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ABNORMALITIES OF THE IMMUNE SYSTEM IN CANCER PATIENTS

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BEATING CANCER IS IN OUR BLOOD.

LEUKEMIA & LYMPHOMA SOCIETY

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Immunodeficiency in Individuals with Leukemia and Lymphoma

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Outline

- Background of immunodeficiency
- Proposed evaluation of immunodeficiency
- Therapeutic options for immunodeficiency

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Categorization of Immune Components

Complement proteins	Neutrophils & phagocytes
T cells	Antibodies

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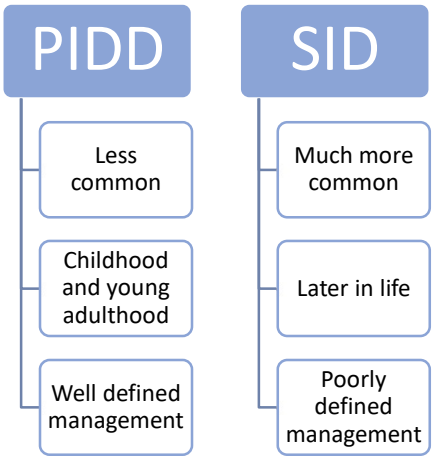
Primary Versus Secondary Immunodeficiency



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Causes of SID

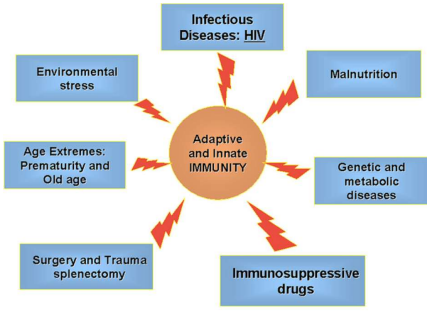

FIG 1. Secondary immunodeficiencies affecting the immune system.

- Kidney disease
- GI malabsorption
- Blood cancers
  - Multiple myeloma
  - *Non-Hodgkin's lymphoma*
  - *Chronic lymphocytic leukemia*
- Medications
  - Systemic steroids
  - Anticonvulsants
  - *Rituximab*
  - *Ibrutinib*

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Chinen. JACI 2008; 121: S388.

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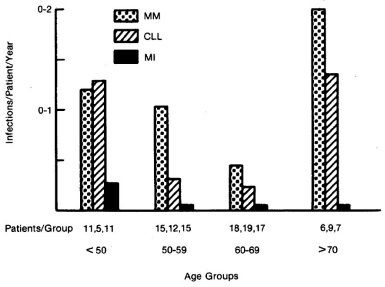
Risk of Infection

Summary of Findings*

Category	MM	CLL	MI
Total No. of patients	50	45	50
% of patients with ≥1 infection	78	84	18
Period in years under observation (average ± SD)	1.58 ± 1.4	3.17 ± 2.4	2.17 ± 3.2
Average annual infection rate	0.026	0.009	0.002
Total No. of infections	102	71	9
% of infections while receiving therapy	36	37	...
Total mortality	36	30	11
% of deaths primarily due to infections	50	63	9
Site of infection			
Pulmonary	49(9)†	36(6)	4(1)
Urinary tract	22	13	4
Ectodermal	11(1)	14	1
Septicemia	10(5)	4(4)	0
Meningitis	7(4)	1(1)	0
Miscellaneous	3	3	0
Pathogens			
Total identified	73	54	8
Pneumococcus	26(3)‡	9(2)	8
Staphylococcus	10(3)	14(6)	1
Escherichia coli	13(2)	11(3)	2
Pseudomonas	6(1)	6(5)	1
Proteus mirabilis	4(1)	7(2)	3
Haemophilus influenzae	5(2)	2	0
Klebsiella enterobacter	4(1)	2(1)	0
Streptococcus	2	2	0
Meningococcus	0	1	0
Mycobacterium tuberculosis	2	1	0
Herpes zoster	1	4	0
Moniila albicans	0	2(1)	0

* MM indicates multiple myeloma; CLL, chronic lymphocytic leukemia; MI, myocardial infarction.
† Numbers in parentheses are those in which infection was the major factor causing death.
‡ Numbers in parentheses are those in which infections were fatal.



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Twomey. Arch Int Med 1973; 132: 562.

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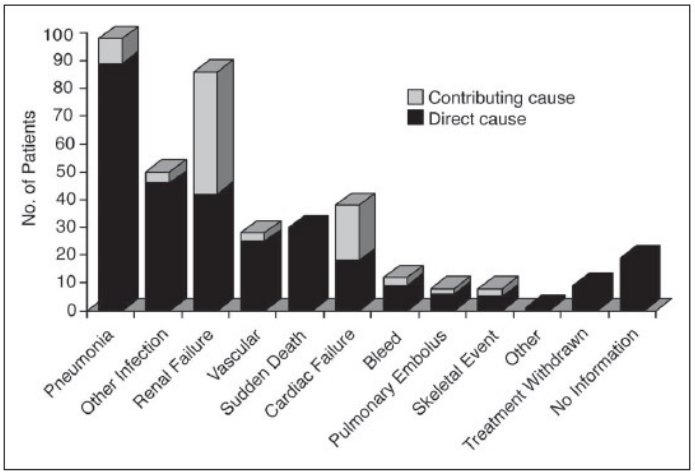
Mortality Associated with Infection



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Augustson. J of Clin Onc 2005; 23(36): 9119.

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Current State

Infection

↓

Pneumonia

↓

Streptococcus pneumoniae

↓

Vaccination

↓

Infection #1 Cause of Morbidity & Mortality

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Conley. Clin Immunol 1999; 93: 190.

