APPROACH TO FEVER & INFECTIONS IN THE IMMUNE COMPROMISED HOST

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Disclosures

- No financial disclosures

BUT

- Thinking slides

- The content of this presentation is taken from multiple sources.

- In HPIM (Chapter 104, and Chapter 169)

OBJECTIVES

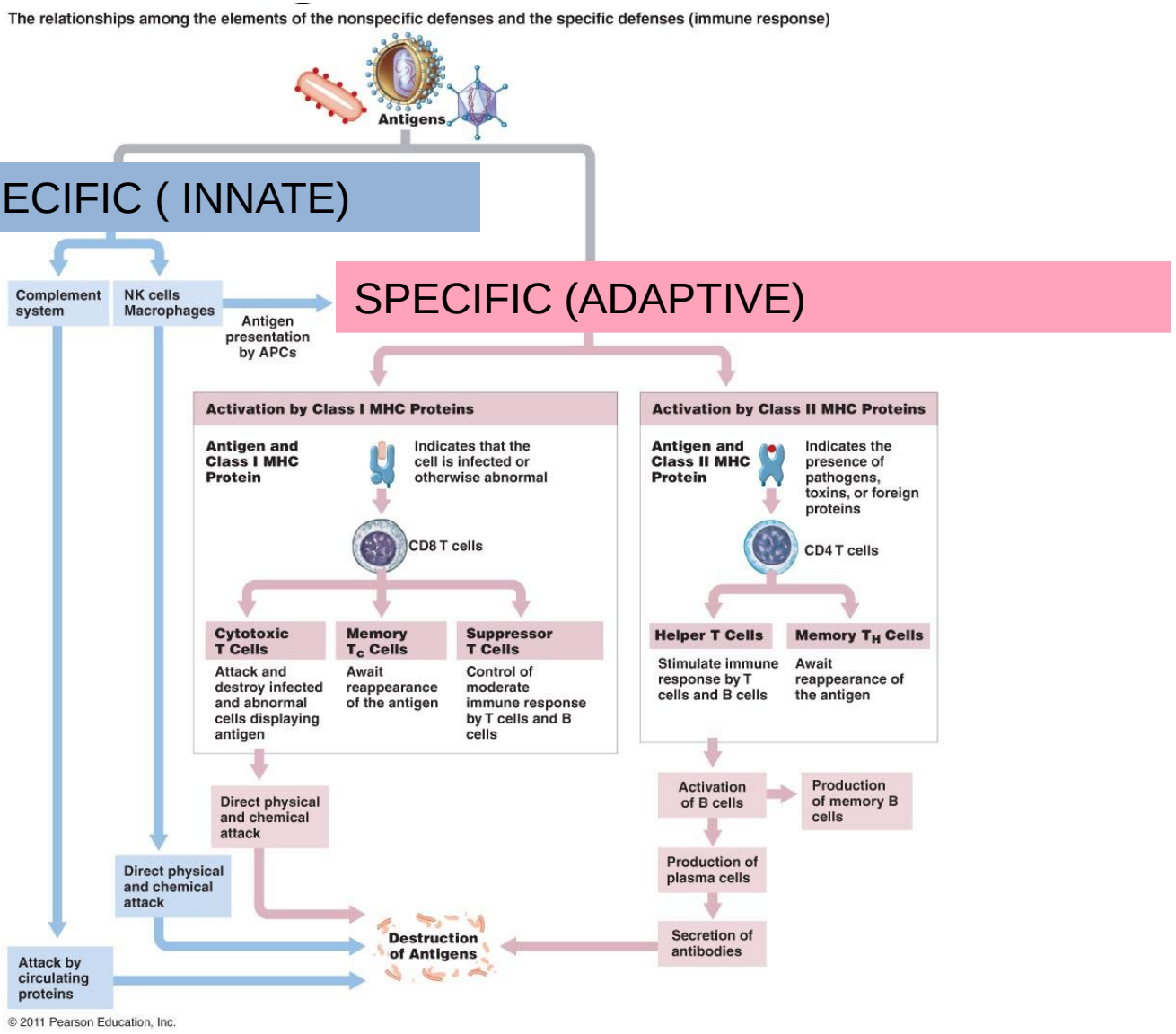
- Review basic immunology
  - Immune defects and the corresponding infections
- Describe the approach to febrile neutropenia
- Describe infections in (non-HIV) immune compromised host
  - SOT, HSCT
- Review strategies for prevention

BACK to the BASICS

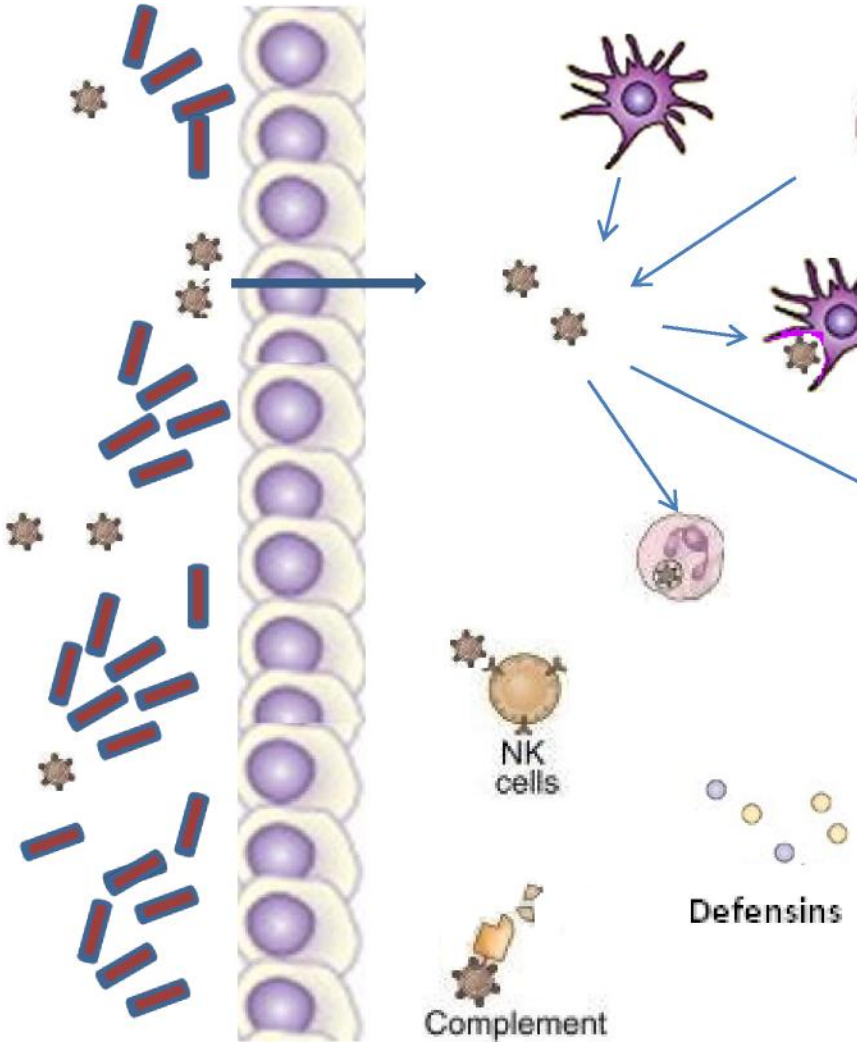
IMMUNITY AND IMMUNE DEFECTS

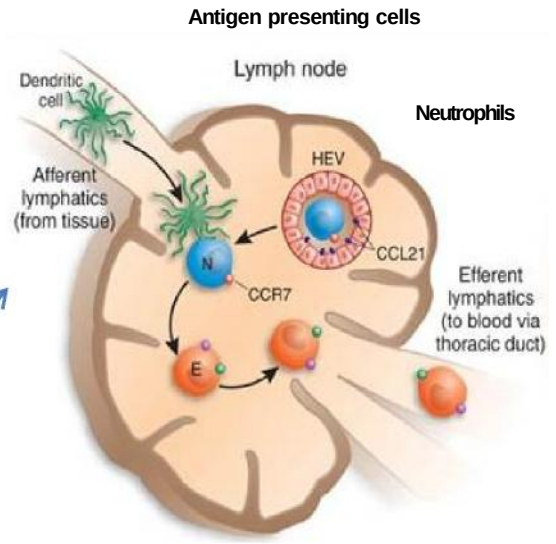
NON SPECIFIC (INNATE)

SPECIFIC (ADAPTIVE)



Non-Specific (Innate) Immunity

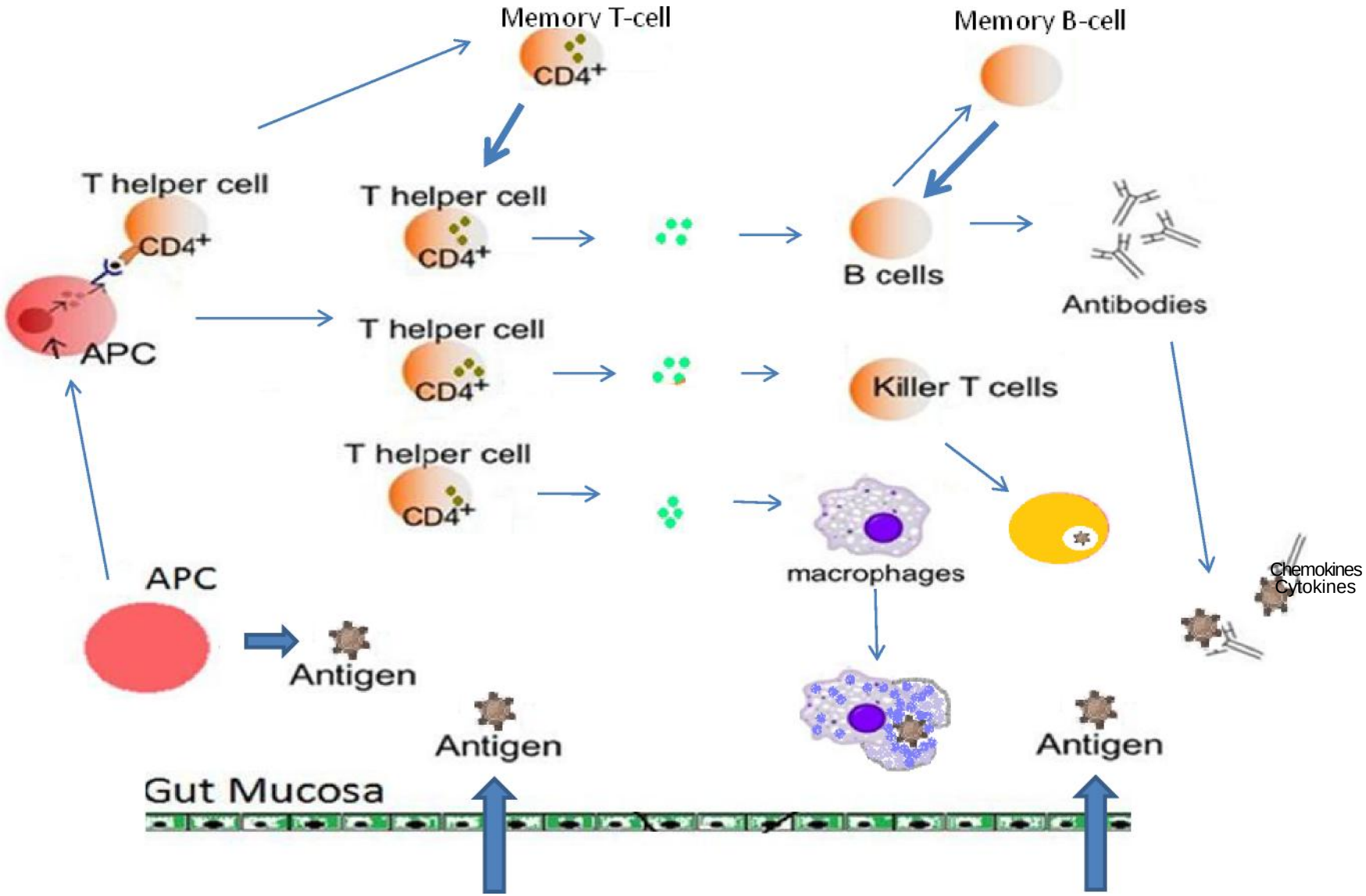




Pattern recognition molecular receptors:

- Toll like receptors
- Nod-like receptors
- C-type lectin receptors
- Retinoic acid inducible gene-I like receptor

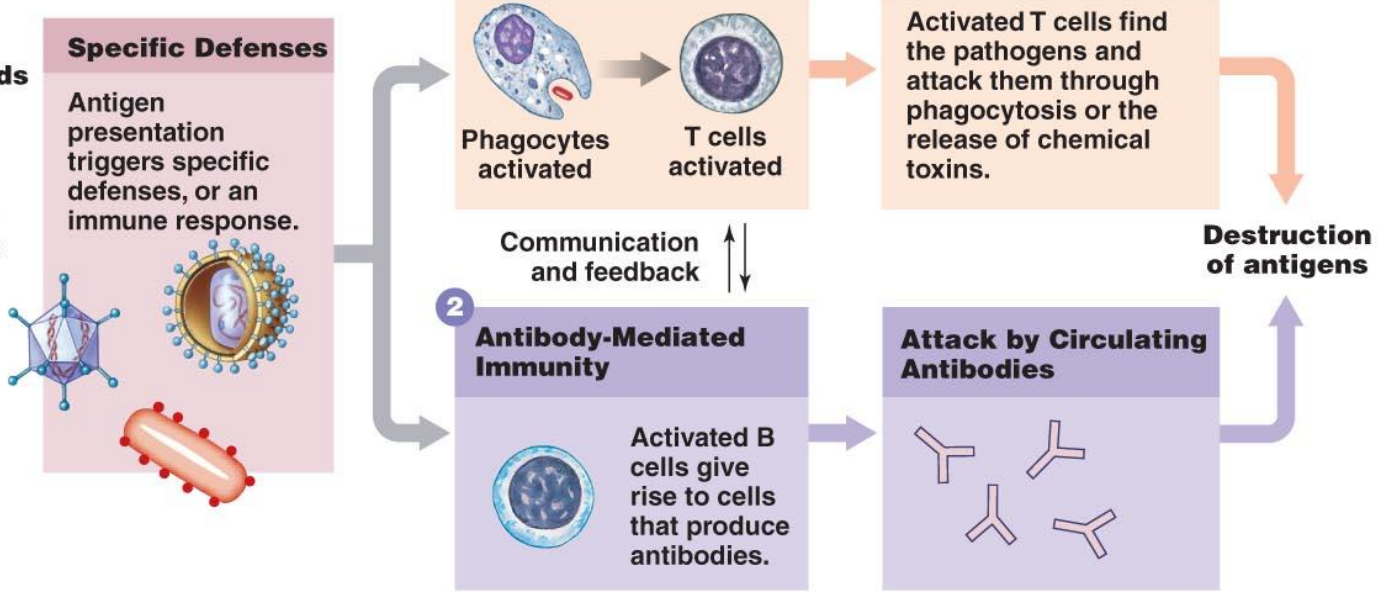
Specific (Adaptive) Immunity



An overview of the immune response

Antigens or Antigenic Fragments in Body Fluids

Most antigens must either infect cells or be "processed" by phagocytes before specific defenses are activated. The trigger is the appearance of antigens or antigenic fragments in plasma membranes; this is called **antigen presentation**.



