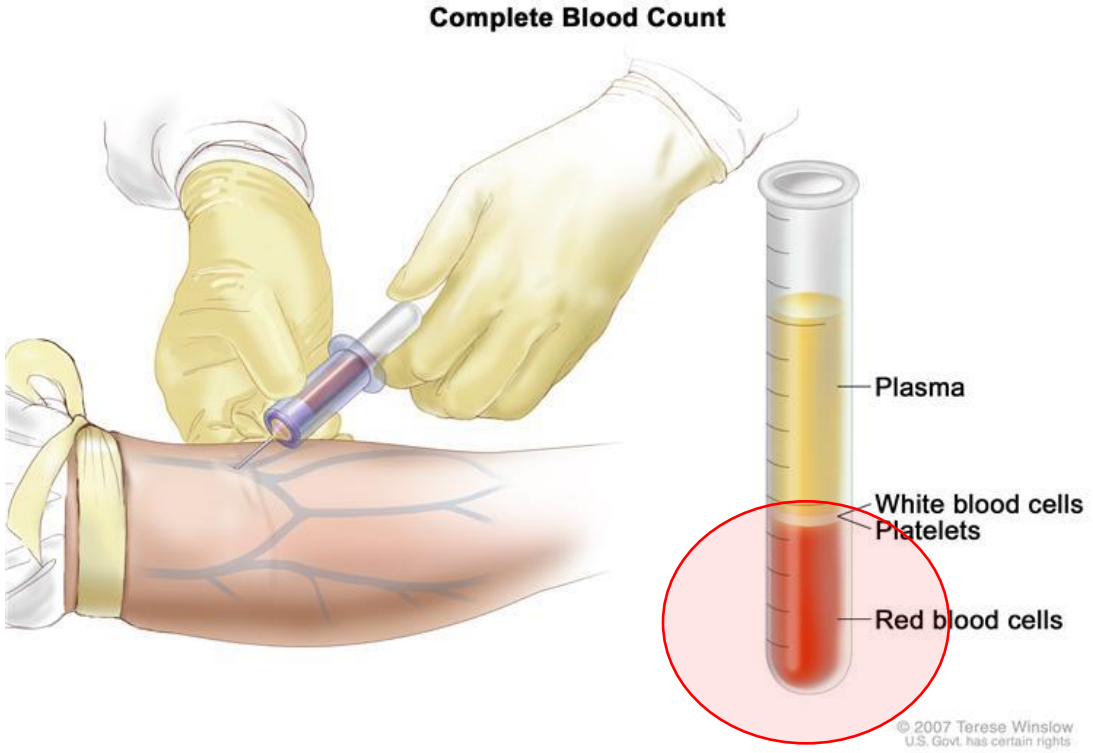
ANEMIA

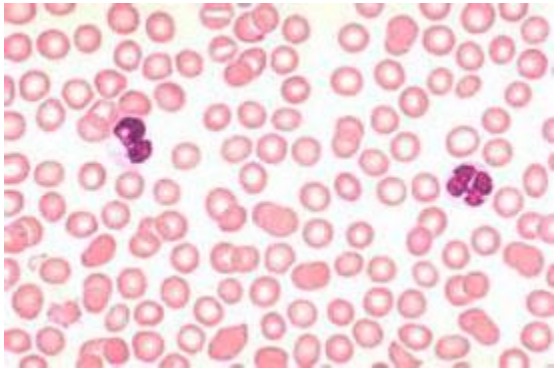
Anemia means low hemoglobin.

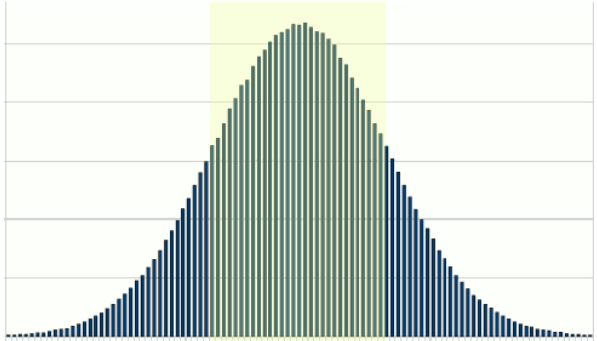


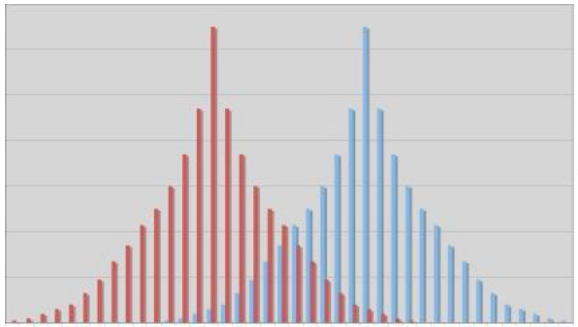
HCT	L 0.25	(0.40 - 0.51)

HEMATOCRIT

Hematocrit is the volume of blood occupied by red blood cells.







MCV	86.2	(79.0 - 97.0)
RDW	14.1	(12.0 - 15.0)

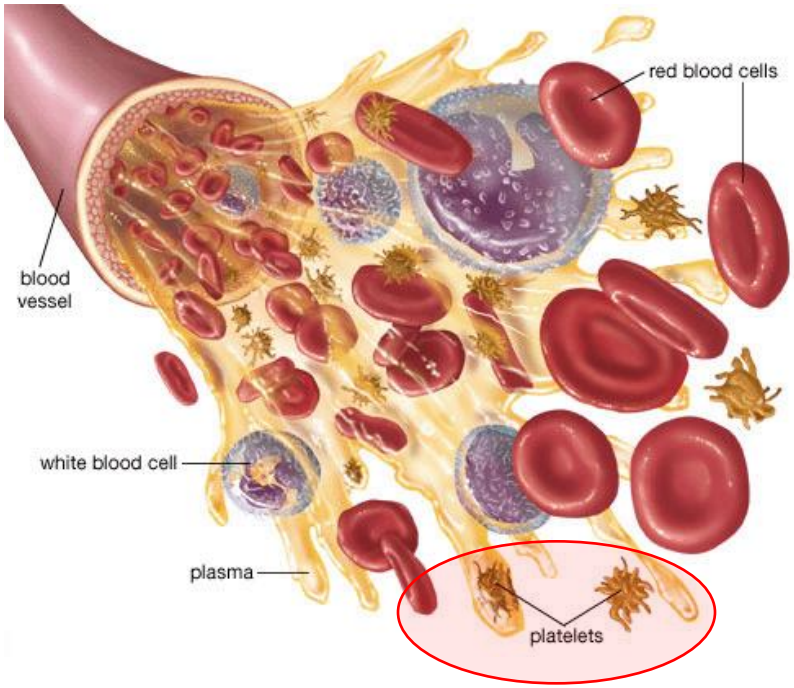
RBC INDICES

MCV = mean cell volume. This is the average size of red blood cells.

RDW = red cell distribution width. This is how variable the size of red cells are.

29 PLATELETS

What are platelets?