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Vaccination in CLL/NHL

Vaccines lead to antibody production

↓

B cells make antibodies

↓

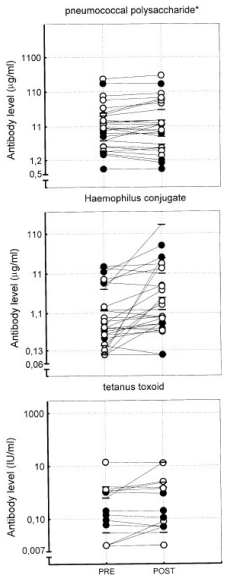
CLL and NHL are B cell cancers

↓

B cells are dysfunctional in CLL and NHL

↓

Patients with CLL and NHL have suboptimal antibody response



Sinisalo. Brit J of Heme 2001; 114: 107.

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Prophylactic Antibiotics

- Minimal studies evaluating effectiveness
- Commonly used practice globally
- Guideline-based practice for infection prophylaxis in CLL
- Most commonly used choices are azithromycin and sulfa

Table 5. Antimicrobial Agents that Should Be Used with Caution in Patients with Multiple Myeloma

Antimicrobial agent	Comment(s)
CYP2C19 and CYP3A4 inducers (nafcilin and rifampin)	May increase metabolism of bortezomib; monitor therapy
CYP2C19 and CYP3A4 inhibitors (fluconazole, erythromycin, doxycycline, metronidazole, norfloxacin, isoniazid, and tetracycline)	May decrease metabolism of bortezomib; consider therapy modification
Drugs that prolong QT interval (macrolides [erythromycin, clarithromycin, telithromycin, azithromycin], intravenous pentamidine, quinolones [levofloxacin, moxifloxacin], and azoles [fluconazole, itraconazole, voriconazole, posaconazole])	Monitor QT interval and use with caution in patients with cardiac amyloidosis or light chain deposition disease
Nephrotoxic drugs (aminoglycosides, glycopeptides, amphotericin B, foscarnet, and immunomodulators[a])	Use alternative therapies in patients with impaired renal function
Drugs that suppress bone marrow function (linezolid, pirymethamine, and TMP-SMX)	Avoid when possible in patients with poor marrow reserve particularly after receipt of myelosuppressive therapies (including myeloablative conditioning regimens for HCT)

NOTE. HCT, hematopoietic stem cell transplantation; TMP-SMX, trimethoprim-sulfamethoxazole.
[a] Immunomodulators include cyclosporin A and tacrolimus.

Edgar. J of Clin Immunol 2018; 38: 204.

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Ig Replacement (IgR)

Immunoglobulin prophylaxis in hematological malignancies and hematopoietic stem cell transplantation (Review)

Raanani P, Gafter-Gvili A, Paul M, Ben-Bassat I, Leibovici L, Shpilberg O

Main results

Forty trials were included: thirty included HSCT patients and ten included patients LPD. When polyvalent immunoglobulins or hyperimmune cytomegalovirus (CMV)-IVIG was compared to control for HSCT, there was no difference in all-cause mortality. Polyvalent immunoglobulins significantly reduced the risk for interstitial pneumonitis but increased the risk for veno-occlusive disease and adverse events. In LPD, no benefit in terms of mortality IVIG could be demonstrated but there was a decrease in clinically and microbiologically documented infections.

Authors' conclusions

In patients undergoing HSCT, routine prophylaxis with IVIG is not supported. Its use may be considered in LPD patients with hypogammaglobulinemia and recurrent infections, for reduction of clinically documented infections.

Indication. Recurrent or severe infection with encapsulated bacteria despite prophylactic oral antibiotic therapy in patients with a serum IgG < 5 g/l (excluding a paraprotein).

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Raanani. Cochrane Data Syst Rev 2008. Oct 8(4): CD006501.
Oscier. Brit J of Haem 2012; 159: 541.

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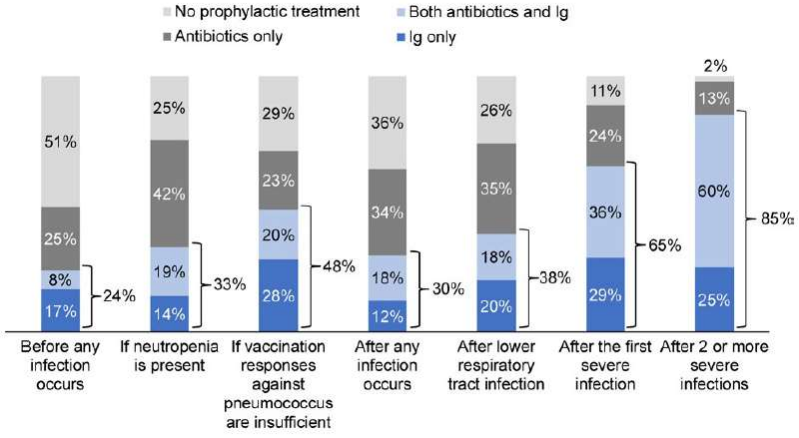
Current State



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Na. Euro J Heme 2019; 102: 447.

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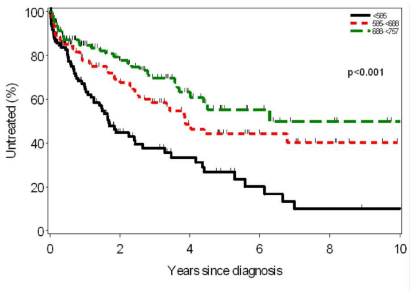
Proposed Immune Evaluation

- Antibody Level
  - IgG, IgM, IgA
- Antibody Function
  - Vaccine Responses
- T Cell Counts
  - Lymphocyte Subsets



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Parikh. Cancer 2015; 121(17): 2883.