Causes of Immune Deficiency

Primary Immune Deficiency

B-Cell Deficiencies
X-LINKED AGAMMAGLOBULINAEMIA
COMMON VARIABLE IMMUNODEFICIENCY (CVID)
SELECTIVE IgA DEFICIENCY
IgG SUBCLASS DEFICIENCY
IMMUNODEFICIENCY WITH THYMOMA
TRANSIENT HYPOAGAMMAGLOBULINAEMIA OF INFANCY

T-Cell & Combined T- & B-Cell Deficiencies
SEVERE COMBINED IMMUNODEFICIENCY
DIGEORGE´S SYNDROME
X-LINKED LYMPHOPROLIFERATIVE SYNDROME
HYPER IgM SYNDROME
MHC CLASS II DEFICIENCY
ATAXIA-TELEANGIECTASIA
WISKOTT - ALDRICH´S SYNDROME
HYPER IgM SYNDROMES, AR- forms
CHRONIC MUCOCUTANEOUS CANDIDIASIS

Phagocyte Deficiencies
CHRONIC GRANULOMATOUS DISEASE, (CDG)
INTERFERON g / INTERLEUKIN 12 DEFICIENCIES
FAMILIAL HEMOPHAGOCYTIC LYMPHOHISTIOCYTOSIS, (FHL)
KOSTMANN´S SYNDROME
CYCLIC NEUTROPENIA
LEUCOCYTE ADHESION DEFICIENCY, (LAD)
CHÉDIAK-HIGASHI'S SYNDROME
HYPER IgE SYNDROME, (HIES)

Complement Deficiencies
PROPERDIN DEFICIENCY
MANNAN-BINDING LECTIN DEFICIENCY, (MBL)
HEREDITARY ANGIOEDEMA, (HAE)
Deficiencies of all other complements

Acquired Immune Deficiency

Anatomic Abnormalities
Bronchial sequestration, COPD

Functional Abnormalities
Cystic Fibrosis, COPD

Transient Immune Deficiency
Pregnancy — Post-surgery
Severe burn — Mumps, CMV, TB

Secondary immune deficiency
Diabetes — HIV
Lymphoma — Leukemia
SLE , RA — Chronic renal/liver failure
Iron overload — Malnutrition

Iatrogenic
Medications for chemotherapy, transplant & autoimmune disorders
Irradiation
Splenectomy

Aging

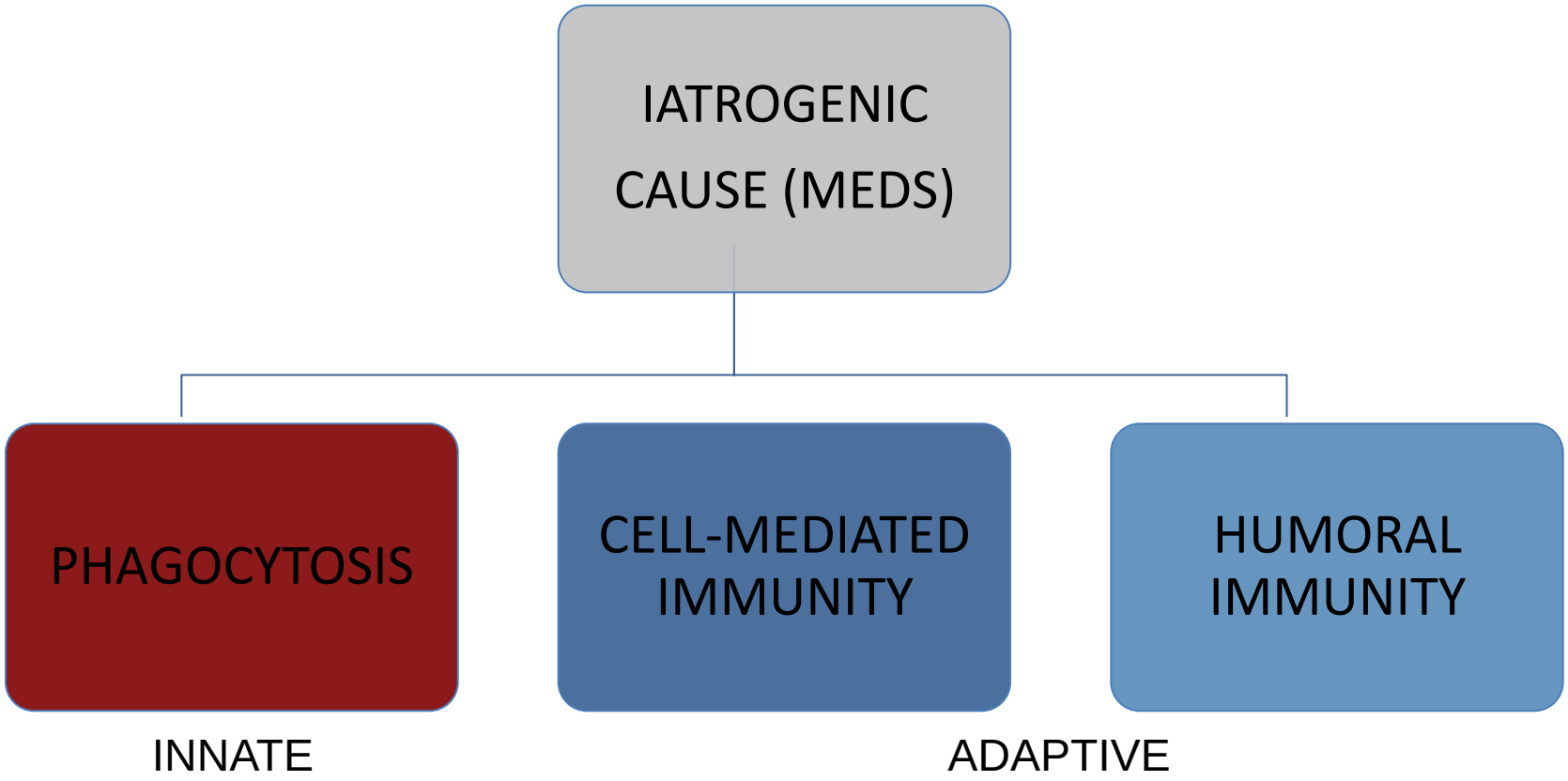
Iatrogenic Causes of Immune Deficiency

- Chemotherapeutic agents
  e.g. Doxorubicin, vinblastin, vincristine

- Transplant immunosuppressants
  e.g. Azathioprine, MTX, cyclophosphamide
- Other immunomodulators

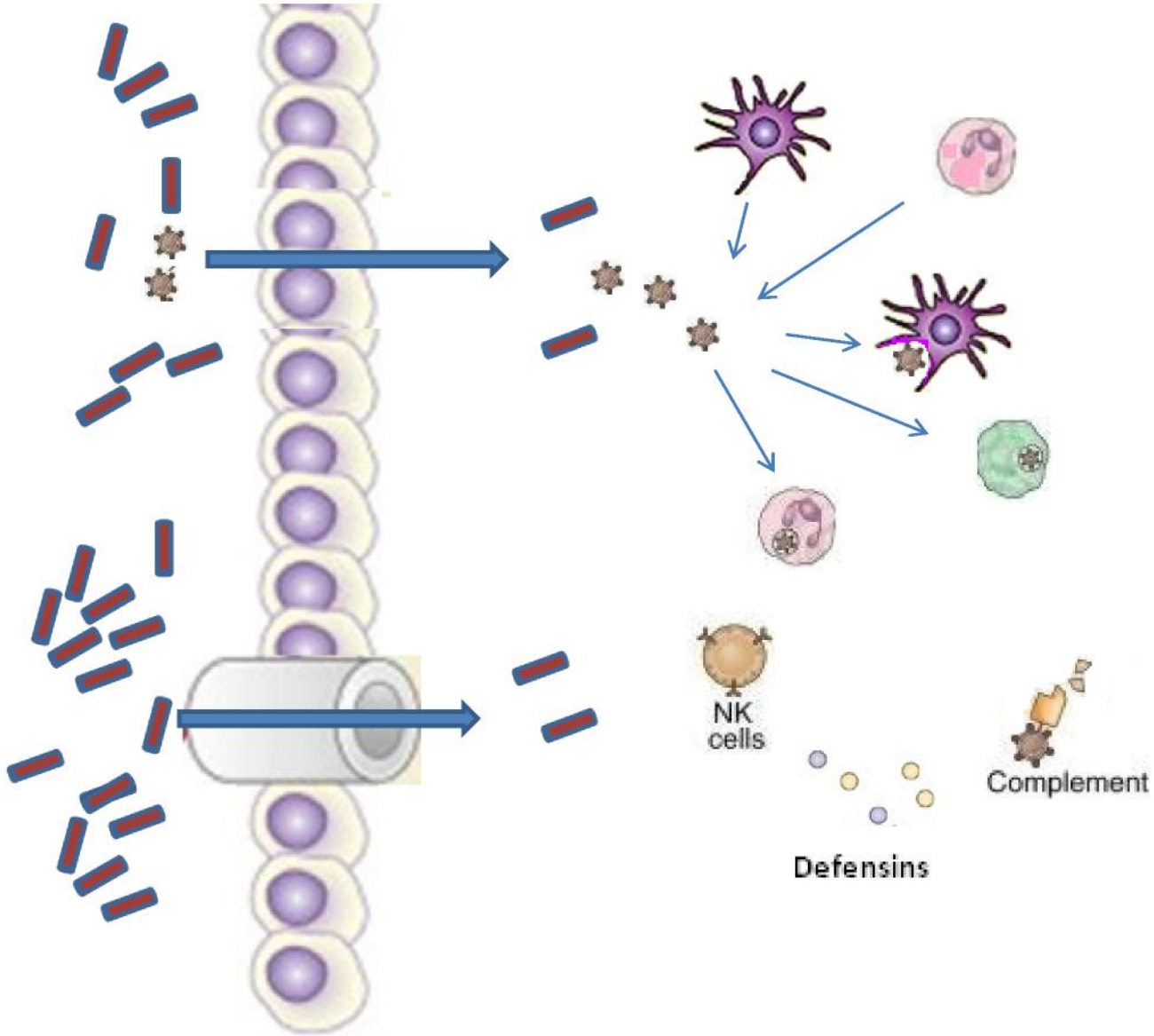
  e.g. Bevacizumab (VEGF), trastuzumab (HER2), cetuximab (EGFR), gemtuzumab (CD33)