BLOOD

Platelets are also called thrombocytes

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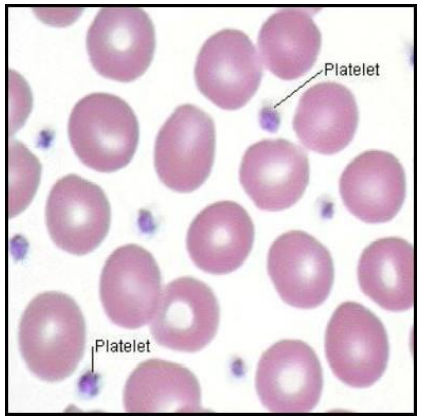
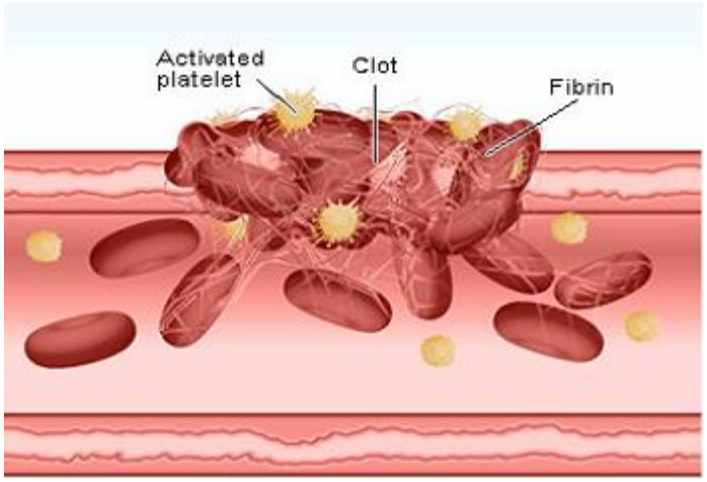
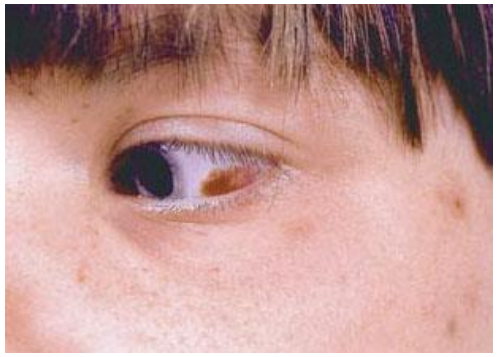
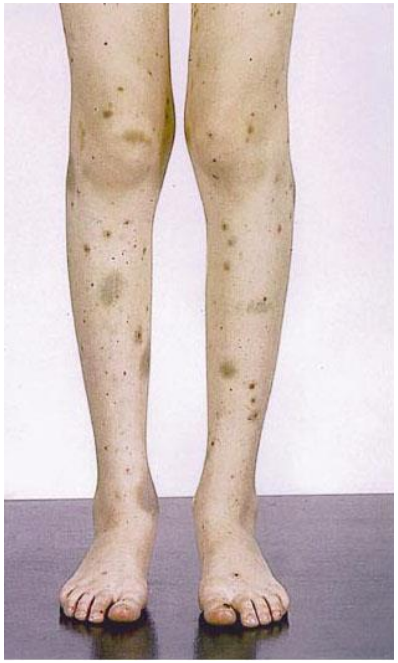




PLATELETS

Function to form a clot along with clotting factors





LOW PLATELETS

Low platelets lead to easy bleeding and bruising

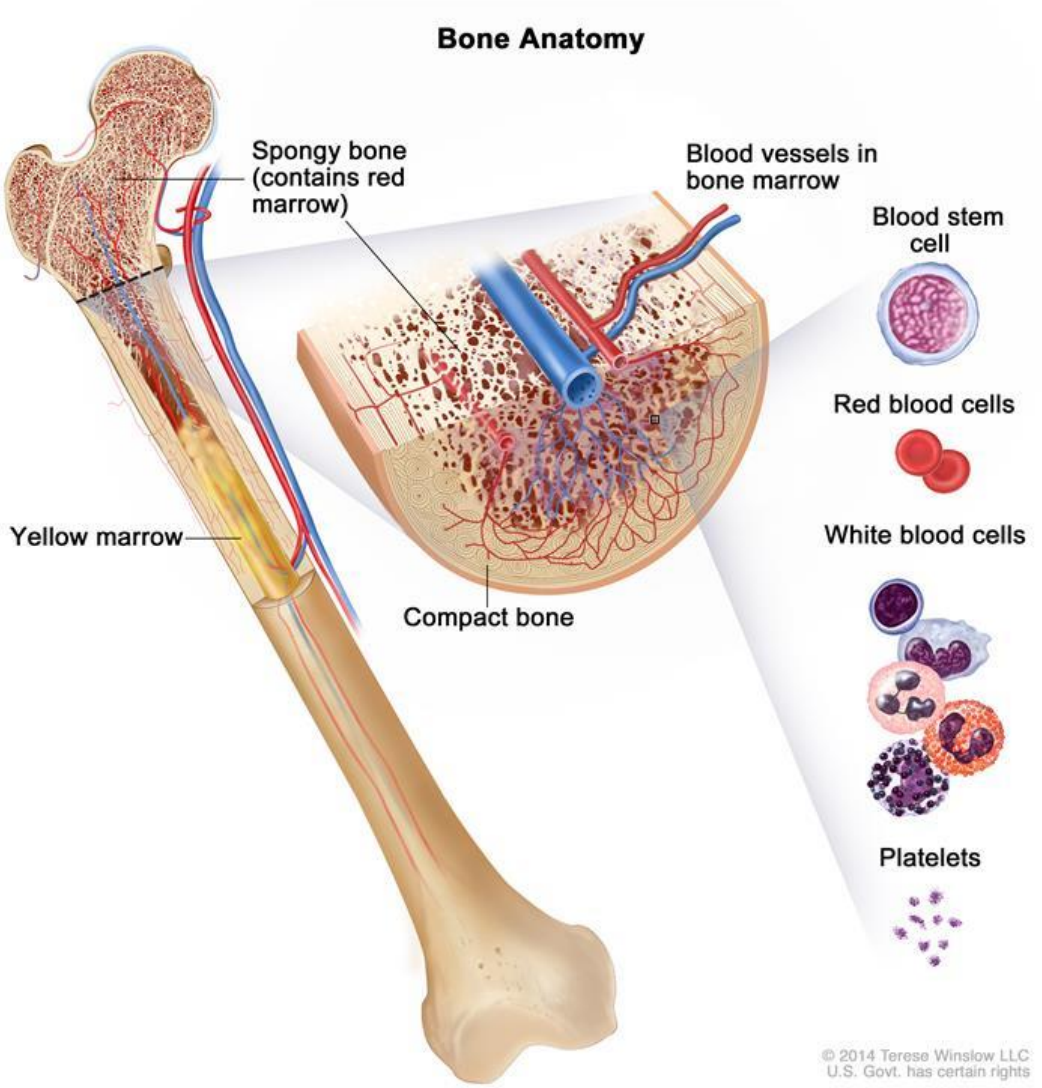
WHERE DO ALL THESE BLOOD CELLS COME FROM?

The factory..

34 BONE MARROW

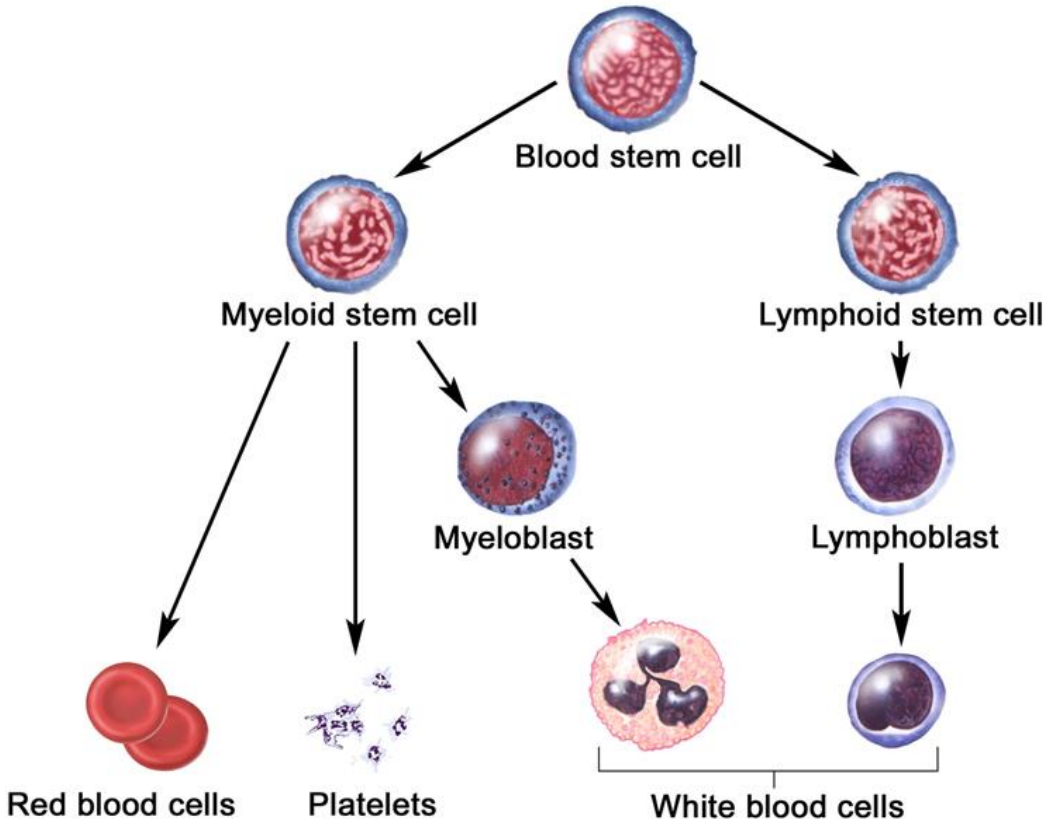
Where do all of our blood cells come from?