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Original Study

Check for updates

The Use of 20% Subcutaneous Immunoglobulin Replacement Therapy in Patients With B Cell Non-Hodgkin Lymphoma With Humoral Immune Dysfunction After Treatment With Rituximab

S. Shahzad Mustafa,[1,2] Saad Jamshed,[3] Karthik Vadamalai,[4] Allison Ramsey[1,2]

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Demographics

Table 1 Demographics

Patient	Age, y	Gender	Diagnosis	Time Since Diagnosis, mos	No. Cycles of Rituximab	Time Since Rituximab, mos	Concurrent Chemotherapy
1	71	M	Lymphoplasmatic lymphoma	49	4	20	Bendamustine
2	81	M	Follicular lymphoma	93	15	11	Bendamustine
3	66	F	Diffuse large B cell lymphoma	10	6	7	CHOP
4	73	F	Diffuse large B cell lymphoma	10	6	7	CHOP
5	66	F	Marginal zone lymphoma	16	3	13	Bendamustine
6	48	M	Diffuse large B cell lymphoma	14	6	1	CHOP
7	77	M	Follicular lymphoma	13	6	9	CHOP
8	73	M	Mantle cell lymphoma	45	14	13	Bendamustine
9	72	F	Follicular lymphoma	26	4	24	None
10	47	F	Follicular lymphoma	70	18	11	Bendamustine
11	79	F	Diffuse large B cell lymphoma	13	6	8	CHOP
12	76	M	Diffuse large B cell lymphoma	20	6	16	CHOP
13	63	M	Follicular lymphoma	194	30	9	Bendamustine
14	68	M	Lymphoplasmatic lymphoma	18	9	3	Bendamustine
15	58	F	Follicular lymphoma	12	6	3	Bendamustine

Abbreviations: CHOP = cyclophosphamide, doxorubicin, vincristine, and prednisone; F = female; M = male.

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Mustafa. Clin Lymph Myel Leuk 2020; 20(19): e590.

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Immune Evaluation

Table 2 Ig Levels and Vaccine Responses

				Diphtheria IgG, IU/mL			Tetanus IgG, IU/mL			Streptococcus Pneumoniae Protective Serotypes (≥ 1.3 mcg/mL)		
Patient	IgG, mg/dL	gM, mg/dL	IgA, mg/dL	Pre-vaccine	Post-vaccine	Responder	Pre-vaccine	Post-vaccine	Responder	Pre-vaccine	Post-vaccine	Responder
1	334	311	57	0.01	0.01	No	0.74	0.77	no	1	1	No
2	1161	52	194	0.01	0.02	No	0.01	0.01	no	13	17	Yes
3	677	19	129	0.15	0.24	No	1.19	1.16	no	6	6	No
4	491	12	122	0.01	0.01	No	1.28	1.3	no	1	0	No
5	661	991	59	0.06	0.04	No	7.00	7.00	no	4	5	No
6	875	59	210	0.20	0.38	No	1.46	2.15	no	1	7	No
7	650	27	176	0.10	0.22	Yes	1.82	2.37	no	19	21	Yes
8	759	38	89	0.21	0.15	No	0.82	0.93	no	6	8	No
9	517	81	106	0.04	3.00	Yes	1.05	5.87	yes	2	4	No
10	474	13	121	0.15	0.19	No	1.05	0.86	no	1	5	No
11	542	34	75	0.01	0.01	No	0.19	0.19	no	3	3	No
12	768	76	121	0.21	0.57	Yes	1.78	2.29	no	14	17	Yes
13	487	18	235	0.57	0.67	No	0.91	0.99	no	1	1	No
14	444	16	1037	0.42	0.35	No	2.12	3.37	no	6	6	No
15	628	48	35	0.15	0.12	No	2.82	2.7	no	3	3	No
Median (IQR)	628 (489-718)	38 (19-68)	121 (82-185)	0.15 (0.03-0.21)	0.21 (0.06-0.37)	3/15 (20%)	1.19 (0.87-1.80)	1.73 (0.95-2.62)	1/15 (6.7%)	3 (1-6)	5 (3-7.5)	3/15 (20%)

Abbreviations: Ig = immunoglobulin; IQR = interquartile range; subq = subcutaneous.

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Mustafa. Clin Lymph Myel Leuk 2020; 20(19): e590.

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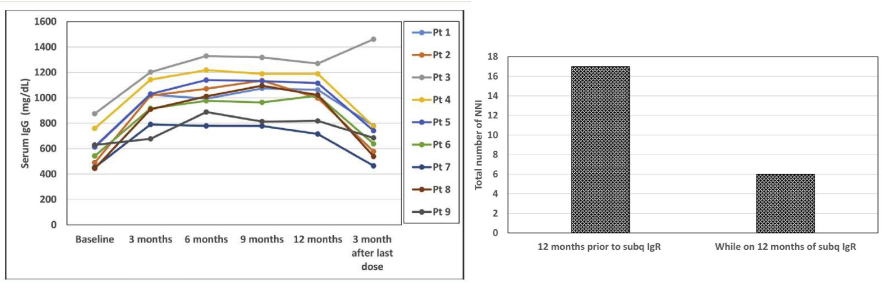
Outcomes



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PLOS ONE

RESEARCH ARTICLE

Subcutaneous immunoglobulin replacement for treatment of humoral immune dysfunction in patients with chronic lymphocytic leukemia

S. Shahzad Mustafa[1,2]*, Saad Jamshed[3], Karthik Vadamalai[4], Allison Ramsey[1,2]

1 Division of Allergy, Immunology, Rheumatology, Rochester Regional Health, Rochester, New York, United States of America, **2** Division of Allergy, Immunology, Rheumatology, University of Rochester School of Medicine & Dentistry, Rochester, New York, United States of America, **3** Division of Hematology and Oncology, Rochester Regional Health, Rochester, New York, United States of America, **4** Division of Critical Care, Mercy Hospital, Springfield, Missouri, United States of America

* shahzad.mustafa@rochesterregional.org

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Demographics

Table 1. Demographics.