- Irradiation


IATROGENIC CAUSE (MEDS)
PHAGOCYTOSIS
CELL-MEDIATED IMMUNITY
HUMORAL IMMUNITY
INNATE
ADAPTIVE

IMPAIRED PHAGOCYTIC FUNCTION

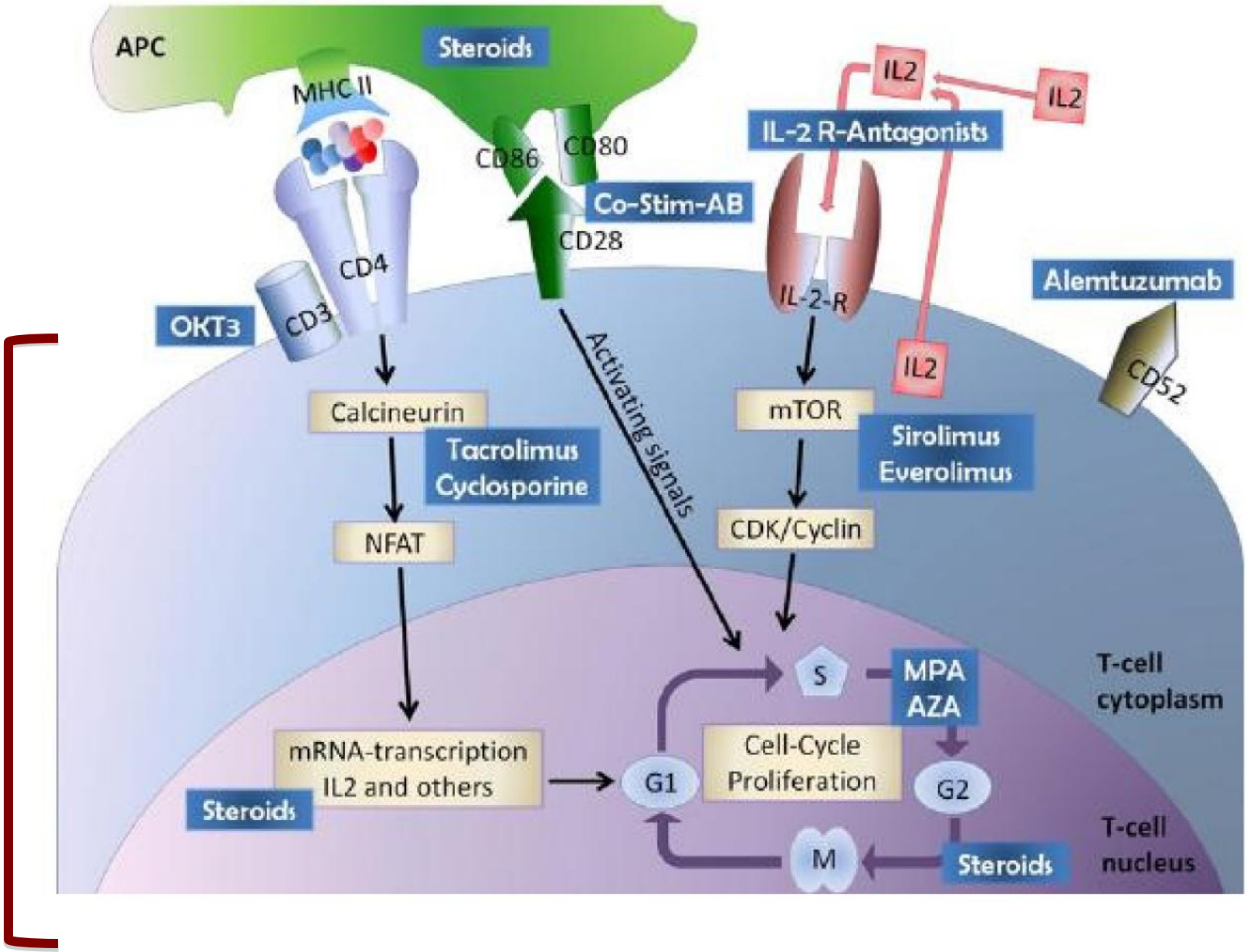
Consequences of Chemotherapy



Consequences of Cytotoxic Medications

Defect	Pathogen		
Granulocytopenia	Gram-positive cocci Staphylococcus aureus Coagulase-neg staph Viridans group strep Granulicatella & Abiotrophia Enterococci spp	Gram-negative bacilli Escherichia coli Pseudomonas aeruginosa Klebsiella pneumoniae Enterobacter & Citrobacter	Aspergillus Mucor
Damaged integument			
Skin–central venous catheter related	Coagulase-neg staphylococci Staphylococcus aureus Corynebacteria	Stenotrophomonas m Pseudomonas aeruginosa Acinetobacter species	Candida spp Rhizopus spp
Oral mucositis	Viridans group strep Abiotrophia & Granulicatella Rothia mucilaginosa Herpes simplex virus	Capnocytophaga spp Fusobacterium spp	Candida spp
Gut mucosal barrier injury	Coagulase-neg staph Enterococci spp	Escherichia coli Pseudomonas aeruginosa	Candida spp
Neutropenic enterocolitis	Clostridium spp Staphylococcus aureus	Pseudomonas aeruginosa	Candida spp

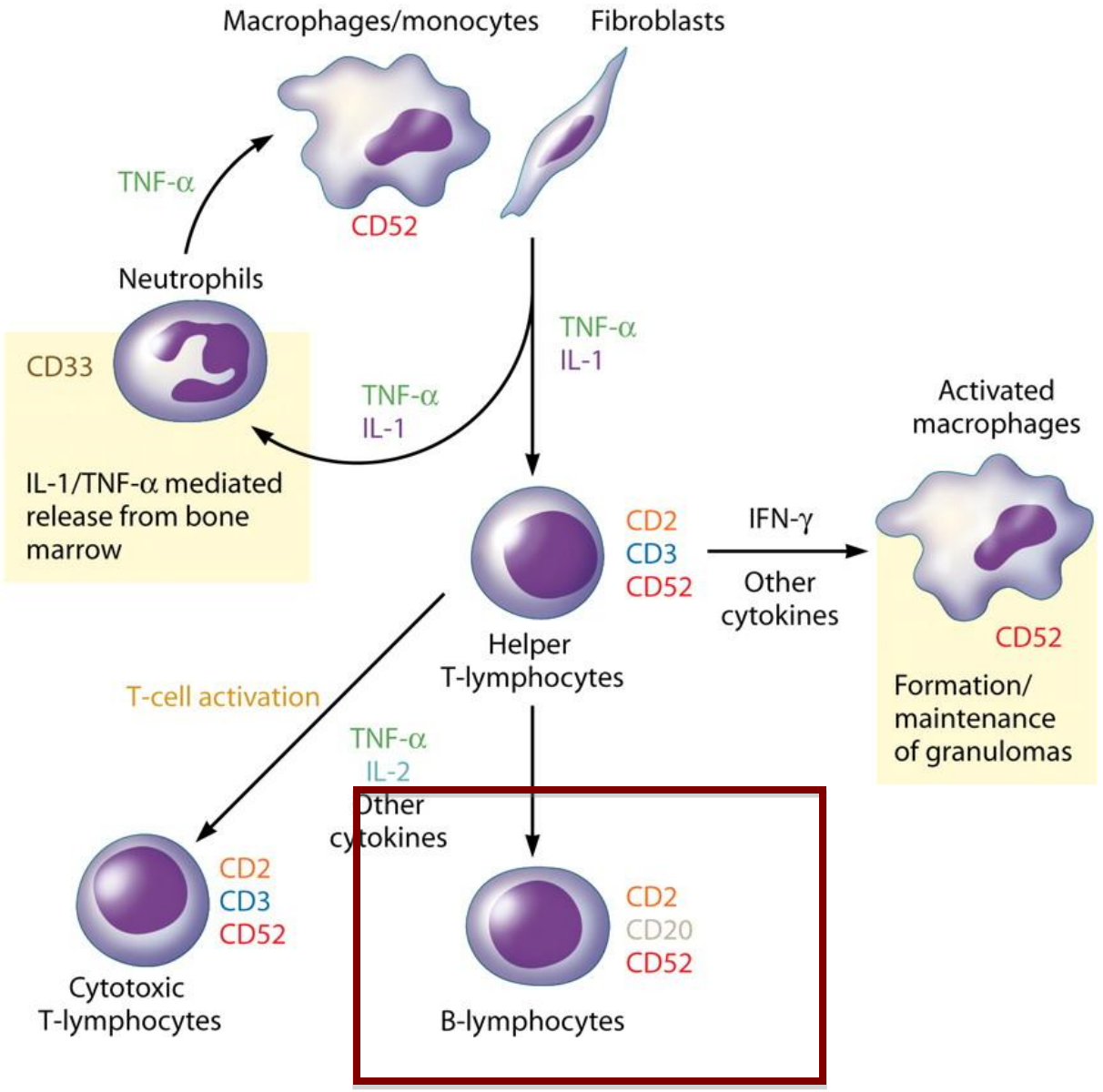
IMPAIRED CELLULAR IMMUNITY


APC
Steroids
MHC II
CD86
CD80
Co-Stim-AB
CD28
CD4
CD3
OKT3
IL2
IL2
IL-2 R-Antagonists
IL-2-R
IL2
Alemtuzumab
CD52
Activating signals
Calcineurin
Tacrolimus
Cyclosporine
mTOR
Sirolimus
Everolimus
NFAT
CDK/Cyclin
S
MPA
AZA
T-cell
cytoplasm
mRNA-transcription
IL2 and others
Steroids
G1
Cell-Cycle
Proliferation
G2
M
Steroids
T-cell
nucleus
T
C
E
L
L

IMPAIRED HUMORAL IMMUNITY

Monoclonal Antibody effects on Immunity

Therapeutic monoclonal antibodies	Key targets
Alemtuzamab	CD52
Adalimumab, Infliximab, Certolizumab pegol, Etanercept	TNF-α
Anakinra, Rilonacept	IL-1
Gemtuzumab ozogamicin	CD33
Alefacept	CD2
Muromonab	CD3
Abatacept, Efalizumab	T-cell activation
Basiliximab, Daclizumab	IL-2
^{90}Y-Ibritumomab tiuxetan, Rituximab, ^{131}I-Tositumomab	CD20



Salvana and Salata, 2009

SUMMARY of IMMUNE DEFECTS

DEFECT	CONSEQUENCE	PATHOLOGY	PATHOGENS
HUMORAL	Impaired opsonization, phagocytosis, Ab dependent cytotoxicity	Recurrent sinopulmonary infections	**SIN** (Streptococcus pneumoniae, H. influenzae, Neisseria sp.)
CELLULAR	Impaired clearance of endogenous or intracellular pathogens	Disseminated infection; pulmonary infection	Human herpes viruses Adenovirus Listeria HPV TB Nocardia PCP Cryptococcus Endemic fungi

SUMMARY of IMMUNE DEFECTS

DEFECT	CONSEQUENCE	PATHOLOGY	PATHOGENS
PHAGOCYTIC	Impaired microbial killing or clearance at sites of tissue invasion	Recurrent skin/lung/liver cold abscesses	S. aureus, CoNS Viridans streptococci E. coli P. aeruginosa K. pneumoniae

NEUTROPENIC FEVER

Clinical vignette

- 54/F with acute myelogenous leukemia (AML) presents at the ER with fever/chills. She also has some shortness of breath
- 1 week PTC, she received her 2nd round of chemotherapy.
- VS are stable. Temp is 39° C. Lungs with rales, bilaterally. CBC = Hgb 102g/L WBC 1.2 cells /mm^3 (S 4%, L 90% M 6%)

DEFINITION

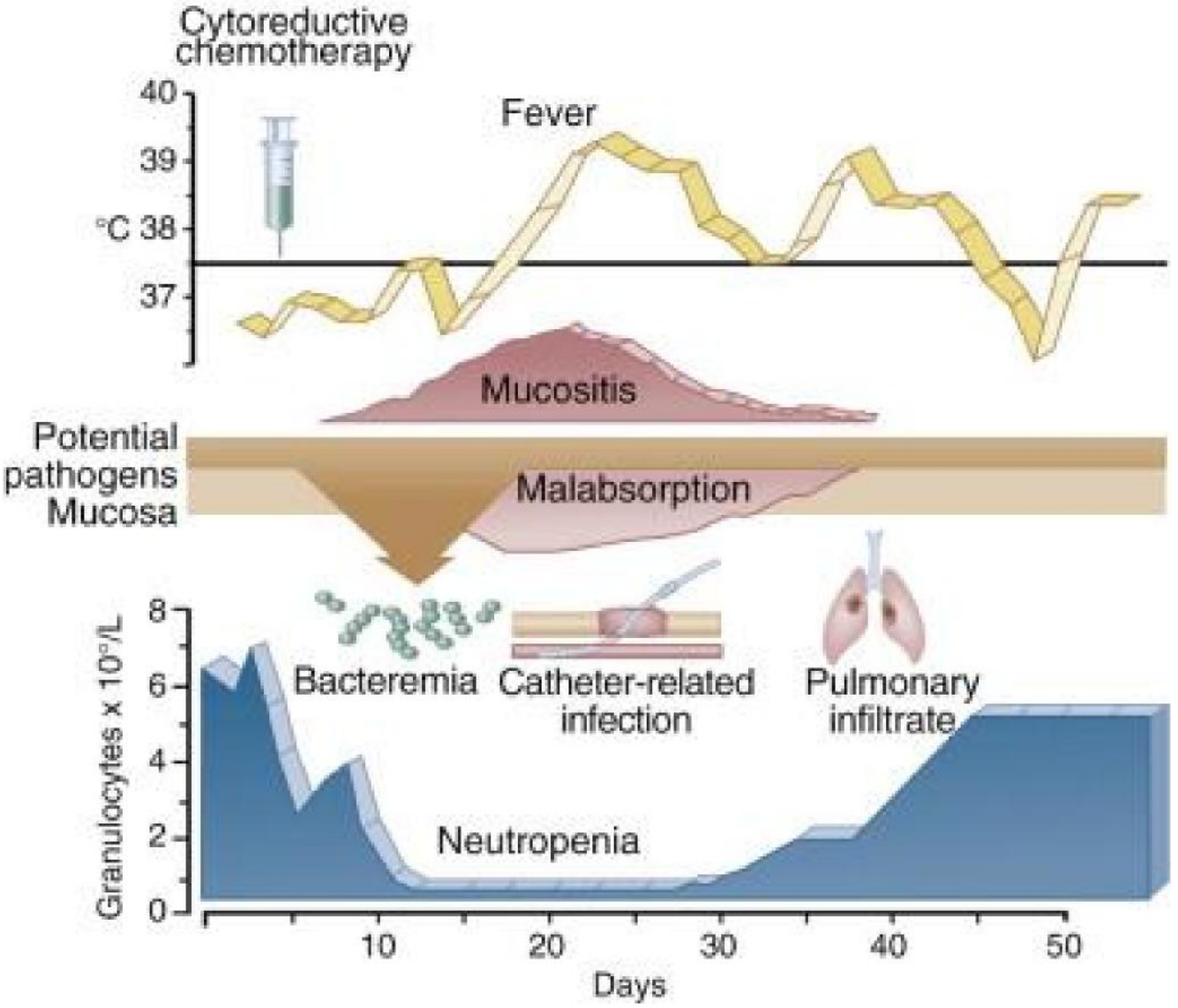
- Fever is defined as a single oral temperature measurement of >38.3C (101F) or a temperature of >38.0C (100.4F) sustained over a 1-h period.
- Neutropenia is defined as an absolute neutrophil count (ANC) of <500 cells/mm^3 or an ANC that is expected to decrease to <500 cells/mm^3 during the next 48 h.
  - **ANC** = WBC X (% bands+segs)/100