April 18, 2020 C. Hsia



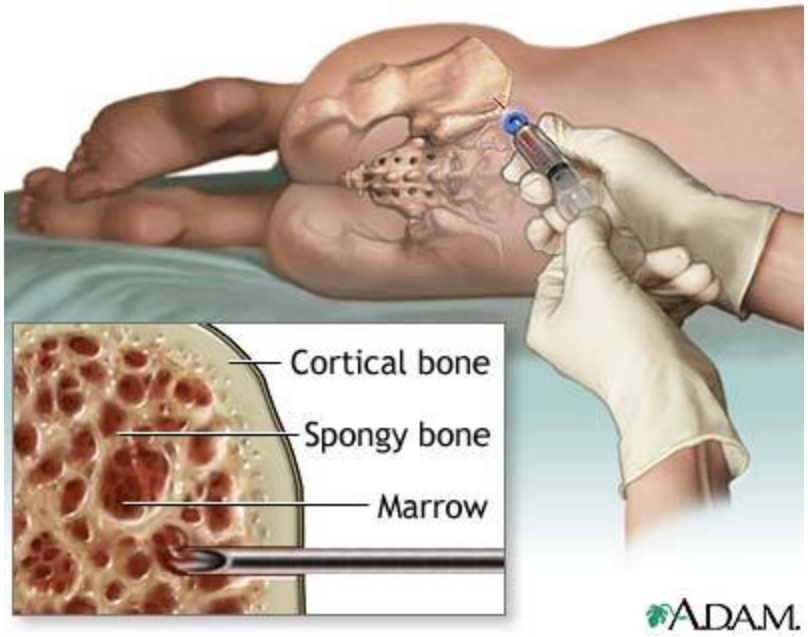
BONE MARROW

This is the factory that makes all of our blood cells..



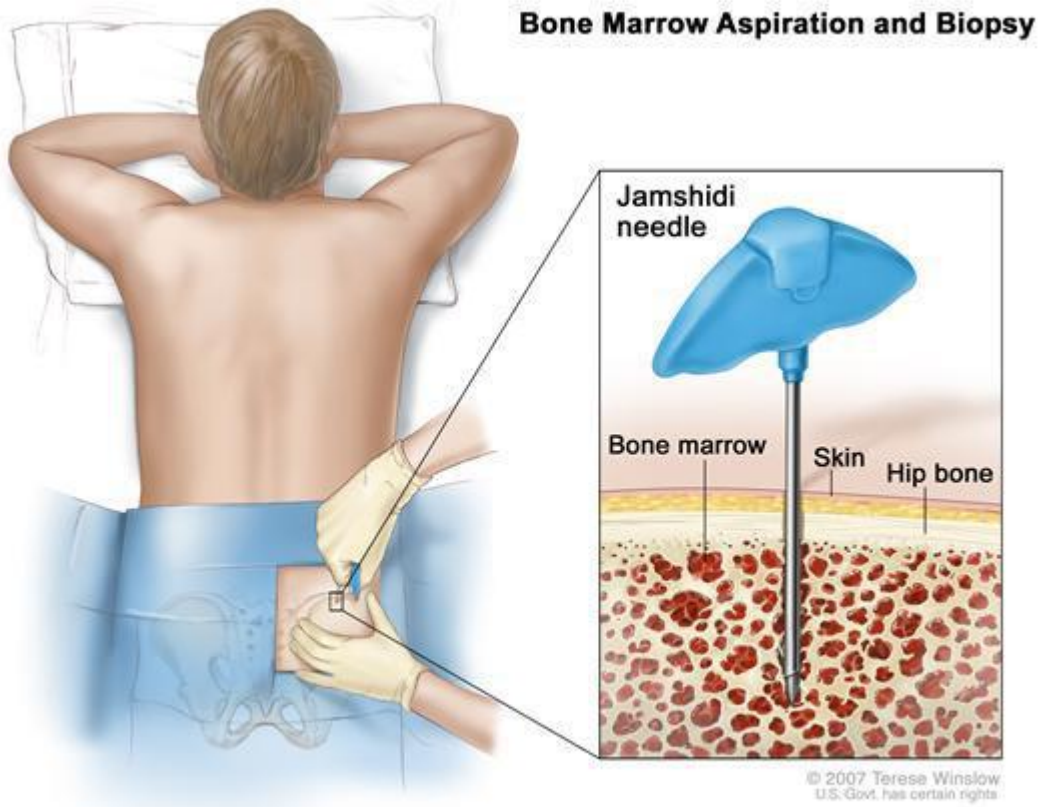
THE STEM CELL

In the bone marrow factory, all of our blood cells come from a stem cell. Stem cells divide and grow and eventually become these different blood cells.



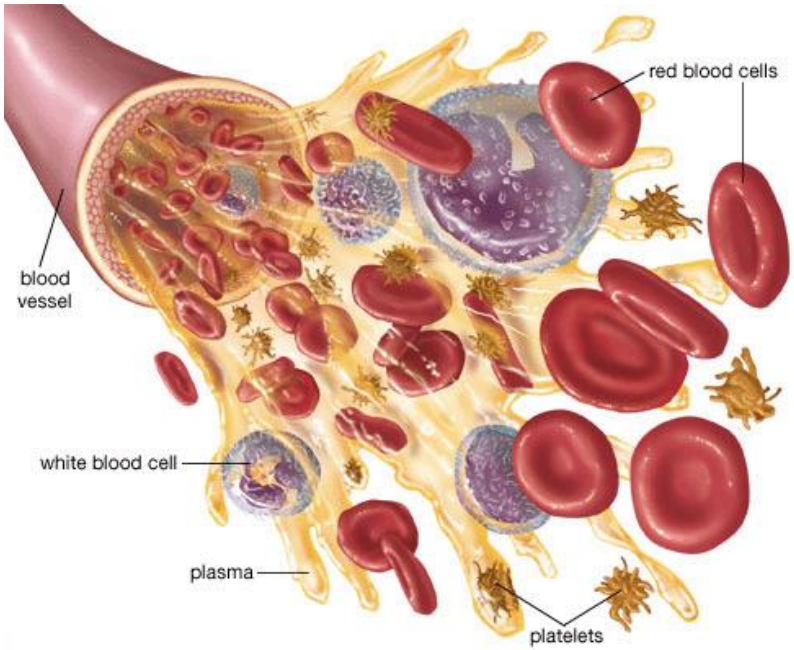
BONE MARROW

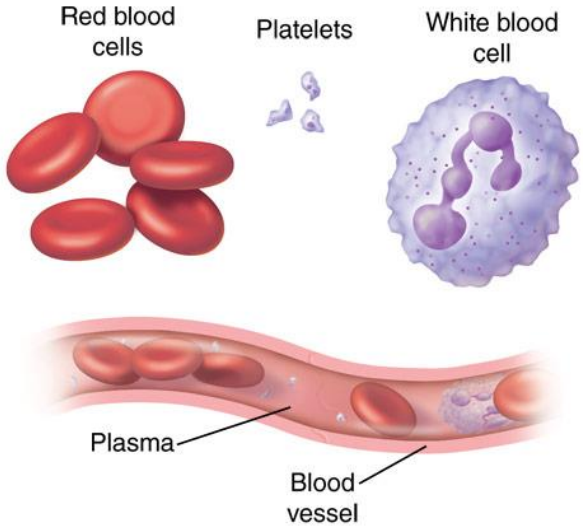
This is how we take a bone marrow sample..