Patient	Age	Sex	Time since diagnosis (years)	NNI treated with antibiotics (previous 6 months)	Current treatment	Previous treatment
1	68	M	14.6	5	Ibrutinib	Fludarabine + rituximab in 2011, rituximab in 2013, bendamustine + cyclophosphamide in 2014
2	75	F	8.3	3	None	None
3	76	M	18.4	1	None	None
4	68	M	20.4	2	None	None
5	66	F	1.8	0	None	None
6	68	M	15.8	0	None	Radiation to tonsil bed
7	71	M	0.5	2	None	None
8	70	M	23.0	0	None	Fludarabine 2003–1013, fludarabine + cyclophosphamide + rituximab 2012–2013
9	56	M	1.8	0	None	None
10	69	M	0.3	1	None	None
11	75	M	3.4	0	None	None
12	79	M	4.3	1	None	None
13	62	M	4.4	2	None	None
14	86	M	4.3	0	None	None
15	53	M	4.7	0	None	Vincristine + cyclophosphamide + rituximab 2012–2013, bendamustine + rituximab 2014–2015, ublituximab + umbralisib 2019

NNI: non-neutropenic infection.

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Immune Evaluation

				Tetanus IgG, (IU/mL)			Diphtheria IgG, (IU/ml)			Streptococcus Pneumoniae Protective Serotypes (≥ 1.3 mcg/ml)		
Patient	IgG, (mg/dL)	IgM, (mg/dL)	IgA, (mg/dL)	Pre-vaccine	Post-vaccine	Responder	Pre-vaccine	Post-vaccine	Responder	Pre-vaccine	Post-vaccine	Responder
1	559	48	98	0.72	0.61	No	0.05	0.04	No	10	9	No
2	443	45	65	1.21	2.98	Yes	0.11	0.34	Yes	7	11	No
3	419	16	43	0.40	0.41	No	0.02	0.03	No	2	2	No
4	684	41	167	1.79	2.03	No	0.16	0.14	No	9	7	No
5	831	44	100	1.54	4.05	Yes	0.58	>3.00	Yes	8	8	No
6	977	44	175	0.98	1.09	No	0.1	0.12	No	5	7	No
7	581	12	38	0.50	2.34	Yes	0.16	0.13	No	2	2	No
8	655	120	149	1.12	0.81	No	0.2	0.19	No	9	17	Yes
9	823	79	151	1.85	6.21	Yes	0.27	1.03	Yes	3	4	No
10	808	76	225	1.07	0.94	No	0.51	0.52	No	14	14	No
11	941	60	200	1.47	1.34	No	0.44	0.92	Yes	19	20	Yes
12	788	228	254	0.10	1.24	Yes	0.02	0.14	Yes	13	16	Yes
13	494	30	57	1.88	2.35	No	<0.01	0.09	No	10	17	Yes
14	1039	42	138	1.41	6.12	Yes	<0.01	<0.01	No	18	21	Yes
15	782	32	97	1.35	2.54	No	0.05	0.1	Yes	5	3	No
Median IQR	782 (570-827)	44 (37-68)	138 (81-171)	1.21 (0.85-1.50)	2.03 (1.01-2.76)	6/15 (40%)	0.16 (0.05-0.27)	0.14 (0.1-0.34)	6/15 (40%)	9 (5-12)	9 (6-17)	5/15 (33%)

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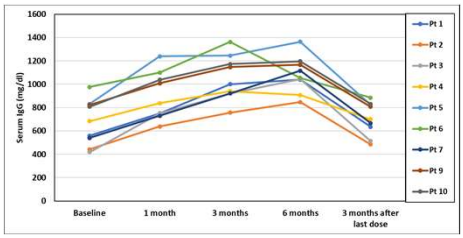
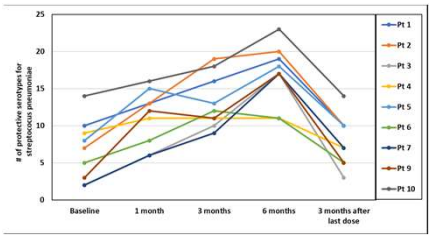
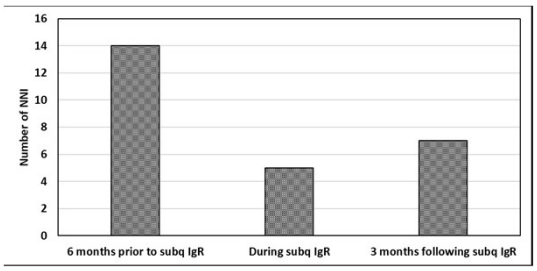
Serum IgG







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SCIg Replacement

Patient	Weight (kg)	Weekly Dose (g)	Weekly Dose (g/kg/week)	# of sites (average)	Infusion time (min) (average)	Pre-medication regimen	Adverse events
1	91	12	0.133	2.5	55	None	None
2	78	10	0.129	2.5	64	None	None
3	88	12	0.137	3	56	None	None
4	103	12	0.117	2.5	57	None	None
5	84	11	0.131	2.5	63	None	None
6	137	18	0.132	3	64	None	None
7	85	11	0.130	2.5	64	None	None
8	104	13	0.126	2.5	56	Diphenhydramine, acetaminophen	Fatigue
9	88	11	0.125	2	62	None	None
10	86	11	0.127	2	59	None	None
Median IQR	88 (85-100)	11.5 (11-12)	0.12 (0.12-0.13)	2.5	61 (56-64)		

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Ig Replacement

- Decreases rate of infections
- Decreased antibiotic dependence
- Decreased hospitalizations
- Does NOT prevent additional cancer
- Routes of administration
  - IM versus IV versus SQ

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Busse PJ. JACI 2002; 109: 1001.