NEUTROPENIC FEVER

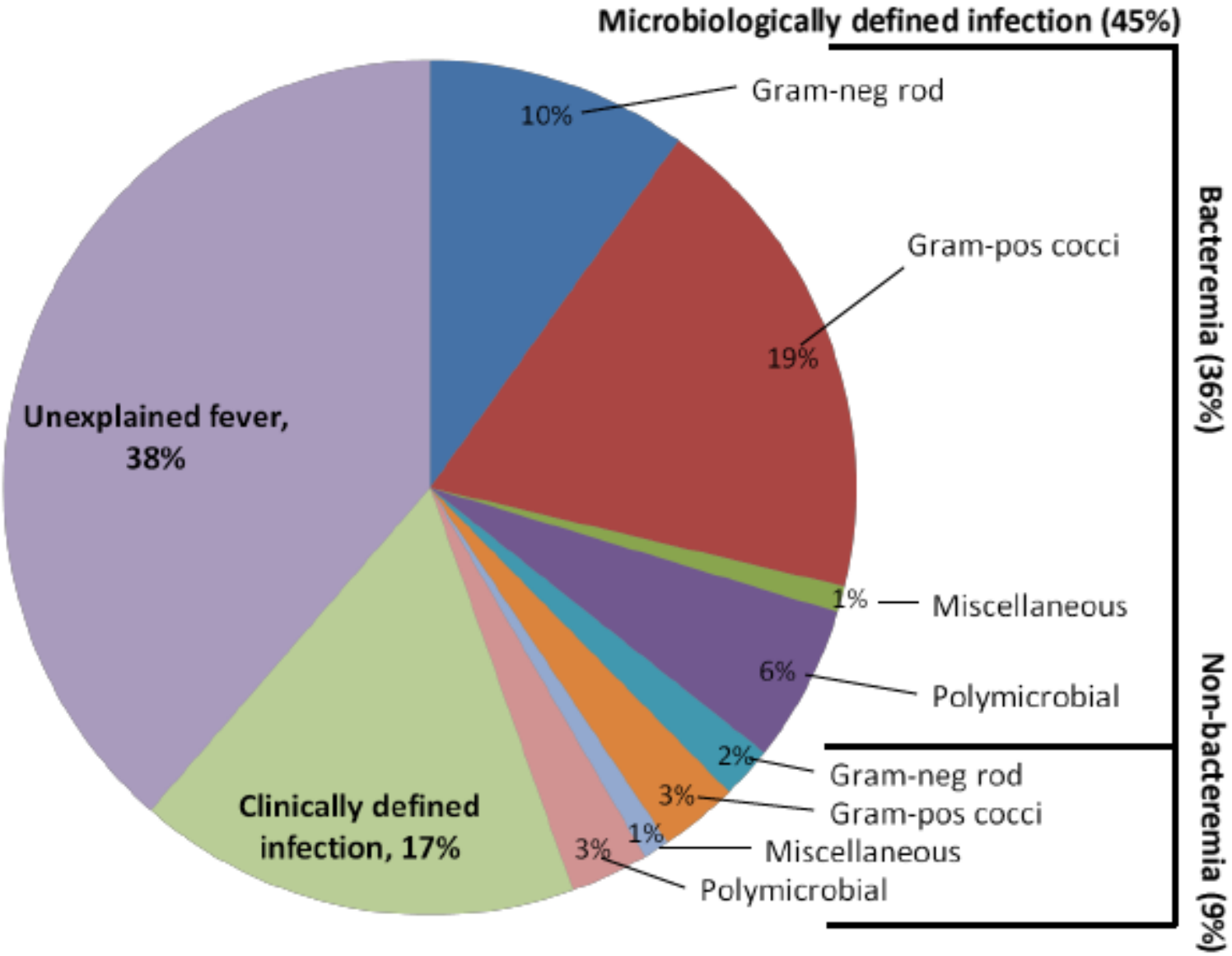
- Fever during chemotherapy-induced neutropenia may be the only indication of a severe underlying infection.

- NF is a medical emergency and physicians must be able to assess risk, diagnose, and appropriately manage patients with NF

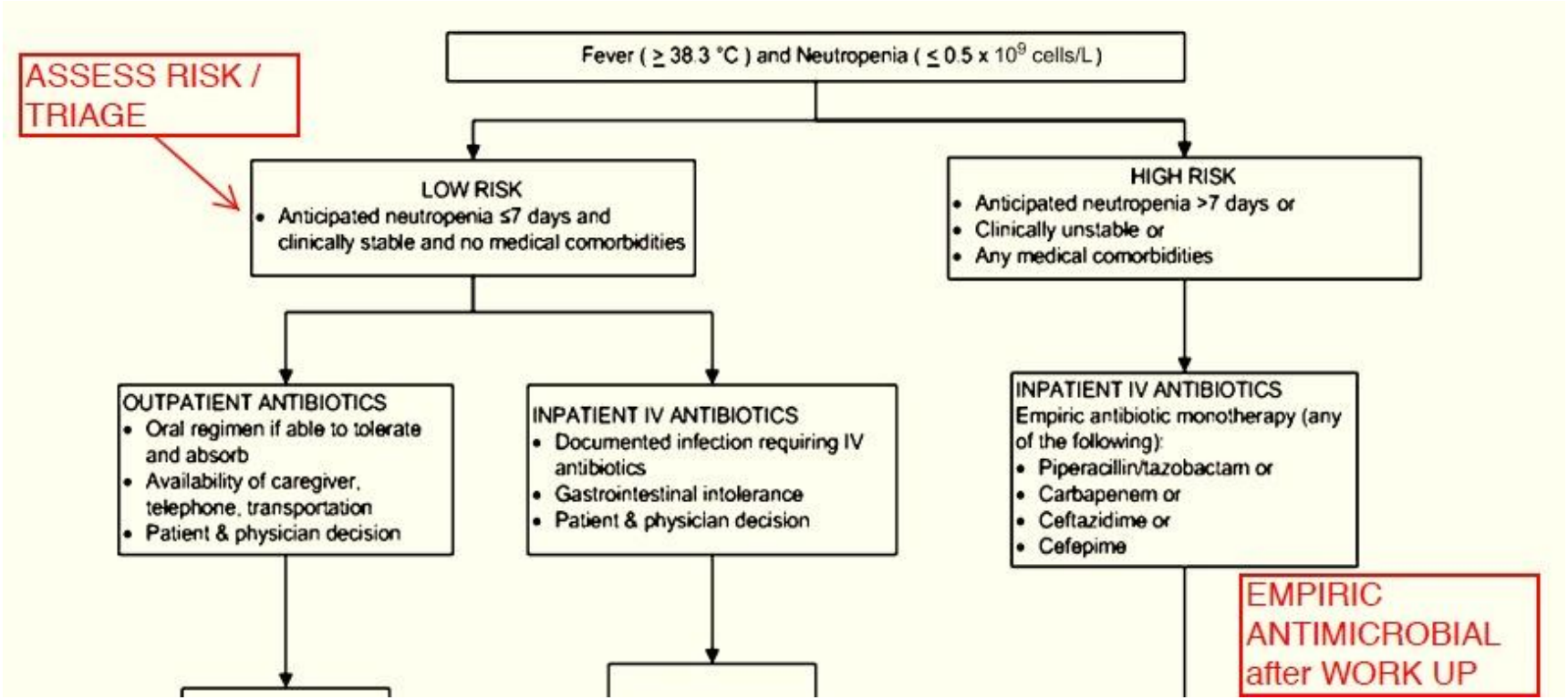
Sequence of events during neutropenia



Causes of Fever in Febrile Neutropenia



Approach to NF



Clinical Infectious Diseases 2011;52(4):e56–e93

Diagnostic Evaluation

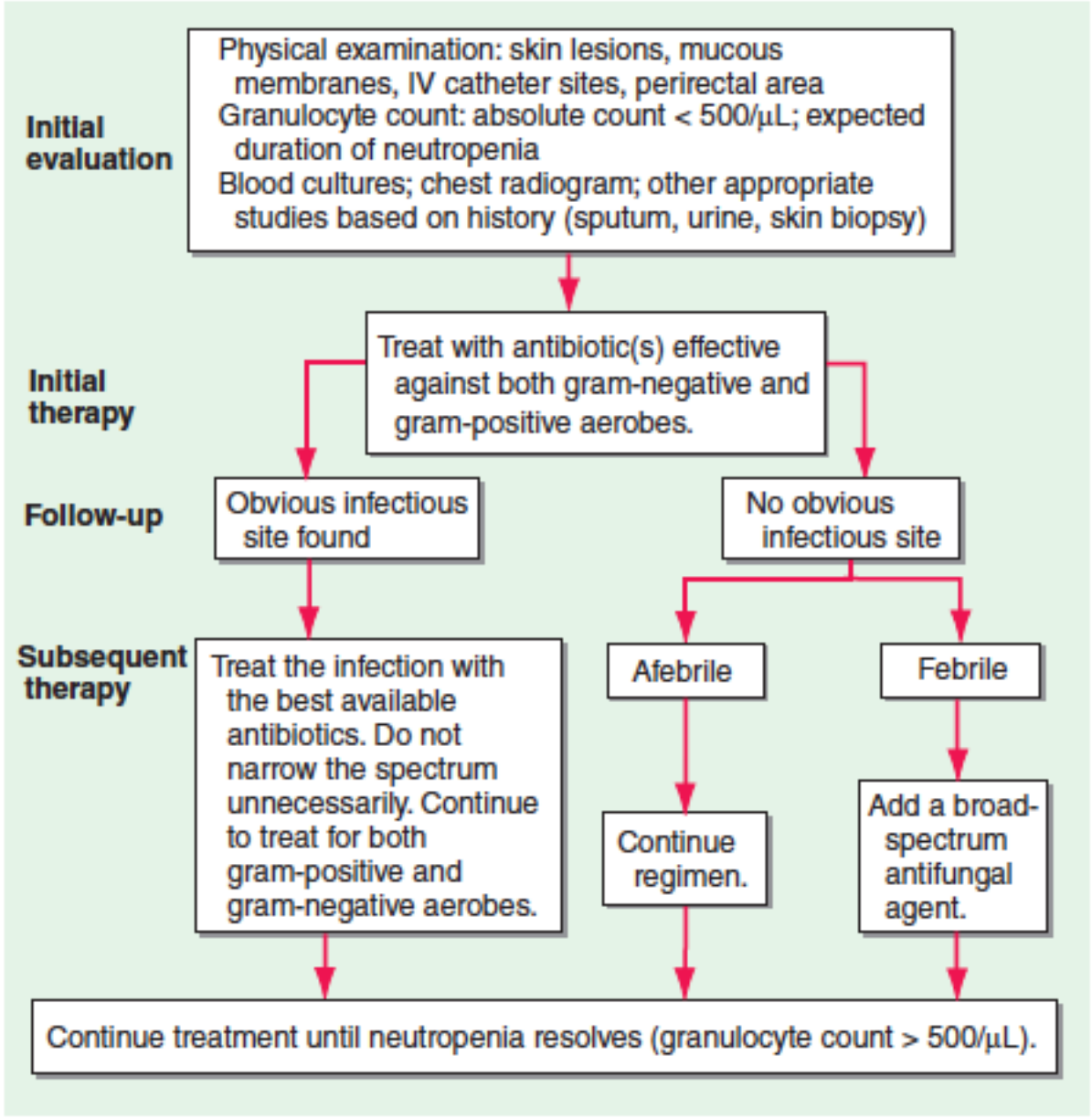
TEST	REASON
CBC	ANC
Creatinine	Kidney function
ALT, AST	Liver function
BLOOD CULTURES X2	Bacteremia
CXR	Pneumonia
Others	Urine, etc.

Common Pathogens in NF

Table 1. Common Bacterial Pathogens in Neutropenic Patients

Common gram-positive pathogens
Coagulase-negative staphylococci
Staphylococcus aureus, including methicillin-resistant strains
Enterococcus species, including vancomycin-resistant strains
Viridans group streptococci
Streptococcus pneumoniae
Streptococcus pyogenes
Common gram-negative pathogens
Escherichia coli
Klebsiella species
Enterobacter species
Pseudomonas aeruginosa
Citrobacter species
Acinetobacter species
Stenotrophomonas maltophilia

Clinical Infectious Diseases 2011;52(4):e56–e93



Harrison's Principles of Internal Med. p 490, Fig 104-2

Antimicrobial Pearls

- High-risk patients require hospitalization for IV empirical antibiotic therapy; monotherapy with an anti-pseudomonal β-lactam agent, such as cefepime, a carbapenem, or piperacillin-tazobactam, is recommended (A-I).

- Other antimicrobials (aminoglycosides, fluoroquinolones, and/or vancomycin) may be added to the initial regimen for management of complications (eg, hypotension and pneumonia) or if antimicrobial resistance is suspected or proven (B-III).

- Vancomycin (or other agents active against aerobic gram positive cocci) is NOTrecommended as a standard part of the initial antibiotic regimen for fever and neutropenia (A-I).

Clinical Infectious Diseases 2011;52(4):e56–
e93

Prevention

- Prophylaxis for high-risk patients with prolonged, or profound neutropenia can be considered
  - Fluoroquinolone
- Age appropriate vaccination
  - E.g. yearly influenza vaccinations
- In certain populations, anti-fungal prophylaxis may be considered
  - E.g. HSCT recipients, those undergoing intensive chemotherapy

INFECTIONS IN LIVER/KIDNEY TRANSPLANT RECIPIENTS

SOLID ORGAN TRANSPLANT

Clinical Vignette

- A U.S.-born adolescent, aged 14 years, with end-stage renal disease as a result of a single dysplastic kidney received a kidney transplant from a deceased donor. He had never traveled outside the United States.
- 10 weeks post –transplant he complained of fever, rash, malaise, anorexia, nausea, vomiting, and diarrhea.
- Two other recipients from the same donor complained of similar symptoms.