BONE MARROW

This is how we take a bone marrow sample..





BLOOD

All blood cells come from the bone marrow factory.

LET'S TALK MDS

What is MDS?

MYELODYSPLASTIC SYNDROMES

- Definition
  - Myelodysplastic syndromes (MDS) form a group of clonal hematopoietic stem cell malignancies characterized by ineffective hematopoiesis in one or more cell lineages, associated peripheral cytopenias, and risk of transformation to acute myeloid leukemia

Sloand EM. Myelodysplastic syndromes: introduction. Semin Hematolo. 2008;45:1-2. Valent P, Horny HP, Bennett JM, et al. Leuk Res 2007;31:72-36.

Dr. Robert Barr and the Ford Pinto

MYELODYSPLASTIC SYNDROMES

- In other words..
  - MDS is a group of blood and bone marrow disorders (cancers) where the blood cells are made with defects and don’t survive as long as it should.
  - This leads to low blood counts in 1 or more of the blood cells.
  - It is NOT leukemia, but can be considered pre-leukemic.
  - It is NOT 1 disease and behaves differently in different people.

HOW COMMON IS MDS?

- Actual incidence very difficult to determine
  - Approx 3-4 per 100,000, much more common in elderly, approx 1 in 1000
  - Median age at diagnosis 65 – 70 years

World Health Organization Classification of Tumours. Pathology & Genetics: Tumours of Haematopoietic and Lymphoid Tissues. Edited by Elaine S. Jaffe, Nacy Lee Harris, Harald Stein, James W. Vardiman. IARC Press Lyon 2001. Silverman, LR. Modulation of the Clone: Altering the Course of Myelodysplastic Syndrome. Blood & Bone Marrow Transplantation Reviews 2006; 16(3):5-8.

WHAT CAUSES MDS?

- Causes?
  - idiopathic (meaning we don't know)
  - can be secondary to toxic exposures such as chemotherapy, radiation, environmental toxins
  - may be associated with some hereditary disorders but MDS in general is NOT hereditary

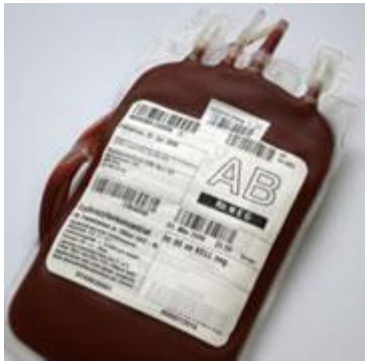
World Health Organization Classification of Tumours. Pathology & Genetics: Tumours of Haematopoietic and Lymphoid Tissues. Edited by Elaine S. Jaffe, Nacy Lee Harris, Harald Stein, James W. Vardiman. IARC Press Lyon 2001. Silverman, LR. Modulation of the Clone: Altering the Course of Myelodysplastic Syndrome. Blood & Bone Marrow Transplantation Reviews 2006; 16(3):5-8.

IMPACT OF MDS

- Patient
  - Poor quality of life - time and commitment to transfusions
  - Complications of Iron Overload
  - Cardiorespiratory symptoms
  - Hospitalizations for cardiac complications, infections, bleeding, increased risk of leukemic transformation
  - Increased risk of shorter survival
- Society
  - Transfusion burden
  - Hospitalizations for cardiac complications, infections, complications of iron overload, bleeding, leukemia

MANAGEMENT FOR MDS PATIENTS

- The mainstay of management is supportive
- Transfusions, antibiotics
  - No specific transfusion threshold, rather patient dependent based on level of hemoglobin associated with symptoms of anemia



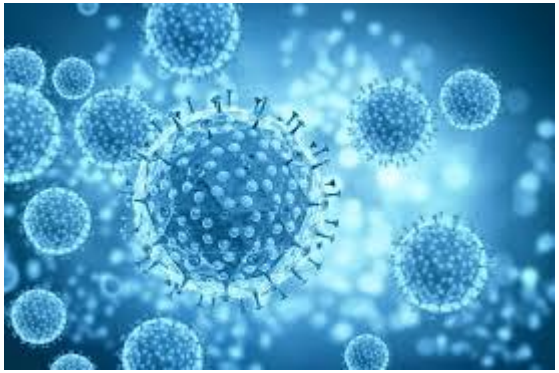
Steensma DP and Bennett JM. The Myelodysplastic Syndromes: Diagnosis and Treatment. Mayo Clin Proc. 2006;81(1):104-130.

TREATMENTS IN MDS

- It depends on the type of MDS you have and how fit you are
- Lower risk MDS
  - Transfusions and other supportive care
  - Erythropoietin (EPO) – if your body is not producing enough
  - Iron chelation therapy – if you have too much iron from transfusions
  - Revlimid (lenalidomide) – if you have the 5q deletion
- Higher risk MDS
  - Transfusions and other supportive care
  - Stem Cell Transplant - Reserved for the “younger” patient with severe disease
  - Vidaza (azacytidine) – For patients who can come to the cancer centre 7 days every 28 days

Steensma DP and Bennett JM. The Myelodysplastic Syndromes: Diagnosis and Treatment. Mayo Clin Proc. 2006;81(1):104-130.

Bone marrow factory - The future



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COVID-19

What does it mean in patients with MDS?

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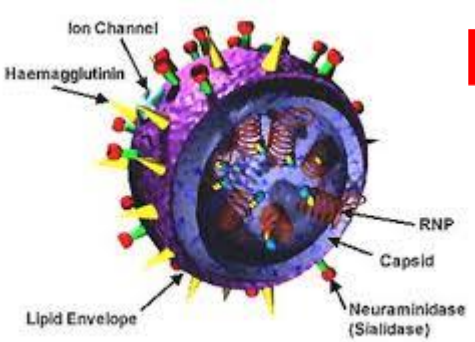
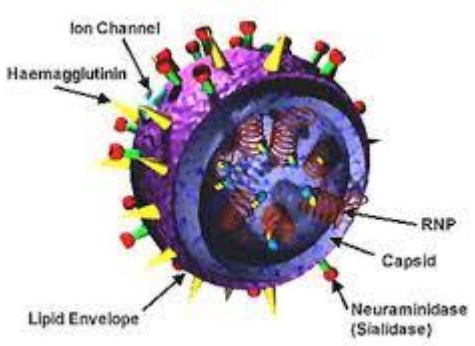
COVID-19



- Coronaviruses are a large family of viruses. Some cause illness in people and others cause illness in animals. Human coronaviruses are common and are typically associated with mild illnesses, similar to the common cold.
- COVID-19 is a new disease that has not been previously identified in humans. Rarely, animal coronaviruses can infect people, and more rarely, these can then spread from person to person through close contact.
- Human coronaviruses cause infections of the nose, throat and lungs. They are most commonly spread from an infected person through:
  - respiratory droplets generated when you cough or sneeze
  - close, prolonged personal contact, such as touching or shaking hands
  - touching something with the virus on it, then touching your mouth, nose or eyes before washing your hands
- Current evidence suggests person-to-person spread is efficient when there is close contact.