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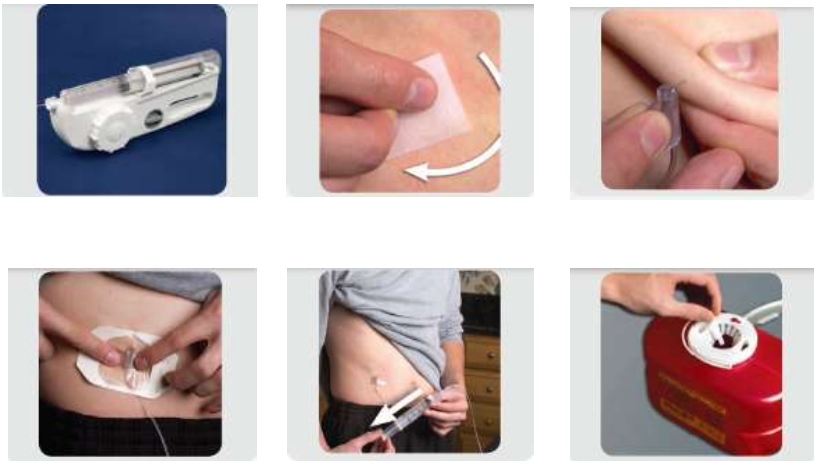
Subcutaneous Ig Replacement



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Adopted from CSL Behring Hizentra Product Monograph.

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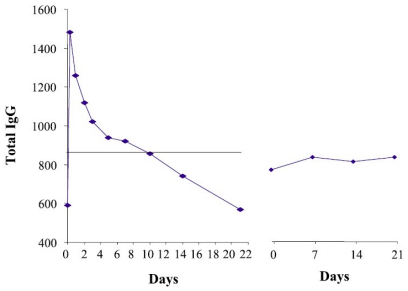
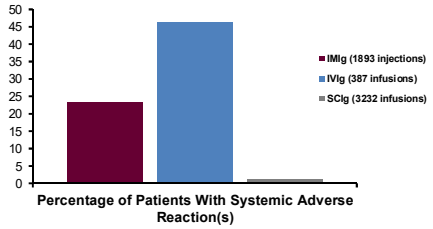
IV Versus SQ Ig Replacement





Berger. Clin Immunol 2004; 112(1): 107.
Gardulf. Lancet 1991; 338(8760): 162.

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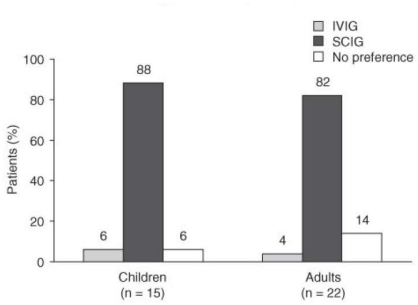
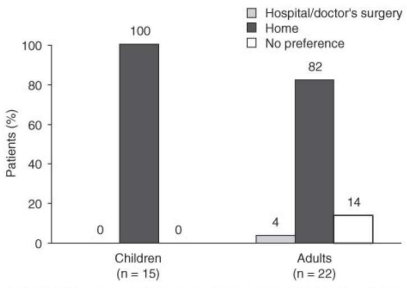
Patient Preference





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Gardulf. Biodrugs 2007; 21(2): 105.

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IV Versus SQ Pros and Cons

Advantages of Intravenous
Ability to administer large doses
Infrequent dosing *

Advantages of Subcutaneous
No need for IV access
Decreased risk of adverse reactions
Consistent levels of IgG
Increased patient autonomy

Disadvantages of Intravenous
Need for IV access
Increased risk of adverse reactions
Large variations in IgG levels
Increased use of medical resources

Disadvantages of Subcutaneous
Historically more frequent dosing *
May apply to small amount of patients

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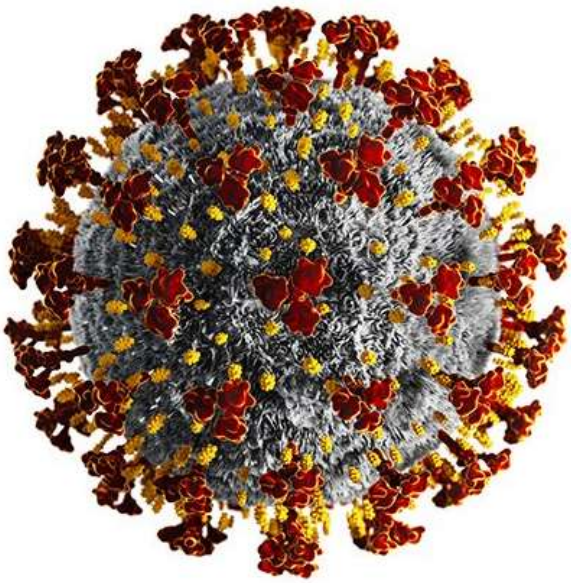

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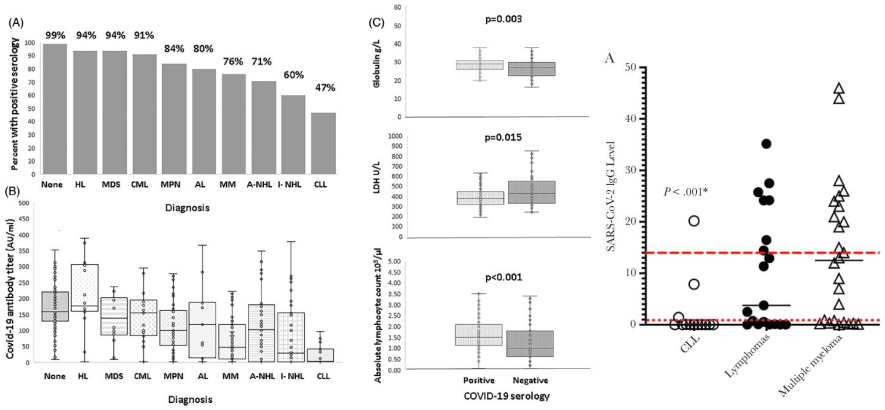
COVID-19 Vaccine in Blood Cancers



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Tzarfati. Amer J of Heme 2021; 96(10): 1195. Agha. OFID 2021; 8(7): 1.