What do you think he has?

A. A nosocomial infection

B. An opportunistic infection

C. A donor-derived infection

D. Reactivation of latent infection

What do you think he has?

A. A nosocomial infection

B. An opportunistic infection

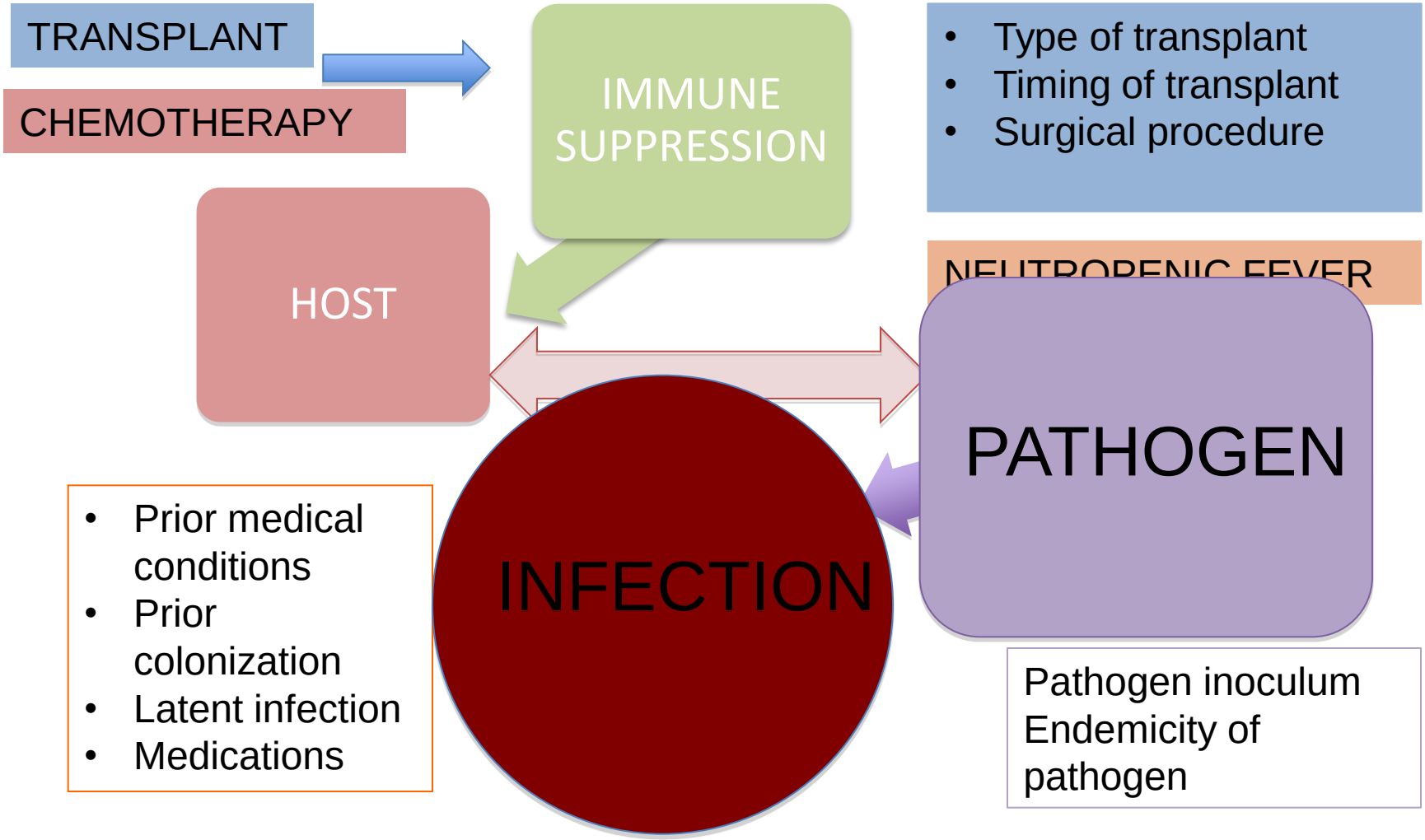
C. A donor-derived infection

D. Reactivation of latent infection

- The CDC requested stored pre-transplant serum from all organ recipients, along with stored donor serum for testing, to determine if infection with *Strongyloides* in the recipients was donor derived or reactivation of chronic infection.
- Evaluation of these specimens revealed that the **donor** had evidence of chronic infection based on positive serologic results.

MMWR Morb Mortal Wkly Rep. 2013 Apr 12;62(14):264-6

PATHOGENESIS OF INFECTION



SOT

- Most infections occur in the first few months after transplantation.
- Infections may be donor or recipient-derived, community or hospital acquired.
- Similar to HSCT patients, infections follow a “timeline”

TIMELINE OF INFECTIONS

Day 0-30:

- Usually either donor-derived infection or nosocomial infections.
- The longer the transplant surgery, the higher the risk of infection. Infections may be associated with surgical technique
- *Opportunistic infections are generally absent during the first month after transplantation*

Day 31- 4 mos

- Viral pathogens and allograft rejection are responsible for the majority of febrile episodes that occur during this period

- Trimethoprim–sulfamethoxazole prophylaxis generally prevents most urinary tract infections and opportunistic infections such as pneumocystis pneumonia

> 6 months

- The risk of infection diminishes 6 months after transplantation, since immunosuppressive therapy is usually tapered in recipients who have satisfactory allograft function.

- Transplant recipients have a persistently increased risk of infection due to community-acquired pathogens.

“Never Do Wells”

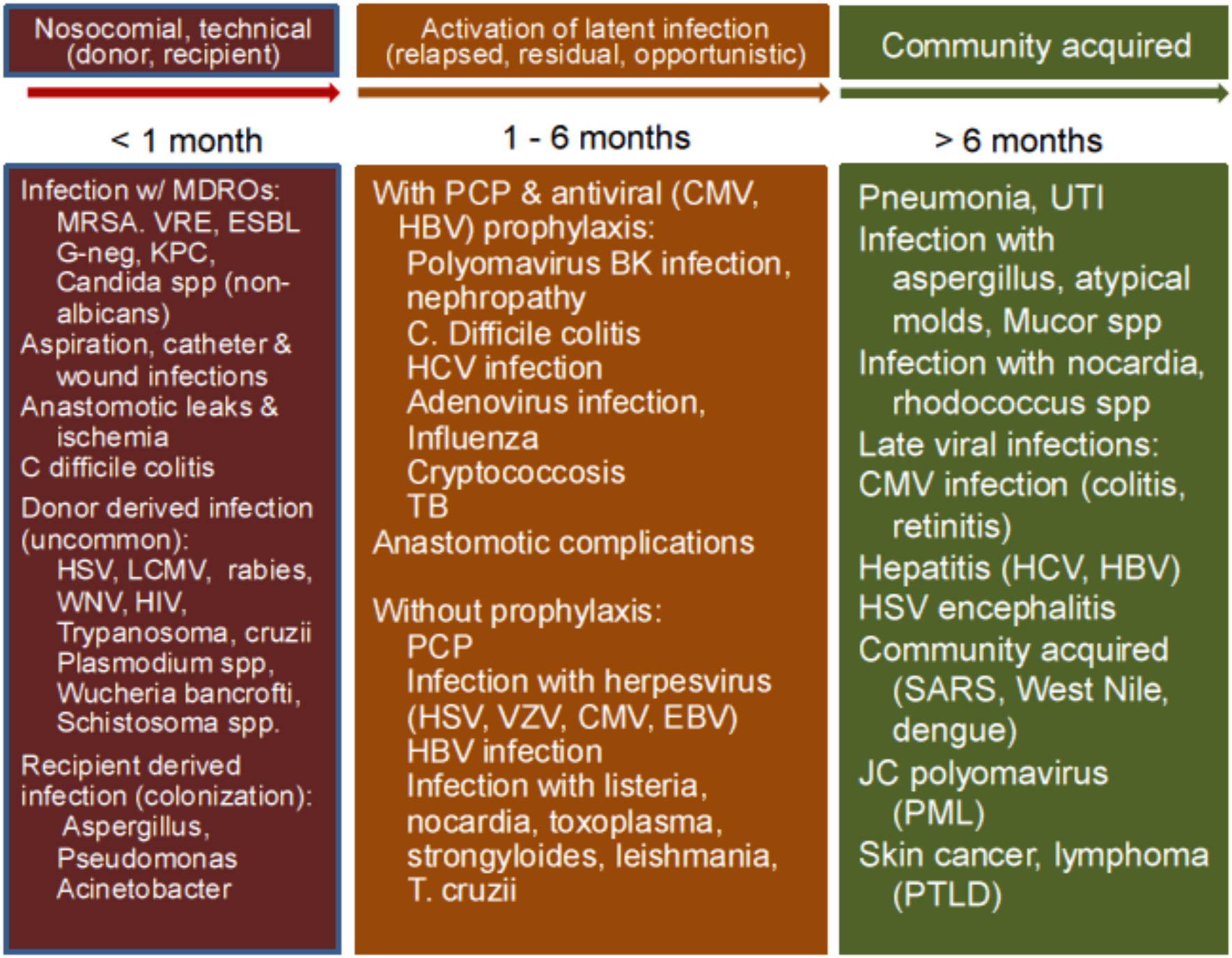
- Recurrent infection may develop in some patients despite minimization of their immunosuppression.

- These patients are at increased risk for opportunistic infection with listeria or nocardia species, invasive fungal pathogens such as zygomycetes and dematiaceous molds, and unusual organisms

TABLE 169-4 COMMON INFECTIONS AFTER SOLID ORGAN TRANSPLANTATION, BY SITE OF INFECTION

	Period after Transplantation		
Infected Site	**Early (<1 Month)**	**Middle (1–4 Months)**	**Late (>6 Months)**
Donor organ	Bacterial and fungal infections of the graft, anastomotic site, and surgical wound	CMV infection	EBV infection (may present in allograft organ)
Systemic	Bacteremia and candidemia (often resulting from central venous catheter colonization)	CMV infection (fever, bone marrow suppression)	CMV infection, especially in patients given early posttransplantation prophylaxis; EBV proliferative syndromes (may occur in donor organs)
Lung	Bacterial aspiration pneumonia with prevalent nosocomial organisms associated with intubation and sedation (highest risk in lung transplantation)	*Pneumocystis* infection; CMV pneumonia (highest risk in lung transplantation); *Aspergillus* infection (highest risk in lung transplantation)	*Pneumocystis* infection; granulomatous lung diseases (nocardial and reactivated fungal and mycobacterial diseases)
Kidney	Bacterial and fungal (*Candida*) infections (cystitis, pyelonephritis) associated with urinary tract catheters (highest risk in kidney transplantation)	Kidney transplantation: BK virus infection (associated with nephropathy); JC virus infection	Kidney transplantation: bacterial infections (late urinary tract infections, usually not associated with bacteremia); BK virus infection (nephropathy, graft failure, generalized vasculopathy)
Liver and biliary tract	Cholangitis	CMV hepatitis	CMV hepatitis
Heart		*Toxoplasma gondii* infection (highest risk in heart transplantation); endocarditis (*Aspergillus* and gram-negative organisms more common than in general population)	*T. gondii* (highest risk in heart transplantation)
Gastrointestinal tract	Peritonitis, especially after liver transplantation	Colitis secondary to *Clostridium difficile* infection (risk can persist)	Colitis secondary to *C. difficile* infection (risk can persist)
Central nervous system		*Listeria* infection (meningitis); *T. gondii* infection; CMV infection	Listerial meningitis; cryptococcal meningitis; nocardial abscess; JC virus–associated PML

Harrison's Principles of Internal Med. Table 169-4


Nosocomial, technical (donor, recipient)
Activation of latent infection (relapsed, residual, opportunistic)
Community acquired
< 1 month
1 - 6 months
> 6 months
Infection w/ MDROs: MRSA. VRE, ESBL G-neg, KPC, Candida spp (non-albicans)
Aspiration, catheter & wound infections
Anastomotic leaks & ischemia
C difficile colitis
Donor derived infection (uncommon): HSV, LCMV, rabies, WNV, HIV, Trypanosoma, cruzii Plasmodium spp, Wucheria bancrofti, Schistosoma spp.
Recipient derived infection (colonization): Aspergillus, Pseudomonas Acinetobacter
With PCP & antiviral (CMV, HBV) prophylaxis:
Polyomavirus BK infection, nephropathy
C. Difficile colitis
HCV infection
Adenovirus infection, Influenza
Cryptococcosis
TB
Anastomotic complications
Without prophylaxis:
PCP
Infection with herpesvirus (HSV, VZV, CMV, EBV)
HBV infection
Infection with listeria, nocardia, toxoplasma, strongyloides, leishmania, T. cruzii
Pneumonia, UTI
Infection with aspergillus, atypical molds, Mucor spp
Infection with nocardia, rhodococcus spp
Late viral infections:
CMV infection (colitis, retinitis)
Hepatitis (HCV, HBV)
HSV encephalitis
Community acquired (SARS, West Nile, dengue)
JC polyomavirus (PML)
Skin cancer, lymphoma (PTLD)