https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection/symptoms.html?topic=ex-col-faq#a

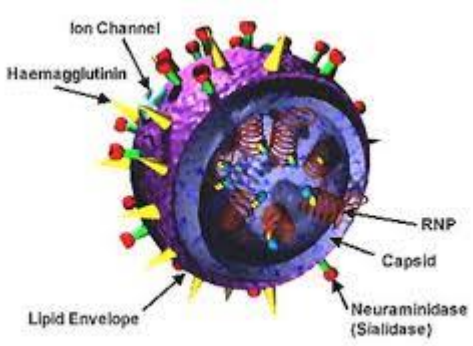
COVID-19



- A pneumonia of unknown cause detected in Wuhan, China was first reported to the WHO Country Office in China on 31 December 2019.
- WHO is working 24/7 to analyse data, provide advice, coordinate with partners, help countries prepare, increase supplies and manage expert networks.
- The outbreak was declared a Public Health Emergency of International Concern on 30 January 2020.
- The international community has asked for US$675 million to help protect states with weaker health systems as part of its Strategic Preparedness and Response Plan.
- On 11 February 2020, WHO announced a name for the new coronavirus disease: COVID-19.

https://www.who.int/emergencies/diseases/novel-coronavirus-2019/events-as-they-happen

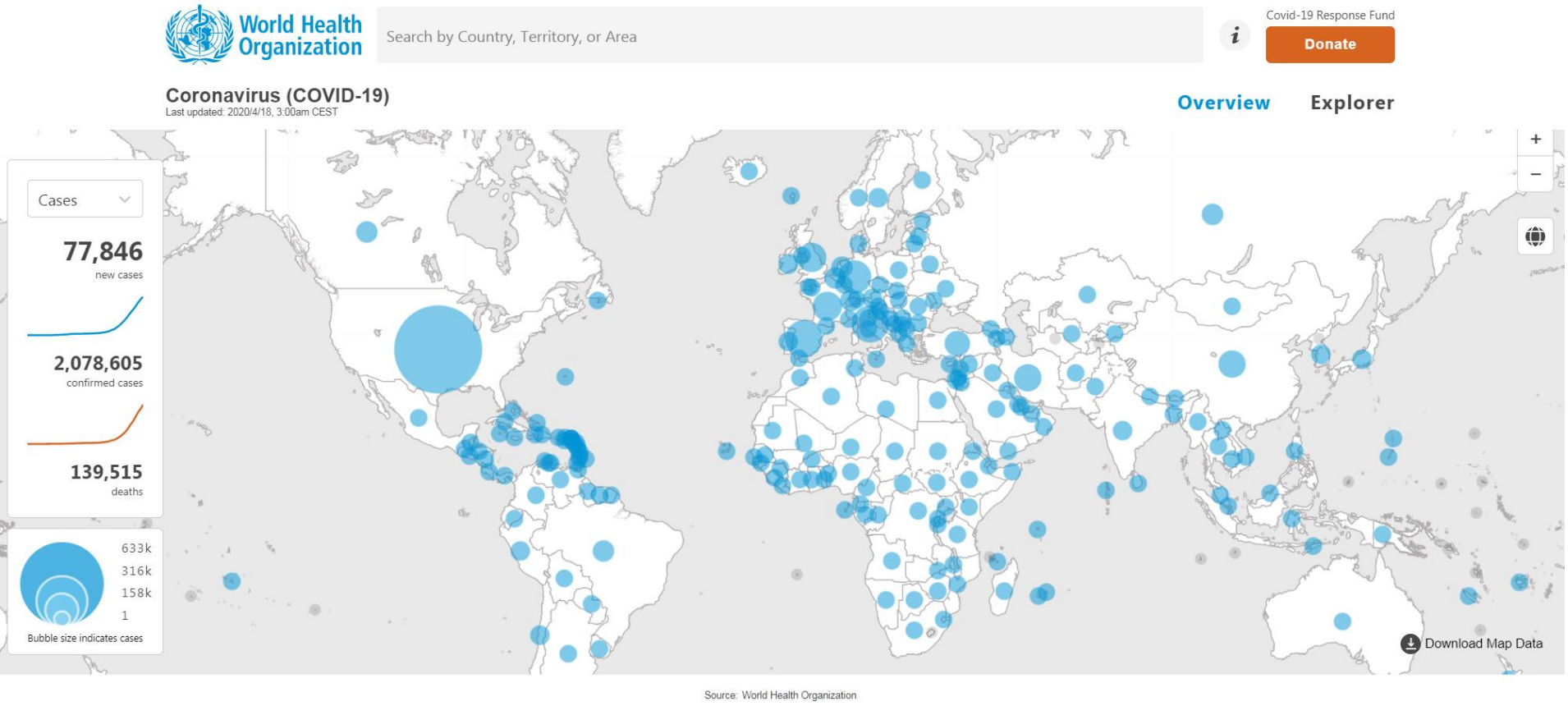
COVID-19



- COVID-19: Disease name
  - COrona Virus Infectious Disease-19
- SARS-COV-2: Virus itself
  - Causative agent of COVID-19
- HCoV-19 –Human Coronavirus-19 (old name)
  - SARS-COV: Severe Acute Respiratory Syndrome -COronaVirus
  - Causative agent of SARS (outbreak 2002 –2003)

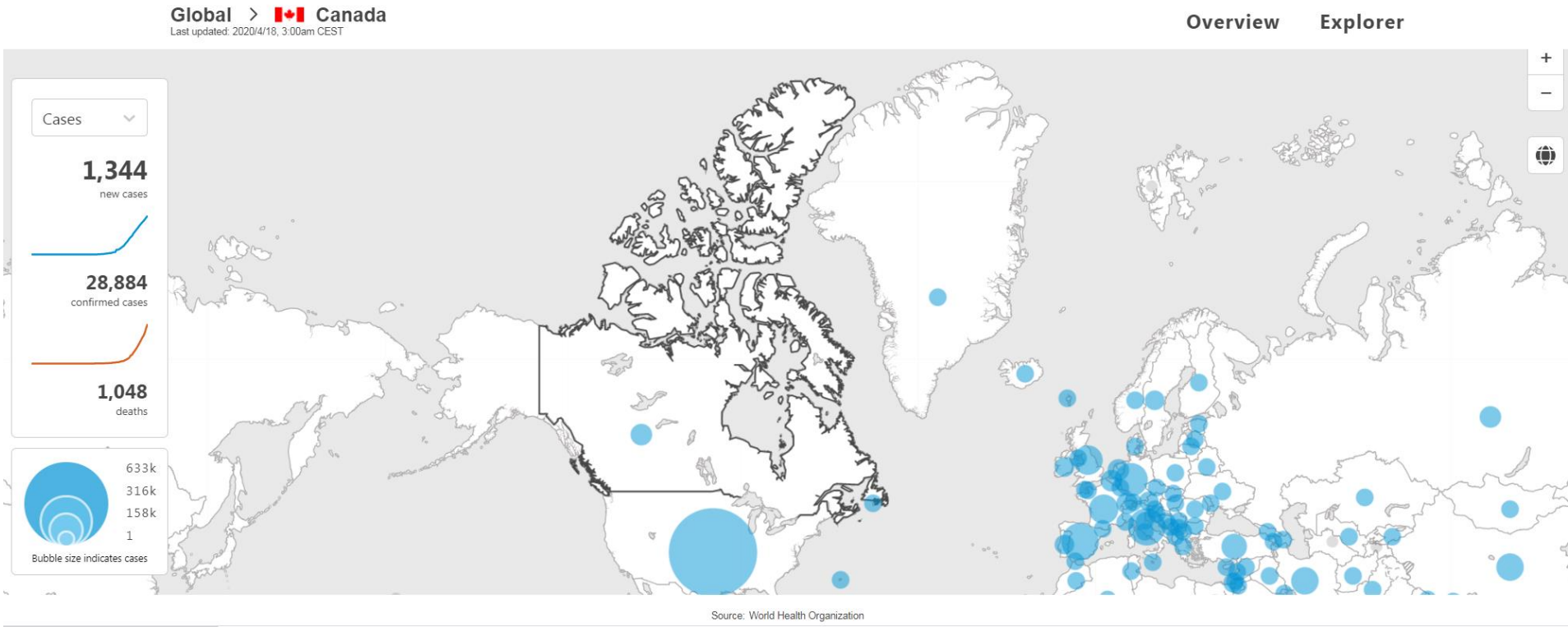
Lu et al.Genomic characterizationand epidemiology of 2019 novel coronavirus: implications for virus origins and receptor Binding. Lancet 2020