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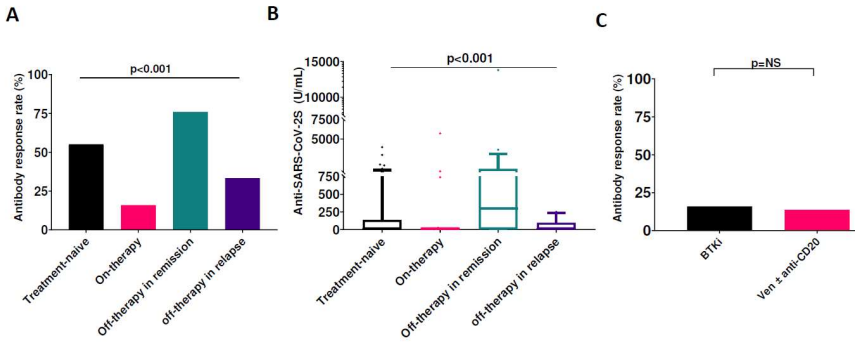
COVID-19 Pfizer Vaccine in CLL



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Herishanu. Blood 2021; 137(23): 3165.

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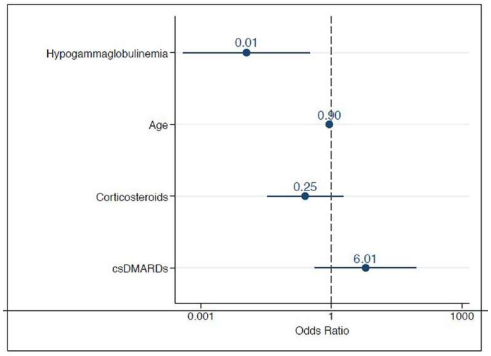
COVID-19 Vaccine s/p Rituximab

- Roughly 1/3 of rheumatology patient demonstrated detectable antibodies



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Magliulo. Clin Immunol 2022; 234: 108897.

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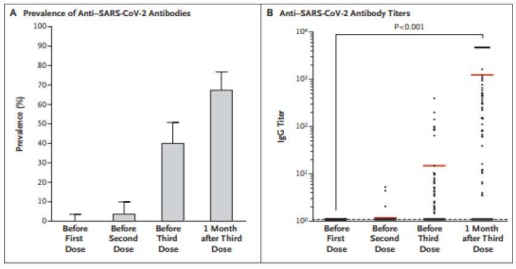
COVID-19 mRNA Vaccine 3rd Dose

Three doses of an mRNA COVID-19 vaccine in solid-organ transplant recipients



- No serious adverse events were reported after administration of the 3rd dose, and no acute rejection episodes occurred (n=99)

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CDC ACIP Meeting July 22, 2021.

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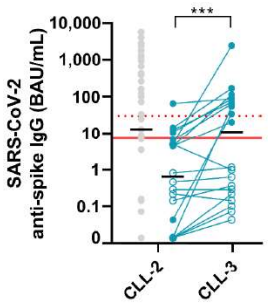
COVID-19 mRNA Vaccine 3rd Dose in CLL

- 41/172 (23.8%) of patients with no detectable antibodies s/p 2nd doses demonstrated antibodies s/p 3rd dose

Table 3. Multivariate analysis for serologic response in CLL patients

Variable	Odds ratio	95% CI	p-value
Age ≤65y	2.5	0.9-6.6	0.067
Lack of active therapy	5.6	2.3-13.8	<0.001
Serum IgG level ≥550, mg/dL	1.0	0.3-3.2	0.974
Serum IgA level ≥80, mg/dL	5.8	2.1-15.9	<0.001



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Herishanu. Blood 2021; online ahead of print, Marlet. Vaccines 2021; 9(10): 1055.

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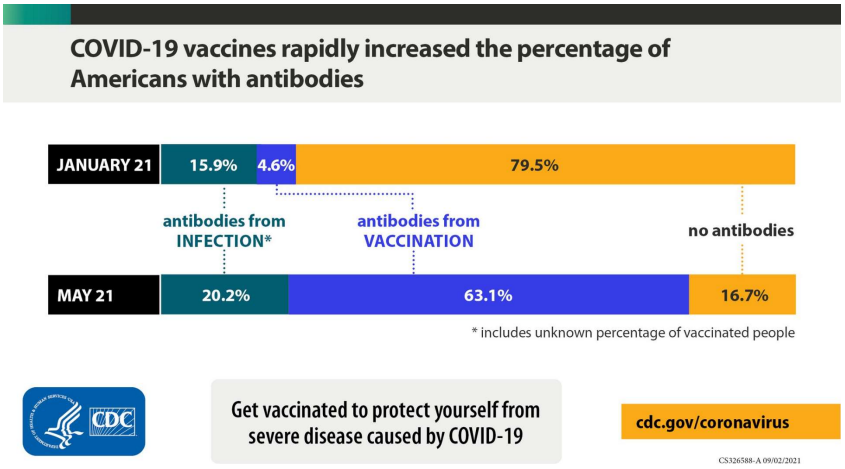
COVID Prophylaxis – Ig Replacement



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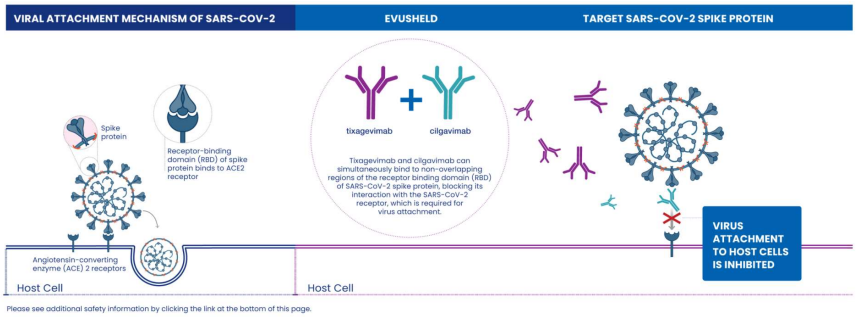
COVID-19 Prophylaxis – Evusheld (tixagevimab + cilgavimab)



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www.evusheld.com

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Evusheld – Efficacy

Figure 1 Kaplan Meier: Cumulative Incidence of Symptomatic COVID-19* (PROVENT)