INFECTIONS IN HEMATOPOIETIC STEM CELL TRANSPLANT (HSCT) RECIPIENTS

HEMATOLOGIC TRANSPLANTS

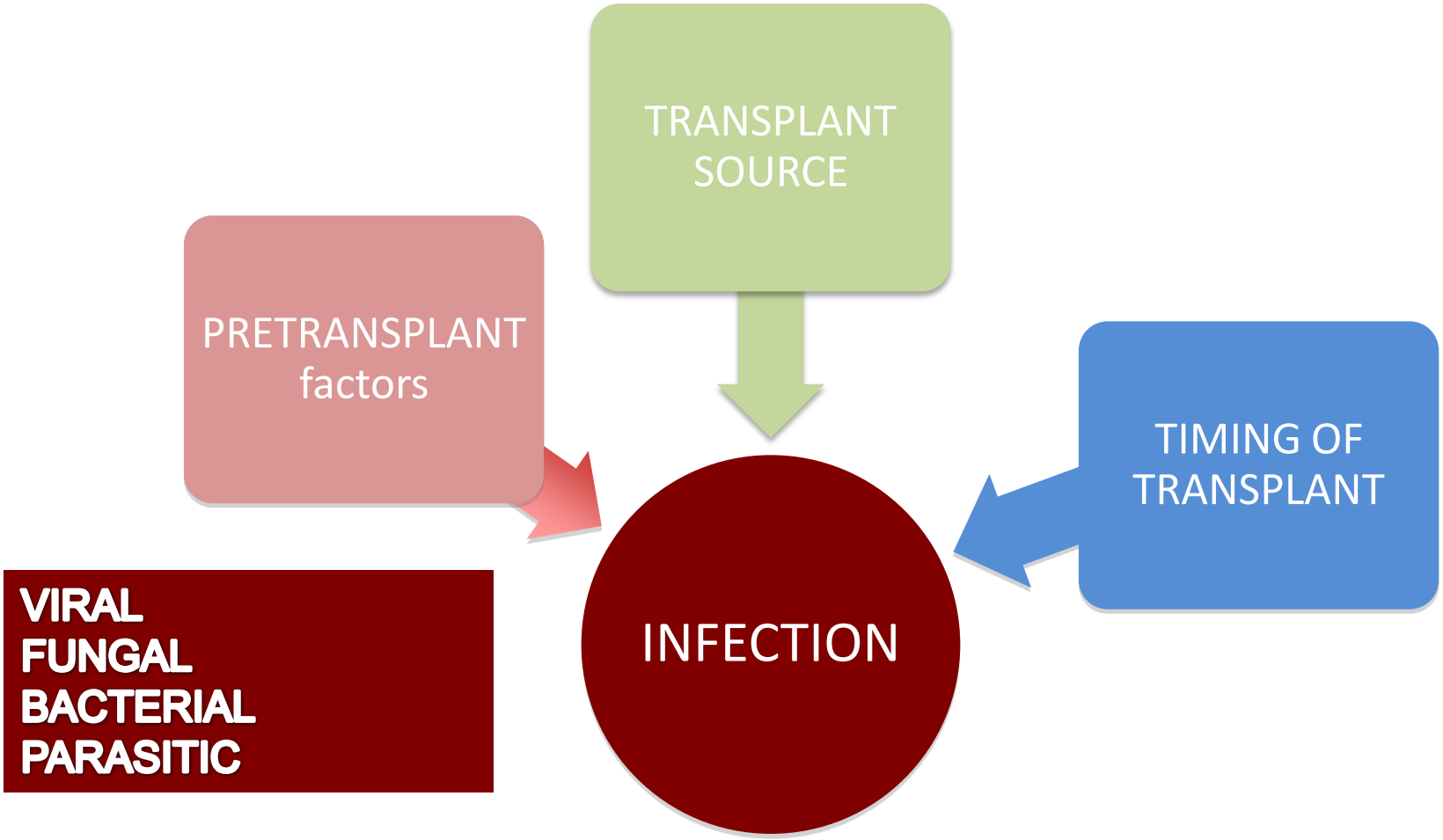
DEFINITION OF TERMS

TERM	DEFINITION
SYNGENEIC	Transplant from an *identical* twin
ALLOGENEIC	Transplant from a sibling or unrelated donor
AUTOLOGOUS	Transplant from “self”
ENGRAFTMENT	Donor transplant is accepted by the recipient
GRAFT versus HOST DISEASE (GVHD)	An immunologic reaction by the donor lymphocytes against the recipient, causing inflammation of the target tissues

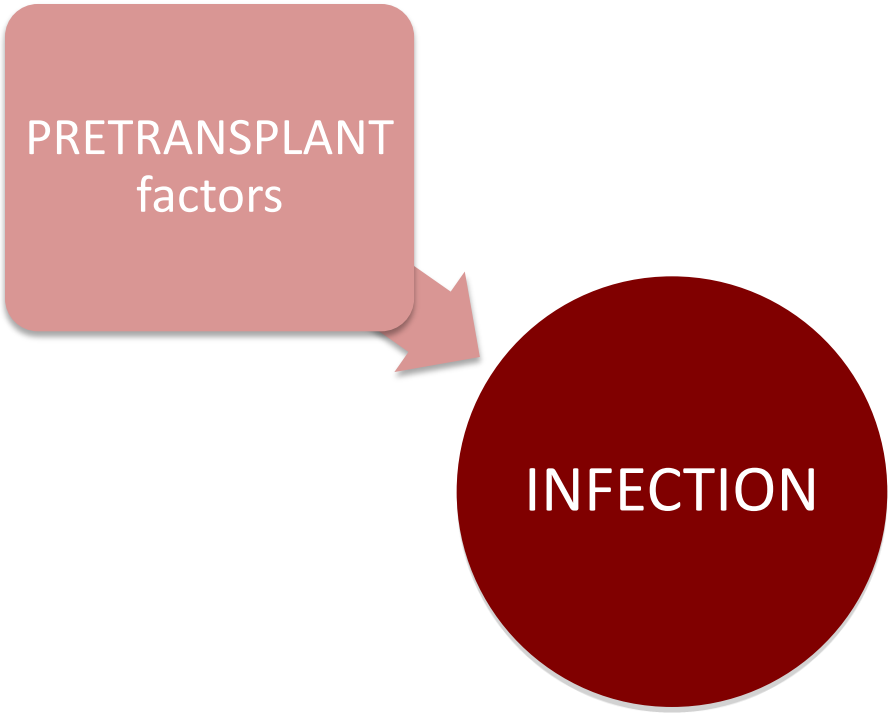
TABLE 169-1 RISK OF INFECTION, BY TYPE OF HEMATOPOIETIC STEM CELL TRANSPLANT

Type of Hematopoietic Stem Cell Transplant	Source of Stem Cells	Risk of Early Infection: Neutrophil Depletion	Risk of Late Infection: Impaired T and B Cell Function	Risk of Ongoing Infection: GVHD and Iatrogenic Immunosuppression	Graft vs. Tumor Effect
Autologous	Recipient (self)	High risk; neutrophil recovery sometimes prolonged	~1 year	Minimal to no risk of GVHD and late-onset severe infection	None (–)
Syngeneic (genetic twin)	Identical twin	Low risk; 1–2 weeks for neutrophil recovery	~1 year	Minimal risk of GVHD and late-onset severe infection	+/–
Allogeneic related	Sibling	Low risk; 1–2 weeks for neutrophil recovery	~1 year	Minimal to moderate risk of GVHD and late-onset severe infection	++
Allogeneic related	Child/parent (haploidentical)	Intermediate risk; 2–3 weeks for neutrophil recovery	1–2 years	Moderate risk of GVHD and late-onset severe infection	++++
Allogeneic unrelated adult	Unrelated donor	Intermediate risk; 2–3 weeks for neutrophil recovery	1–2 years	High risk of GVHD and late-onset severe infection	++++
Allogeneic unrelated cord blood	Unrelated cord-blood units (×2)	Intermediate to high risk; neutrophil recovery sometimes prolonged	Prolonged	Minimal to moderate risk of GVHD and late-onset severe infection	++++
Allogeneic mini (nonmyeloablative)	Donor (transiently coexisting with recipient cells)	Low risk; neutrophil counts close to normal	1–2+ years	Variable risk of GVHD and late-onset severe infection[a]	++++ (but develops slowly)

RISK FACTORS OF INFECTION in HSCT



RISK FACTORS OF INFECTION in HSCT



PRE-TRANSPLANT FACTORS

- Includes viral serologic status of the transplant recipient (and donor)
  - DONOR = D / RECIPIENT = R
- The donor may accidentally transmit infection to the recipient OR
- There are *latent* infections that may reactivate and proliferate once the recipient is immunosuppressed

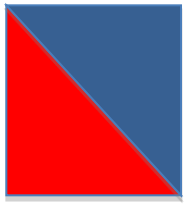
D+

R+

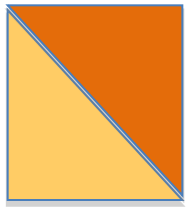
D-

R-

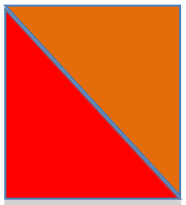
D+/R+



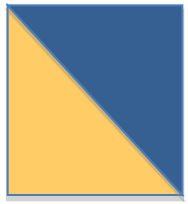
D-/R-

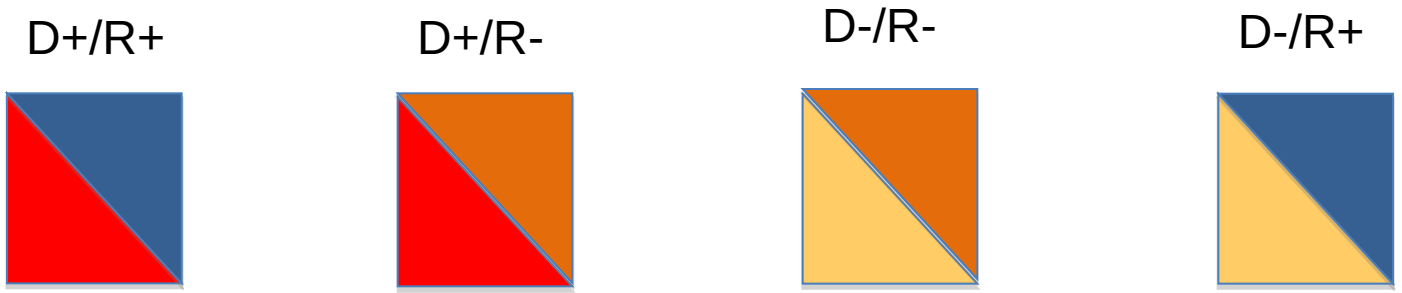


D+/R-



D-/R+





Which combination is LOWEST RISK for CMV INFECTION?

- Herpes viruses are most common after transplantation because many patients are latently infected w/ one or more species that reactivate

TABLE 169-3 HERPESVIRUS SYNDROMES OF TRANSPLANT RECIPIENTS

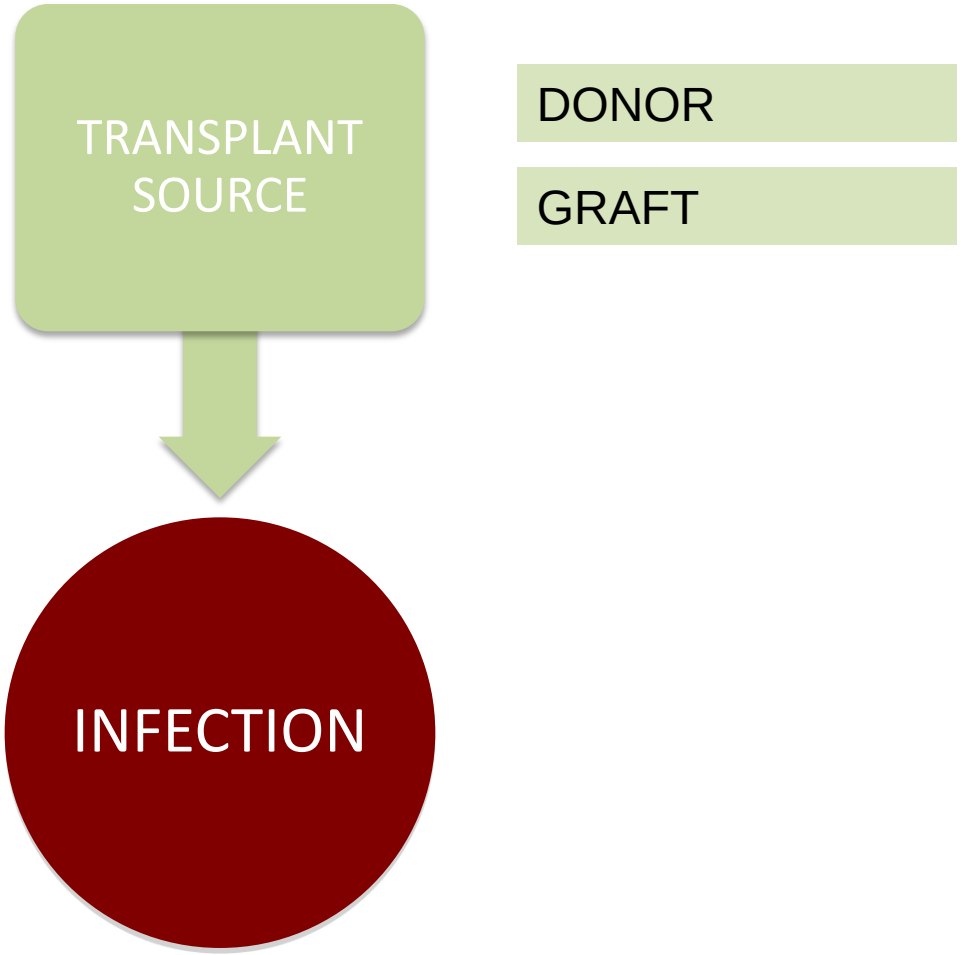
Virus	Reactivation Disease
Herpes simplex virus type 1	Oral lesions
	Esophageal lesions
	Pneumonia (primarily HSC transplant recipients)
	Hepatitis (rare)
Herpes simplex virus type 2	Anogenital lesions
	Hepatitis (rare)
Varicella-zoster virus	Zoster (can disseminate)
Cytomegalovirus	Associated with graft rejection
	Fever and malaise
	Bone marrow failure
	Pneumonitis
	Gastrointestinal disease
Epstein-Barr virus	B cell lymphoproliferative disease/ lymphoma
	Oral hairy leukoplakia (rare)
Human herpesvirus type 6	Fever
	Delayed monocyte/platelet engraftment
	Encephalitis (rare)
Human herpesvirus type 7	Undefined
Kaposi's sarcoma–associated virus	Kaposi's sarcoma
	Primary effusion lymphoma (rare)
	Multicentric Castleman's disease (rare)
	Marrow aplasia (rare)