COVID-19 WORLD



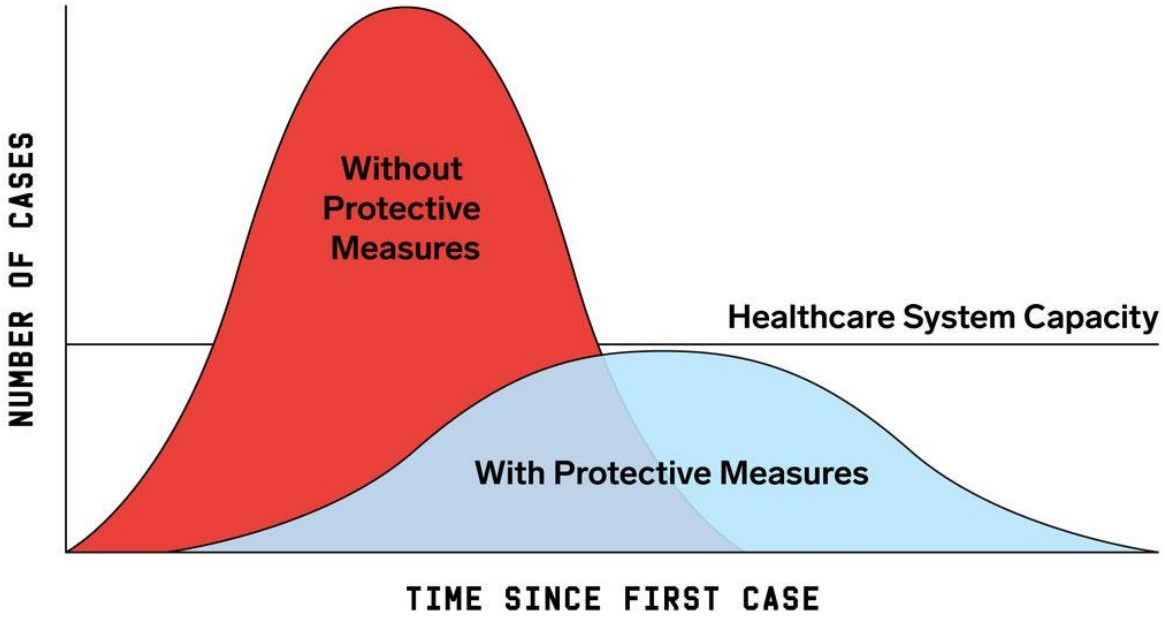
https://www.who.int/emergencies/diseases/novel-coronavirus-2019/events-as-they-happen

COVID-19 CANADA

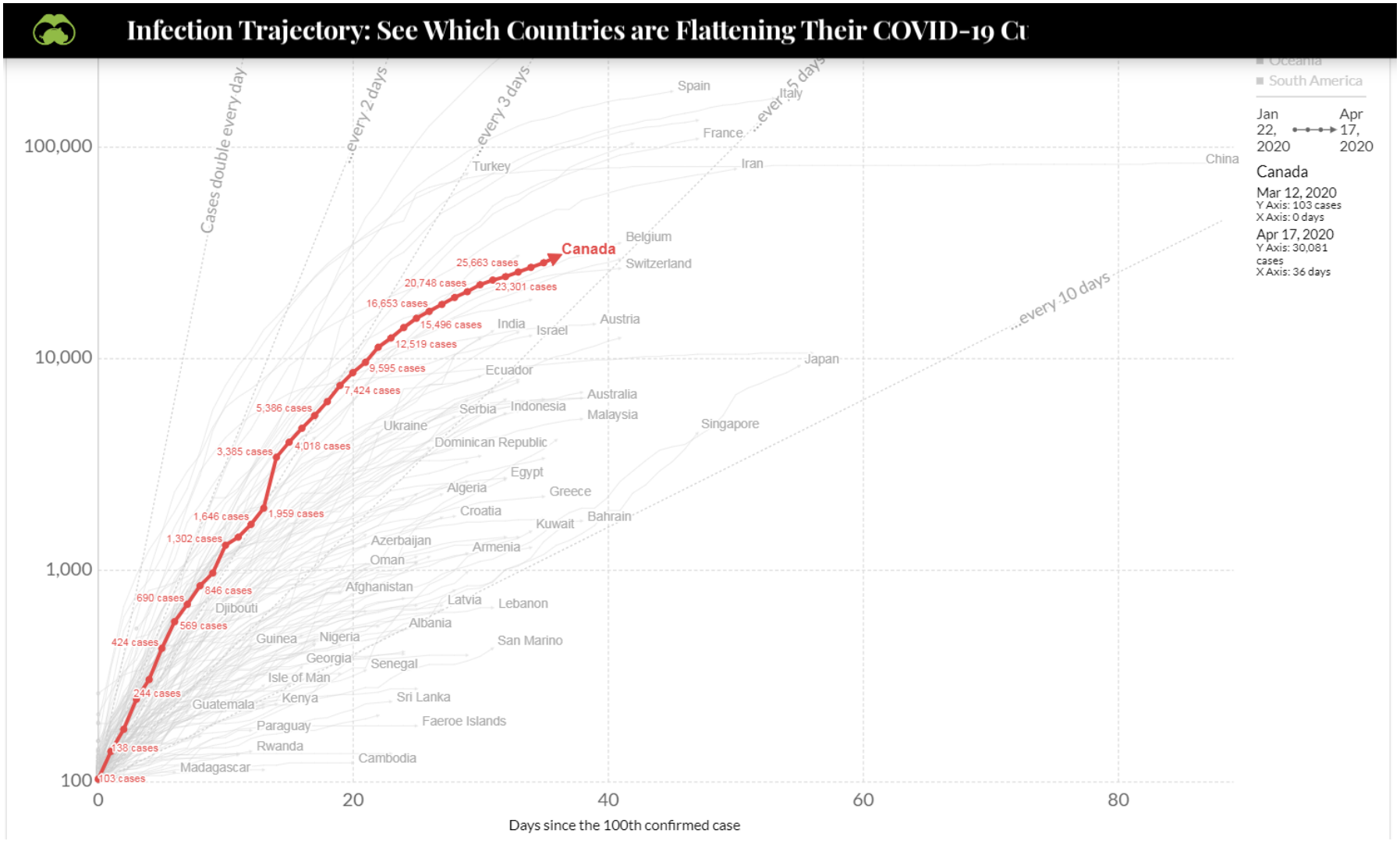


https://www.who.int/emergencies/diseases/novel-coronavirus-2019/events-as-they-happen

FLATTENING THE CURVE



https://www.wired.com/story/whats-social-distancing-flattening-curve-covid-19-questions/