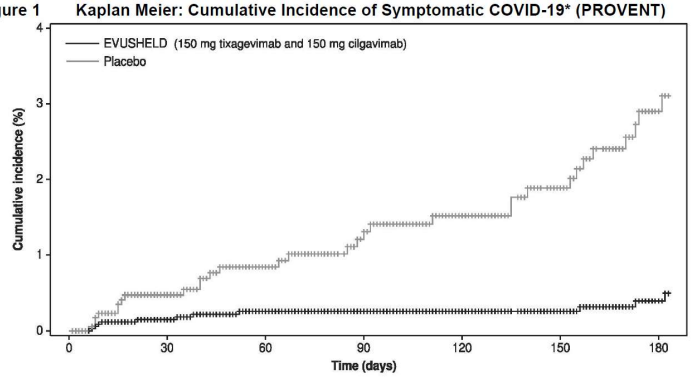

Table 6 Incidence of Symptomatic COVID-19 in Adults (PROVENT)

	N*	Number of events, n (%)	Relative Risk Reduction, % (95% CI)
EVUSHELD†	3,441	8 (0.2%)	77% (46, 90)
Placebo	1,731	17 (1.0%)	

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Evusheld EUA Healthcare Provider Fact Sheet

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Evusheld – Adverse Events

Table 3 Cardiac SAEs Regardless of Causality in PROVENT with Onset Prior to Day 183 Using the Median 6-Month Data Cut-off Date

	EVUSHELD N= 3,461	Placebo N= 1,736
Subjects with any cardiac SAE*	22 (0.6%)	3 (0.2%)
SAEs related to coronary artery disease or myocardial ischemia†	10 (0.3%)	2 (0.1%)
Myocardial infarctions‡	8 (0.2%)	1 (0.1%)
SAEs related to cardiac failure§α	6 (0.2%)	1 (0.1%)
SAEs related to an arrhythmia¶	4 (0.1%)	1 (0.1%)
Other (cardiomegaly, cardiomyopathy, and cardio-respiratory arrest)	3 (0.1%)	0

* One EVUSHELD recipient and one placebo recipient had two cardiac SAEs each.
† Includes the preferred terms angina pectoris, coronary artery disease, arteriosclerosis, troponin increased, acute myocardial infarction, and myocardial infarction.
‡ Includes the preferred terms acute myocardial infarction, myocardial infarction, and troponin increased (with a discharge diagnosis of myocardial infarction).
§ Includes the preferred terms cardiac failure congestive, acute left ventricular failure, cardiac failure, and cardiac failure acute.
¶ Includes the preferred terms atrial fibrillation, arrhythmia, paroxysmal atrioventricular block, and heart rate irregular.

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Evusheld EUA Healthcare Provider Fact Sheet

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Evusheld – Moderate to Severe Immune Compromise

Proposed Tiers (subject to change)

Tier 1:
- B-cell depleting therapy (rituximab, ocrelizumab, natalizumab, ofatumumab, alemtuzamab) within last 12 months
- Current therapy with tyrosine kinase inhibitor
- HCT/CAR-T within 1 year of transplant or GVHD on therapy
- Multiple myeloma on therapy
- CLL on therapy
- SOT on immunosuppressive therapy
- Severe congenital immunodeficiency
- HIV with CD4 < 200

Tier 2:
- Other hematological malignancy on active therapy
- Common variable immunodeficiency

Tier 3:
- Other immunosuppressive condition on active therapy
- Solid tumors on active therapy

Tier 4:
- Adverse reaction preventing administration of COVID-19 vaccine

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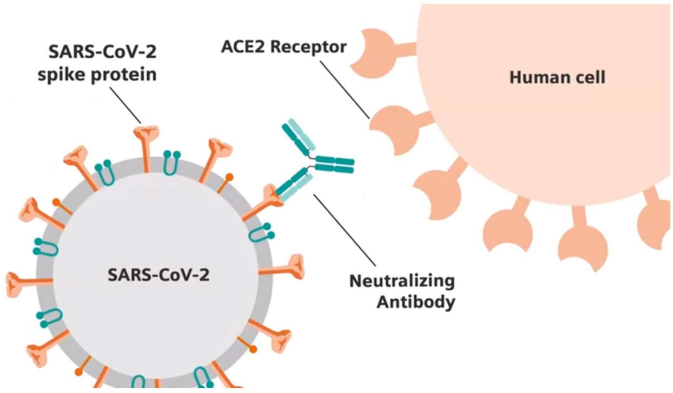
COVID Treatment – Monoclonal Antibodies



- Sotrovimab (GSK), Casirivimab w/ imdevimab (Regeneron), Bamlanivimab + etesevimab (Eli Lilly)

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COVID Treatment Outcomes

- Quicker decrease in viral load
- Decreased rate of hospitalization
- Quicker resolution of symptoms
- No increased risk of side effects as compared to placebo

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Eligible Patients for MABs

Treatment of mild to moderate COVID-19 in adults and pediatrics (≥ 12 years) with positive results for SARS-CoV-2 testing and are at high risk for progressing to severe COVID-19 and/or hospitalization.

NOT authorized for use in:

- Hospitalized due to COVID-19
- Who require oxygen therapy due to COVID-19
- Require an increase in baseline oxygen flow rate due to COVID-19

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The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Early Remdesivir to Prevent Progression to Severe Covid-19 in Outpatients

R.L. Gottlieb, C.E. Vaca, R. Paredes, J. Mera, B.J. Webb, G. Perez, G. Oguchi, P. Ryan, B.U. Nielsen, M. Brown, A. Hidalgo, Y. Sachdeva, S. Mittal, O. Osiyemi, J. Skarbinski, K. Juneja, R.H. Hyland, A. Osinusi, S. Chen, G. Camus, M. Abdelghany, S. Davies, N. Behenna-Renton, F. Duff, F.M. Marty,* M.J. Katz, A.A. Ginde, S.M. Brown, J.T. Schiffer, and J.A. Hill, for the GS-US-540-9012 (PINETREE) Investigators†