PRE-TRANSPLANT FACTORS

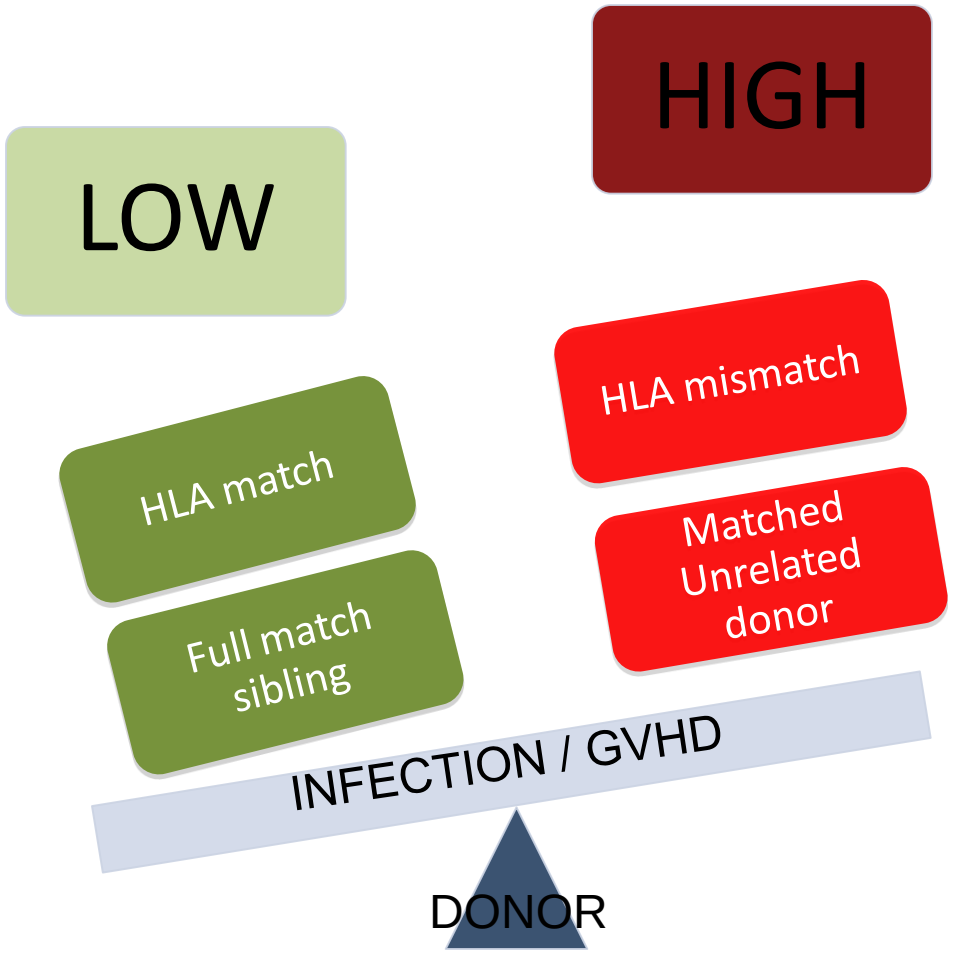
- Higher risk with extensive pretransplant immunosuppressive therapy (eg, fludarabine, clofaribine), prolonged pretransplant neutropenia, or pretransplant infection

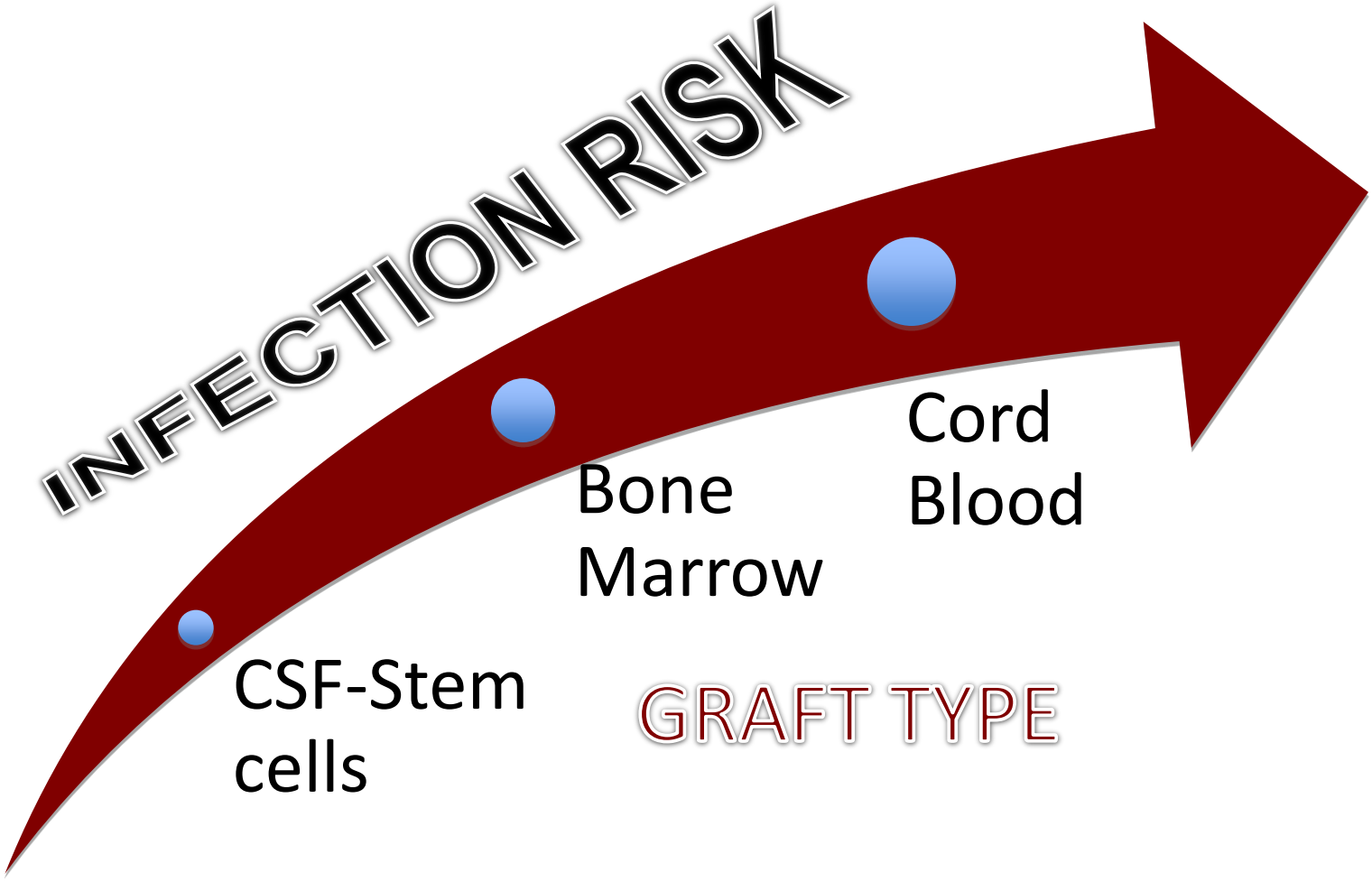
- Higher risk with more advanced disease at the time of transplant

RISK FACTORS OF INFECTION in HSCT



TRANSPLANT SOURCE

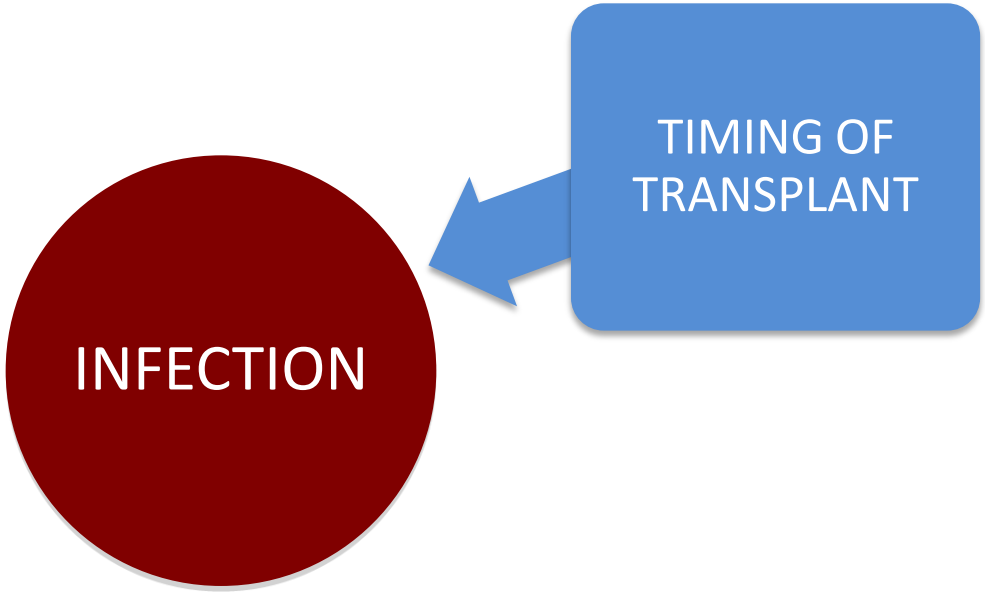



INFECTION RISK
CSF-Stem cells
Bone Marrow
Cord Blood
GRAFT TYPE

TRANSPLANT SOURCE

– The distinguishing determinant of infectious risk between between *autologous* and *allogeneic* grafts is the associated risk by ongoing immunosuppression from GVHD and its therapy

ELEMENTS OF INFECTION in HSCT

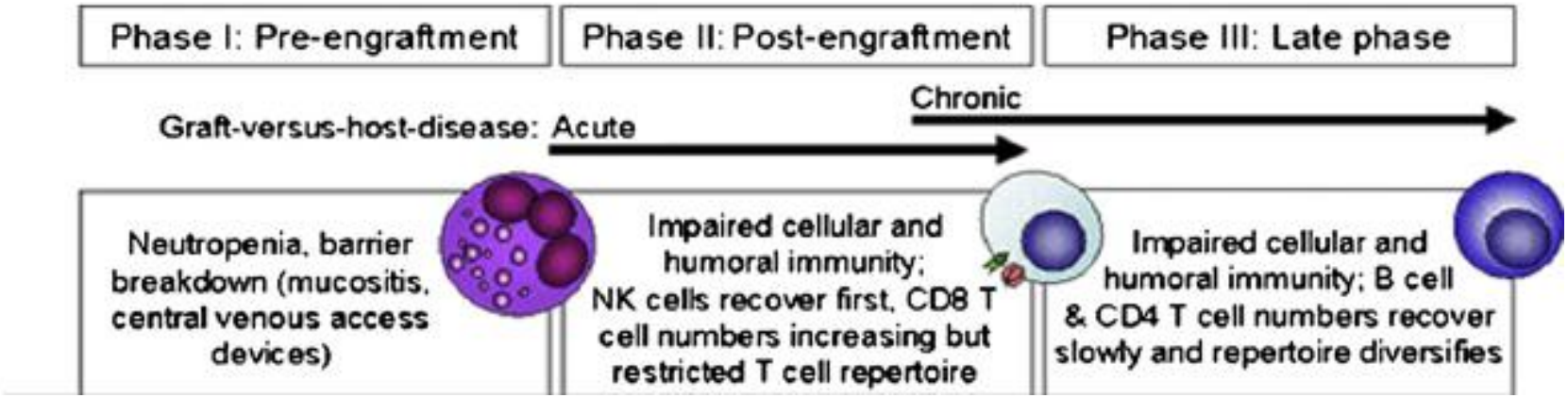


TIMING OF TRANSPLANT

- There are “3” periods of immunologic deficiency in HSCT recipients
  - Pre-engraftment (0-30 days)
  - Engraftment (30-100)
  - Post engraftment (>100)

- Understanding the immune deficiency in each period helps in recognizing uncommon presentation of infectious pathogens