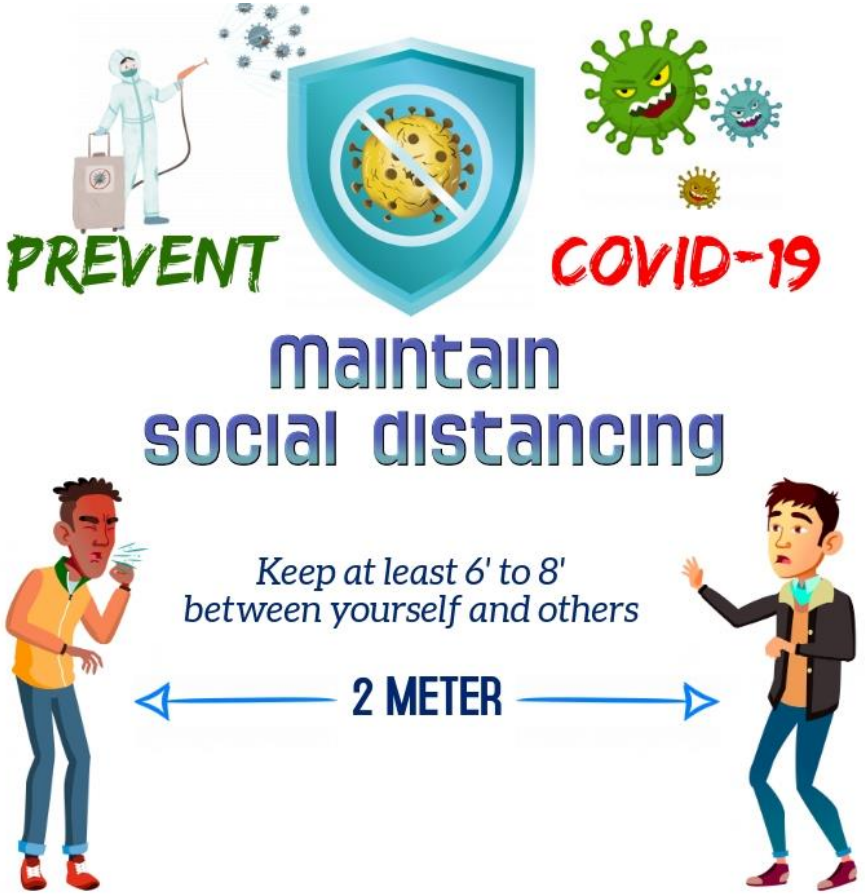
https://www.visualcapitalist.com/infection-trajectory-flattening-the-covid19-curve/

PREVENTIVE MEASURES

- In an effort to prevent the spread of COVID-19 within communities and across the country, all Canadians are advised to:
  - stay at home unless you have to go to work
  - talk to your employer about working at home if possible
  - avoid all non-essential trips in your community
  - do not gather in groups
  - limit contact with people at higher risk, such as older adults and those in poor health
  - go outside to exercise but stay close to home
  - if you leave your home, always keep a distance of at least 2 arms lengths (approximately 2 metres) from others
  - household contacts (people you live with) do not need to distance from each other unless they are sick or have travelled in the last 14 days

https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection/symptoms.html?topic=ex-col-faq#a

PREVENTIVE MEASURES



https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection/symptoms.html?topic=ex-col-faq#a

PREVENTIVE MEASURES

- Hygiene: Proper hygiene can help reduce the risk of infection or spreading infection to others:
  - wash your hands often with soap and water for at least 20 seconds, especially after using the washroom and when preparing food
  - use alcohol-based hand sanitizer if soap and water are not available
  - when coughing or sneezing:
  - cough or sneeze into a tissue or the bend of your arm, not your hand
  - dispose of any tissues you have used as soon as possible in a lined waste basket and wash your hands afterwards
  - avoid touching your eyes, nose, or mouth with unwashed hands

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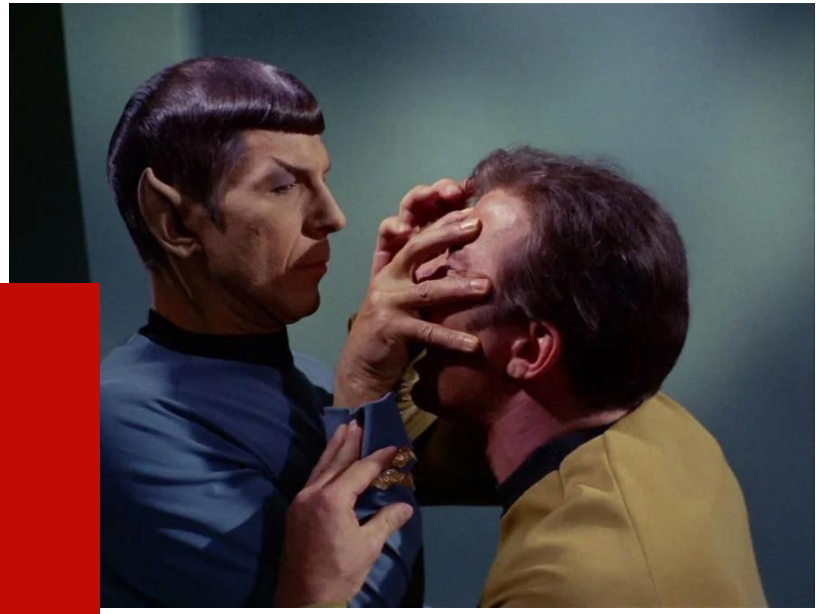
PREVENTIVE MEASURES



https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection/symptoms.html?topic=ex-col-faq#a

COVID-19 & MDS

Are patients with Myelodysplastic Syndromes (MDS) or related conditions more likely to contract COVID-19 or to get seriously ill from it?

There are no data yet indicating that patients with MDS or related conditions are more likely to contract COVID-19 than patients with fully functional bone marrows. The neutropenia and functional neutrophil defects that many patients with MDS have increase risk of bacterial and fungal infections to a much greater extent than the risk of viral infections.

That being said, preliminary studies seem to indicate a high percentage of hospitalized patients have a current or previous cancer diagnosis, and patients with MDS who have recently undergone allogeneic hematopoietic cell transplant have a markedly increased risk of viral infection and this risk is likely to extend to coronaviruses. It is thus reasonable to presume that patients with MDS, particularly those who are more lymphopenic or who have undergone transplant within the last year, are compromised in their ability to contain the virus once infected, and have a higher likelihood of hospitalization and possible need for intensive care. Neutropenia may also increase the risk of a secondary bacterial infection after viral infection.

The American Society of Hematology (ASH)
https://www.hematology.org/covid-19/covid-19-and-myelodysplastic-syndromes

COVID-19 & MDS

Should the approach to therapy in patients with MDS and related conditions be altered? (starting treatment, choice of treatment, transplant considerations)

Patients with higher-risk MDS (IPSS-R score of >3.5) should still be started on therapy with a hypomethylating agent without delay, and without dose adjustment. Those already on such therapy with adequate tolerance and clinical response should continue, given the relapse risk if hypomethylating agents are discontinued. It is unclear if hypomethylating agents influence the clinical course of COVID-19 infection; hypomethylating agents do alter cellular type 1 interferon response, which could hypothetically alter replication of or cellular response to viruses, but there is no evidence of clinical significance of this observation.

For patients with lower-risk MDS (IPSS-R score <3.5), goals of therapy are to minimize transfusions and improve quality of life. In these patients, treatments that risk compromising the immune system can reasonably be delayed. Therapy that results in increased contact with a health care environment (e.g., with frequent laboratory draws for monitoring or visits for injections) can be delayed. Therapies that reduce transfusion needs (such as erythropoiesis stimulating agents) may result in a net decrease of health care visits and potential viral exposure, and thus can be considered.

For some patients, such as those for whom hypomethylating agents have failed, clinical trials may represent the only treatment option. Such trials should continue to be pursued on a case-by-case basis.

Allogeneic transplant may still be feasible, but it may be difficult to obtain donor cells from unrelated donors, especially from outside the United States. Some institutions may need to delay allogeneic transplants due to lack of available hospital beds, particularly in intensive care units, but this may increase risk of disease progression.

The American Society of Hematology (ASH)
https://www.hematology.org/covid-19/covid-19-and-myelodysplastic-syndromes

COVID-19 & MDS

Should transfusion thresholds be altered in patients with MDS and related conditions?