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Remdesivir for Outpatient COVID

Table 2. Efficacy Calculated with the Use of a Cox Proportional-Hazards Model with Baseline Stratification Factors as Covariates.*

End Point	Remdesivir (N=279)	Placebo (N=283)	Hazard Ratio (95% CI)	P Value
Primary efficacy end point				
Covid-19–related hospitalization or death from any cause by day 28 — no. (%)†	2 (0.7)	15 (5.3)	0.13 (0.03 to 0.59)	0.008
Secondary efficacy end points				
Covid-19–related hospitalization or death from any cause by day 14 — no. (%)	2 (0.7)	15 (5.3)	0.13 (0.03 to 0.59)	
Covid-19–related medically attended visit or death from any cause — no./total no. (%)‡				
Day 14	2/246 (0.8)	20/252 (7.9)	0.10 (0.02 to 0.43)	
Day 28	4/246 (1.6)	21/252 (8.3)	0.19 (0.07 to 0.56)	
Death from any cause by day 28 — no.	0	0	NC	
Hospitalization for any cause by day 28 — no. (%)§	5 (1.8)	18 (6.4)	0.28 (0.10 to 0.75)	

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Gottlieb. NEJM 2021; Online ahead of print.

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COVID-19 Treatment – Oral Antivirals

Treatment of mild to moderate COVID-19 in adults and pediatrics (≥ 12 years) with positive results for SARS-CoV-2 testing and are at high risk for progressing to severe COVID-19 and/or hospitalization.

- Paxlovid (nirmetrelvir + ritonavir)
  - Consider drug-drug interactions
- Molnupiravir
  - Contraindicated in pregnancy or in individuals who may become pregnant

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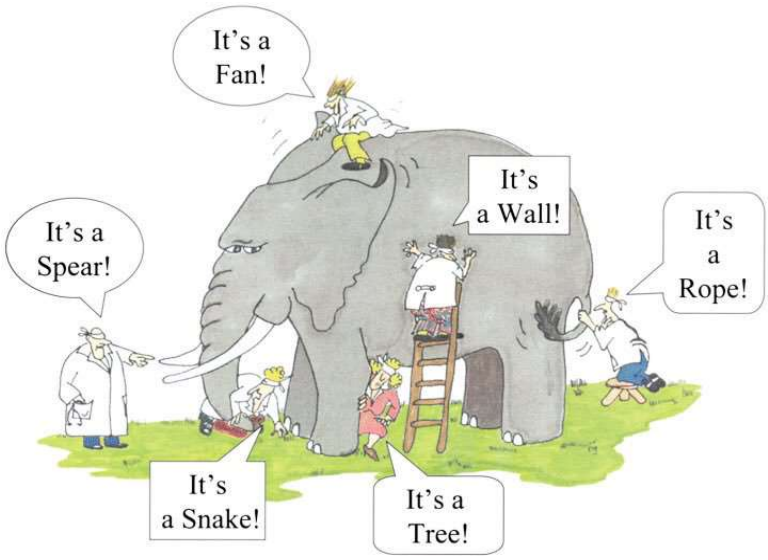

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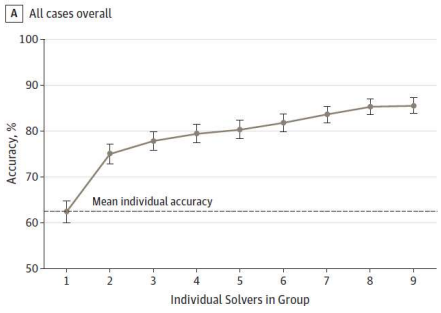
Multi-disciplinary Approach

JAMA Network Open

Original Investigation | Health Informatics

Comparative Accuracy of Diagnosis by Collective Intelligence of Multiple Physicians vs Individual Physicians

Michael L. Barnett, MD, MS; Dhruv Boddupalli, MD, MBA; Shantanu Nundy, MD, MBA; David W. Bates, MD, MSc



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Barnett. JAMA Network Open 2019; 2(3): e190096.

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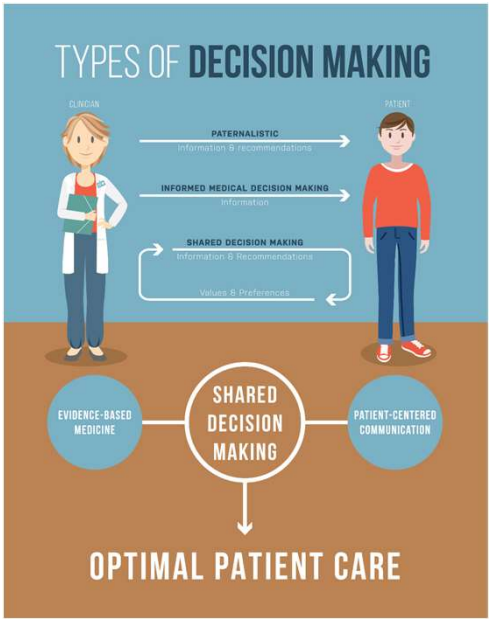

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Summary

- Individuals with blood cancers have immune dysfunction and should be routinely evaluated
- Infections are the #1 cause of complications in patients with blood cancers
- Vaccines are recommended but response is often suboptimal
- Additional strategies to decrease infectious complications should be considered on a case by case basis
- COVID pandemic poses increased risk to individuals with CLL

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Thank You

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585-922-8350

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QUESTIONS & ANSWERS

With Dr. Mustafa

BEATING CANCER IS IN OUR BLOOD.

LEUKEMIA & LYMPHOMA SOCIETY

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LLS EDUCATION & SUPPORT RESOURCES

HOW TO CONTACT US:

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Chat live online: www.LLS.org/InformationSpecialists
Monday to Friday, 10 a.m. to 7 p.m. ET.

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THANK YOU

Please fill out Program Evaluation at

www.LLS.org/ImmunologyEval

SCAN ME

We have one goal: A world without blood cancers

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