Phases of Opportunistic Infections



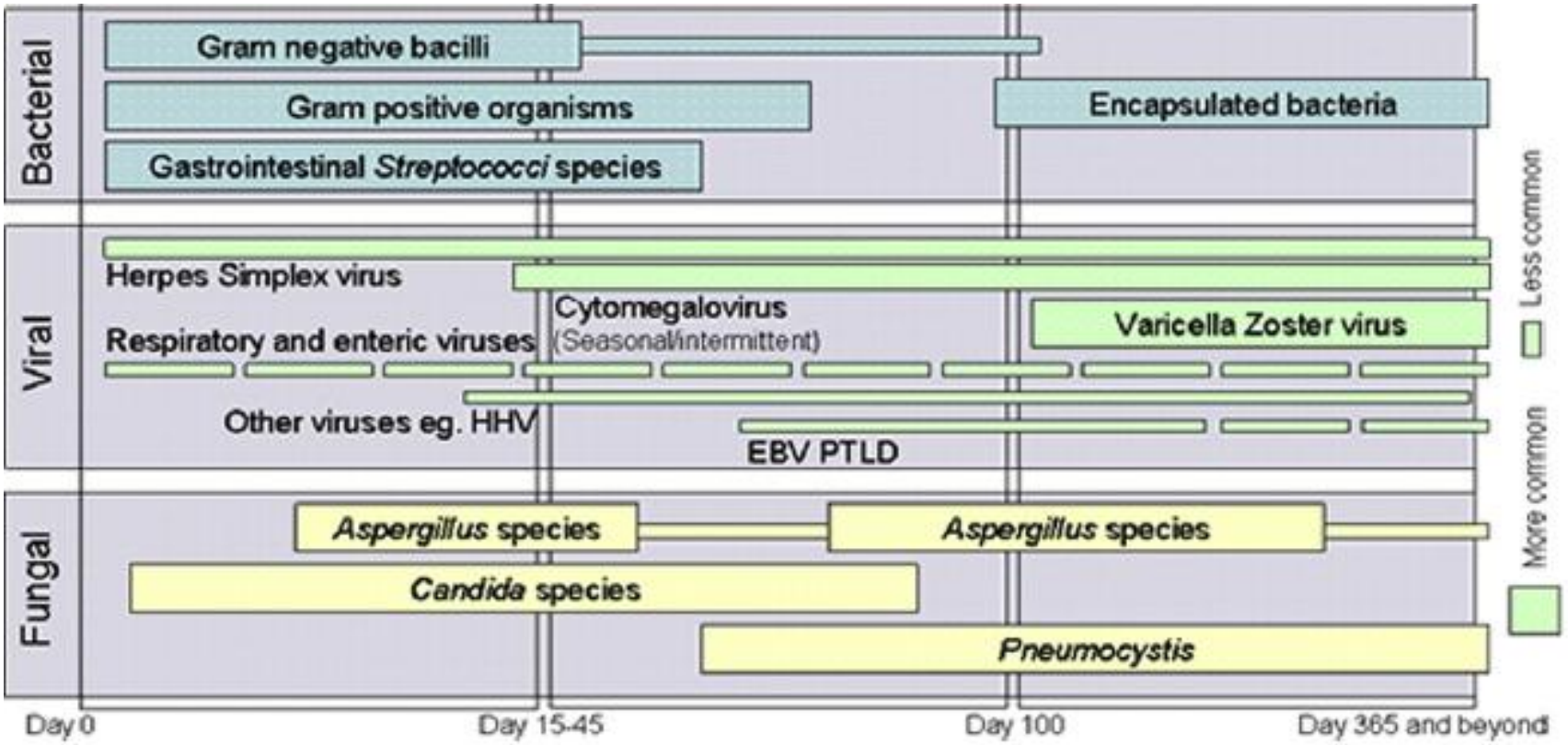
0-30 days 30-100 days >100

Biol Blood Marrow Transplant 15: 1143-1238 (2009)

TABLE 169-2 COMMON SOURCES OF INFECTIONS AFTER HEMATOPOIETIC STEM CELL TRANSPLANTATION

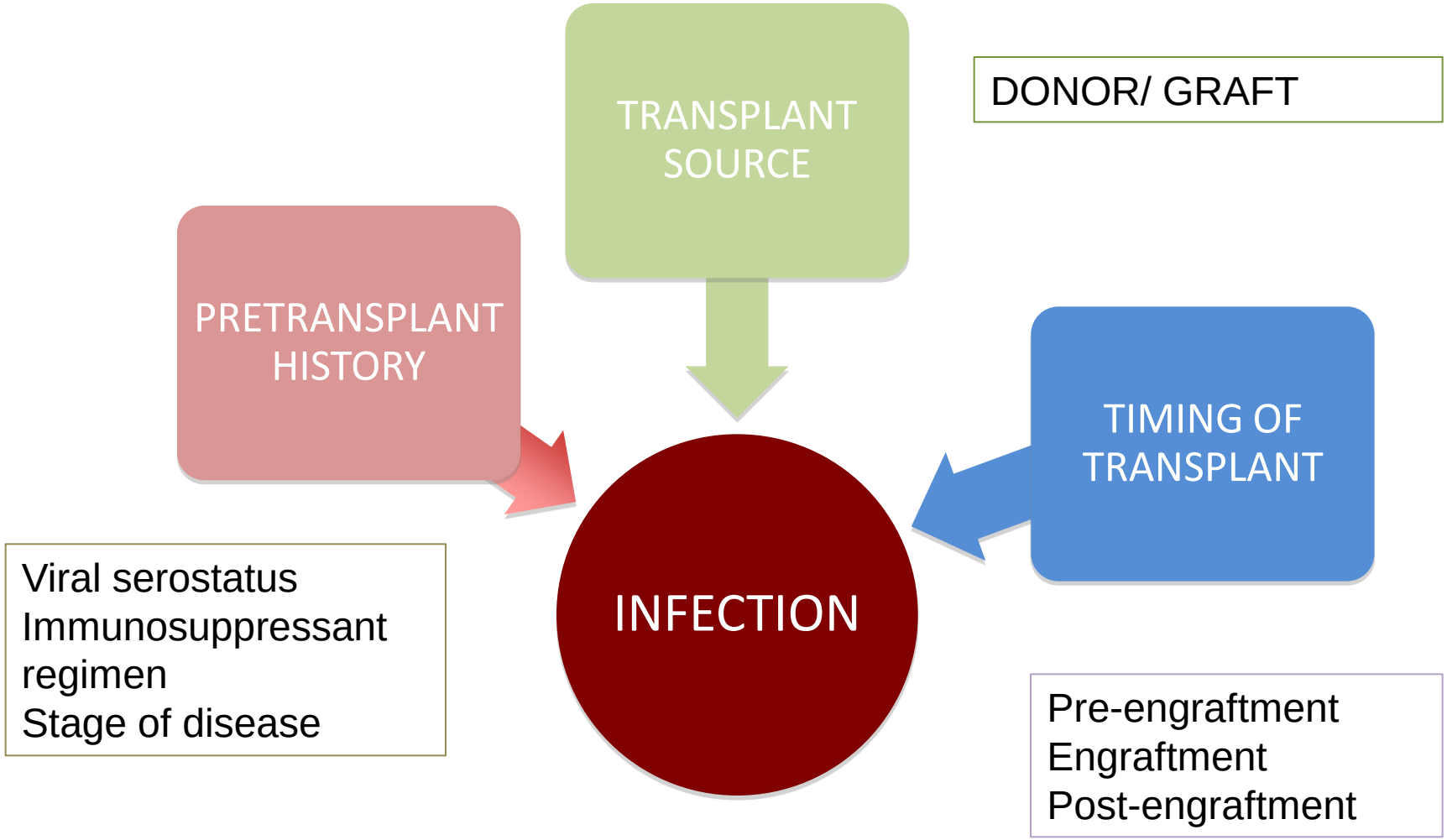
	Period after Transplantation		
Infection Site	**Early (<1 Month)**	**Middle (1–4 Months)**	**Late (>6 Months)**
Disseminated	Aerobic bacteria (gram-negative, gram-positive)	*Candida, Aspergillus,* EBV	Encapsulated bacteria (*Streptococcus pneumoniae, Haemophilus influenzae, Neisseria meningitidis*)
Skin and mucous membranes	HSV	HHV-6	VZV, HPV (warts)
Lungs	Aerobic bacteria (gram-negative, gram-positive), *Candida, Aspergillus,* other molds, HSV	CMV, seasonal respiratory viruses, *Pneumocystis, Toxoplasma*	*Pneumocystis, Nocardia, S. pneumoniae*
Gastrointestinal tract	*Clostridium difficile*	CMV, adenovirus, *Bradyrhizobium enterica* (cord blood cells)	EBV, CMV, *B. enterica* (cord blood cells)
Kidney		BK virus, adenovirus	
Brain		HHV-6, *Toxoplasma*	*Toxoplasma,* JC virus (rare)
Bone marrow		CMV, HHV-6	CMV, HHV-6

Timeline



Biol Blood Marrow Transplant 15: 1143-1238 (2009)

SUMMARY OF KEY RISK FACTORS



Reducing the risk of infection from transplant immunosuppression

PREVENTIVE STRATEGIES

- Ways to reduce risk of infection for SOT recipients
  - Donor selection/Donor and recipient screening
  - Vaccination
  - Pre-emptive treatment – starting treatment ONCE there is evidence of infection or disease
  - Universal prophylaxis – starting treatment for primary prevention BEFORE there is evidence of infection

TABLE 169-6 VACCINATION OF HEMATOPOIETIC STEM CELL TRANSPLANT (HSCT) AND SOLID ORGAN TRANSPLANT (SOT) RECIPIENTS

	Type of Transplantation	
Vaccine	**HSCT**	**SOT[a]**
Streptococcus pneumoniae, *Haemophilus influenzae*, *Neisseria meningitidis*	Immunize after transplantation. See CDC-ACIP recommendations. (For *S. pneumoniae*, a new primary series may be indicated.)	Immunize before transplantation. See CDC-ACIP recommendations. (For *S. pneumoniae*, a booster dose of polysaccharide vaccine after 5 years is recommended.)
Influenza	Vaccinate in the fall. Vaccinate close contacts.	Vaccinate in the fall. Vaccinate close contacts.
Polio	Administer inactivated vaccine.	Administer inactivated vaccine.
Measles/mumps/rubella	Immunize 24 months after transplantation if GVHD is absent.	Immunize before transplantation.
Diphtheria, pertussis, tetanus	Reimmunize after transplantation with primary series, DTaP. See IDSA 2013 recommendations (*www.idsociety.org/Other_Guidelines/#immunizationForthe CompromisedHost*).	Immunize or boost before transplantation with Tdap; give boosters at 10-year intervals or as required.
Hepatitis B and A	Reimmunize after transplantation. See recommendations.	Immunize before transplantation.
Human papillomavirus	Recommendations are pending (*www.cdc.gov/std/hpv/stdfact-hpv-vaccine-hcp.htm*).	Recommendations are pending.

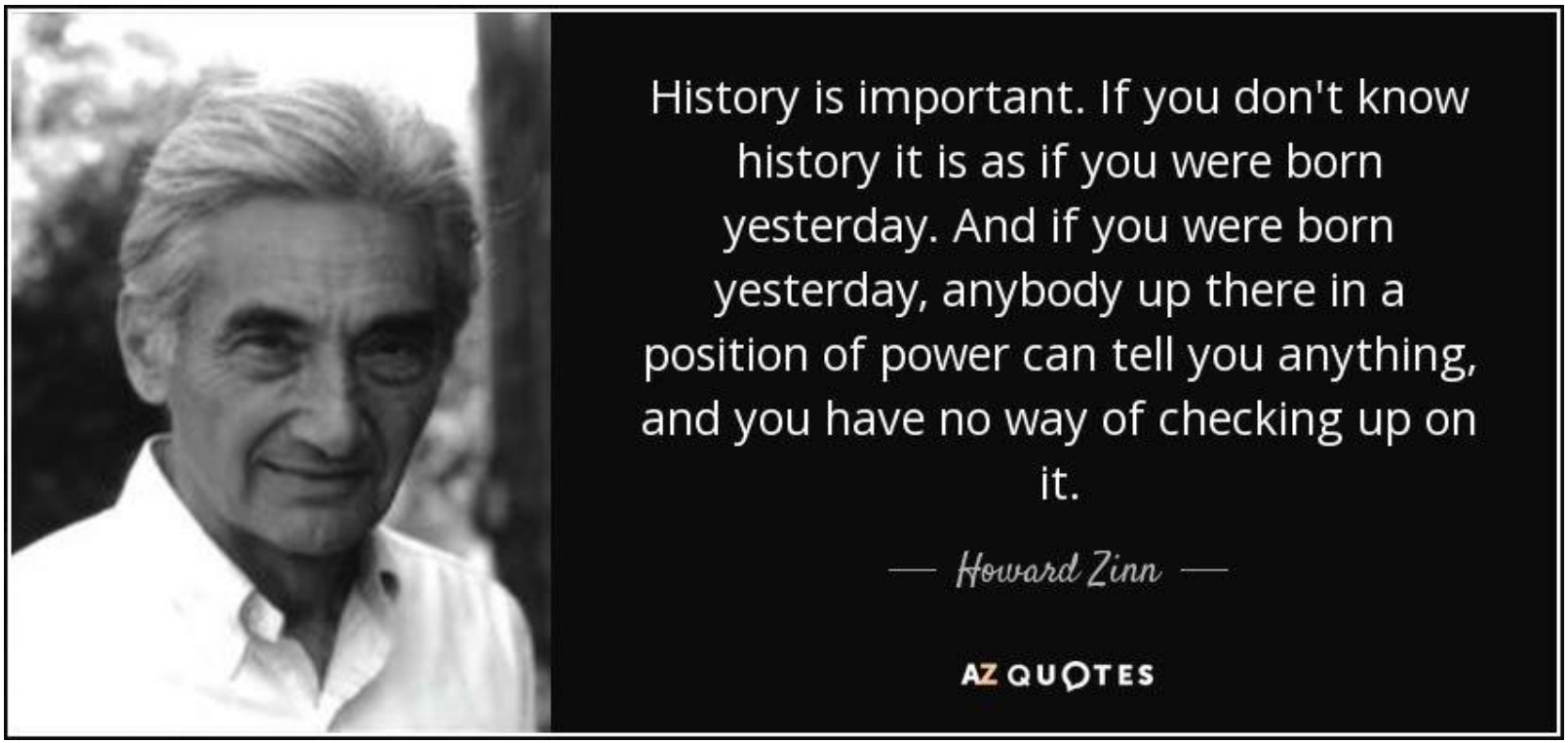
TAKE HOME POINTS

- Individuals who undergo chemotherapy and transplant comprise a special population who are at increased risk of infection
- Both pre-transplant and transplant factors contribute to the increased risk of infection in SOT/HSCT patients.
- The TIMING OF INFECTION is critical in trying to determine the type of infection

TAKE HOME POINTS

- Understanding the underlying immune deficiency is KEY in identifying possible pathogens.

- SOT recipients are immune suppressed FOR LIFE, (while HSCT recipients are NOT, though recovery is prolonged).


History is important. If you don't know history it is as if you were born yesterday. And if you were born yesterday, anybody up there in a position of power can tell you anything, and you have no way of checking up on it.
— Howard Zinn —
AZ QUOTES

WHAT HAPPENED AUGUST 21, 1983?
(And no, It's not JUST Eid al-Adha (Feast of the Sacrifice)

MAG-ARAL. MAGBASA.
(Facebook not counted)

QUESTIONS?

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