Given evolving shortages in blood products in many locations, it is reasonable to attempt to increase transfusion intervals and lower transfusion thresholds for red blood cells to a hemoglobin of 7 g/dl or lower for patients with MDS who will tolerate this. This may need to be modified for symptomatic patients or those with certain comorbidities such as severe cardiopulmonary disease. Platelets should be transfused for levels 10 x 109/L or lower, or for symptomatic bleeding, as per usual care. At this time there is no evidence that COVID-19 can be transmitted in blood products.

Should frequency of visits for patients with MDS and related conditions be changed?

Acknowledging that patients with MDS and related conditions often have a significantly compromised bone marrow and require frequent transfusions and assessments, if at all possible face-to-face visits and laboratory checks should be reduced or eliminated. MDS patients and those with related conditions who are being followed with a "watch and wait" approach can have visits delayed until after the risk of COVID-19 decreases, or spaced out so that they occur less frequently. For those receiving active therapy, it may not be possible to alter visit frequency, as regular monitoring of blood counts is still medically necessary. In these patients, laboratory visits should continue, but direct examinations can be minimized or eliminated on a case-by-case basis.

The American Society of Hematology (ASH)
https://www.hematology.org/covid-19/covid-19-and-myelodysplastic-syndromes

COVID-19 & MDS

Should the management of a patient calling with neutropenic fever be altered during the current pandemic?

MDS patients with febrile neutropenia remain at increased risk for life-threatening infections. Clinical assessment in the standard timelines remains appropriate with access to antibiotics as appropriate. Testing of COVID-19 should remain symptom-driven in patients with new respiratory symptoms (fever, cough, shortness of breath, sore throat.) Acetaminophen is preferable to ibuprofen for reducing a fever.

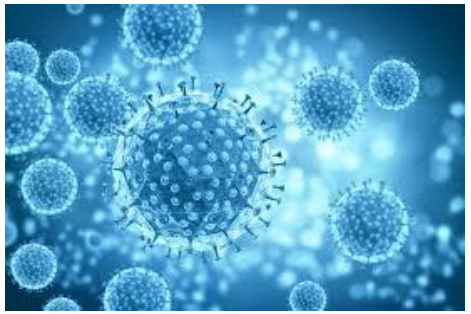
Should MDS patients and those with related conditions (for example, those with Del (5q) being treated with lenalidomide) stockpile medications?

At the time of these recommendations, there have not been reported medication shortages specific to patients with MDS and related conditions. There is not a process in place to supply a medication amount greater than typical monthly supplies.

For additional information, see:

- AAMDS
- MDS foundation

The American Society of Hematology (ASH)
https://www.hematology.org/covid-19/covid-19-and-myelodysplastic-syndromes



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HOW CAN YOU PARTICIPATE IN RESEARCH?

Consider enrolling in a registry

American Society *of* Hematology

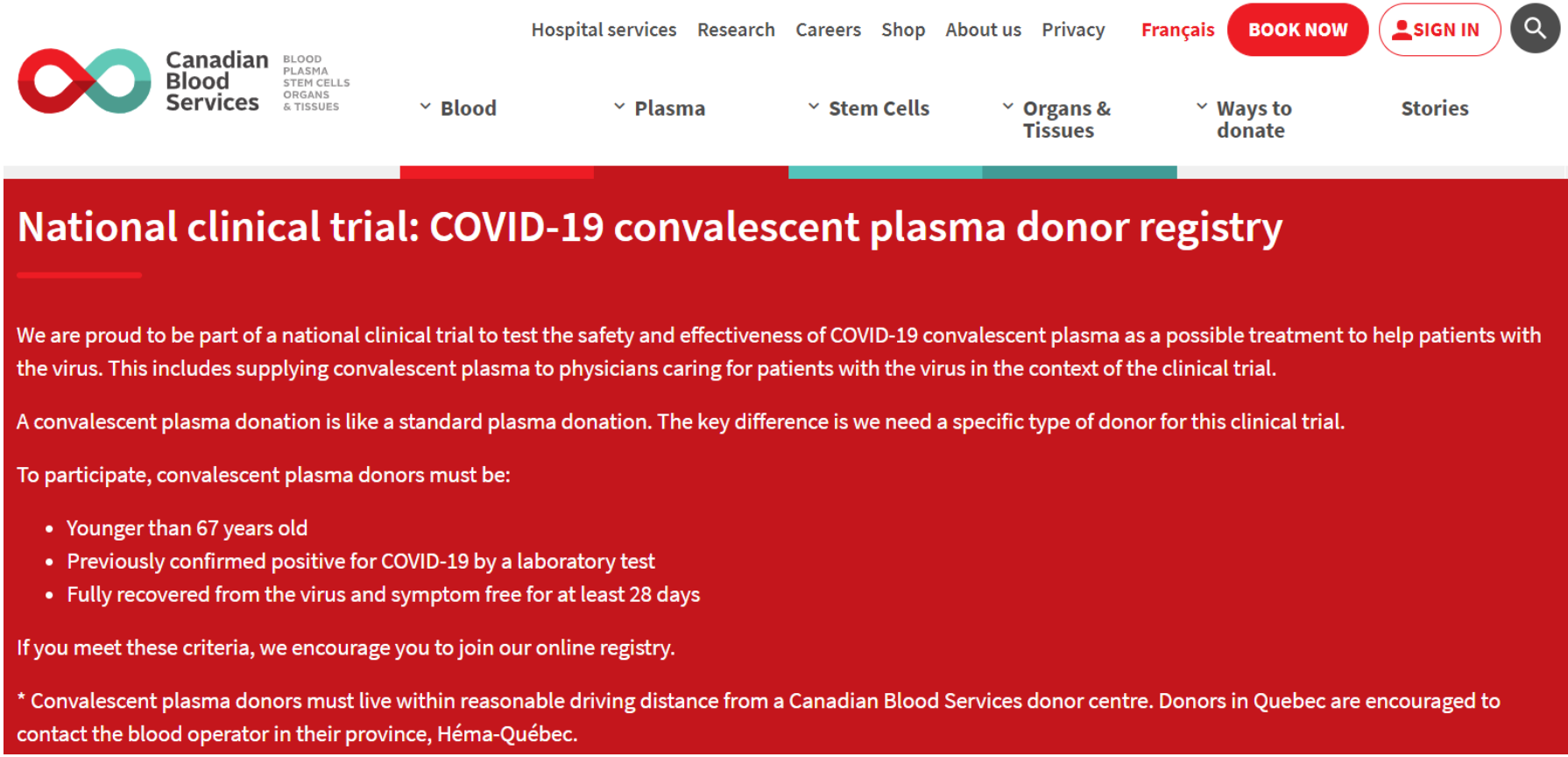
Helping hematologists conquer blood diseases worldwide

ASH Research Collaborative's Data Hub Creates International Data Registry to Help Inform Care for People with Blood Cancers and COVID-19

The ASH Research Collaborative's (ASH RC) Data Hub launched the ASH RC Data Hub COVID-19 Registry for Hematologic Malignancy, a global registry with clinical data exclusively on people with COVID-19 and a current or past diagnosis of a hematologic malignancy.

The Registry is intended to provide near real-time observational data summaries to clinicians on the front line of the COVID-19 pandemic, serving as a resource for patient care through aggregation of global experience. We invite clinicians and other health care providers worldwide to enter de-identified data on all confirmed COVID-19 cases for malignant hematology patients, regardless of recovery or active treatment status. A sample data collection case form is available, and the online data entry takes approximately 5 minutes to complete. You will need to set up a quick login that allows you to save records and complete them later.

https://www.hematology.org/covid-19/covid-19-and-myelodysplastic-syndromes



https://blood.ca/en/convalescentplasma

LET'S TAKE YOUR QUESTIONS..

- Do you have any questions about this talk?
- Do you have questions about your own blood tests and results?

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APPENDICES