

## ANTINEOPLASTIC DRUG CARD ASSEMBLY INSTRUCTIONS

approximate assembly time: 2-3 hours

These drug cards are designed to help you organize the 91 antineoplastic drugs presented in IHO. Preparing these cards is therefore *highly* recommended --- but you can choose not to use them. The “need to know” drugs are different from last year, and these instructions have been changed significantly in order to make the card assembly simpler.

There is no “right” way to set the cards up. The way that I’d set them up is shown below. Some people prefer to put only the drug name labels on the front, and the rest of the stickers on the back (this makes it easier to test chemical classes/resistance etc., but limits the amount of additional info you can add, making it harder to study pharmacokinetics/uses/toxicities. Some people copy all of the info for a particular drug from the lecture notes; others copy just the unique info. Summary versions of how I would set the cards up will be posted on my website in advance of the scheduled “lecture” sessions, with the thought that you’ll want to put the final info onto the cards as part of your preparation.

CCS or CCNS	Regimens
<b>DRUG NAME(S)</b>	
Chemical Subclass	Mechanism subclass, Protein target and/or Resistance

Therapeutic Uses: _____ _____
PK: _____ _____
Toxicities: _____ _____ _____

There are three steps to the primary card assembly process: 1) putting all of the labels onto the cards (pages 2-3); 2) organizing the cards according to lecture (pages 7-8), and 3) adding specific information for each of the drugs (not covered in these instructions).

You might have some extra stickers. Don’t worry about those, but let Barb or me know if anything is missing.

## Step 1: Apply drug name stickers (~20 minutes)

The colour of the card indicates a drug's chemical class. Chemical class information is particularly useful with respect to understanding resistance and toxicities.

**10 ORANGE** cards for **METABOLITES and ANTIMETABOLITES**

**9 BLUE** cards for **ALKYLATING AGENTS**

**10 GREEN** cards for **NATURAL PRODUCTS**

**3 PURPLE CARDS** for **IMMUNOSUPPRESSANTS**

**16 PINK** cards for **THERAPEUTIC PROTEINS**

**14 WHITE** cards for **MISCELLANEOUS** agents

The colours of the drug name *labels* refer to the *mechanism of action* of the drugs, which is how the drugs are going to be grouped from my teaching perspective. Apply the name labels to the front (unlined) face of the cards. Yes, there are only 62 cards -- sometimes similar drugs are grouped on the same card (i.e., some drug cards will have 1 drug listed, others will have multiple drugs/card).

### Orange labels: Drugs that prevent DNA synthesis

**ON ORANGE CARDS:** 5-Fluorouracil [Capecitabine], 6-Mercaptopurine [Azothioprine], 6-Thioguanine, Cladribine, Cytarabine, Fludarabine, Gemcitabine, Methotrexate [Pemetrexed, Pralatrexate]

**ON WHITE CARDS:** Hydroxyurea

### Blue labels: Drugs that disrupt DNA, prevent DNA repair and/or interfere with DNA/RNA synthesis

**ON BLUE CARDS:** Busulfan, Carmustine (BCNU)/Lomustine (CCNU), Cyclophosphamide [Ifosfamide], Dacarbazine, Mechlorethamine, Melphalan, Procarbazine, Temozolamide

**ON WHITE CARDS:** Cisplatin [Carboplatin, Oxaloplatin]

**ON GREEN CARDS:** Bleomycin, Doxorubicin [Daunorubicin, Idarubicin, Epirubicin, Mitoxantone], Etoposide, Irinotecan/Topotecan, Mitomycin

**Green labels: Drugs that prevent mitosis (spindle poisons)**

**ON GREEN CARDS:** Ixabepilone, Paclitaxel [Docataxel, Cabazitaxel], Vinblastine [Vinorelbine], Vincristine

**Purple labels: Immunosuppressants**

**ON PURPLE CARDS:** Prednisone / Dexamethasone

**ON GREEN CARDS:** Cyclosporine / Tacrolimus

**ON PINK CARDS:** Alemtuzumab, Denileukin diftitox, Gemtuzumab, Rituximab / Ibritumumab / Tositumomab

**Pink labels: Drugs that stimulate the immune system**

**ON PINK CARDS:** Interferon  $\alpha$ , Interleukin-2 (IL-2), Tumor necrosis factor  $\alpha$

**Black labels: Drugs that target altered protein or pathway function**

**ON GREEN CARD:** L-asparaginase

**ON PINK CARDS:** Cetuximab / Panitumomab (2 labels on 1 card), Trastuzumab

**ON WHITE CARDS:** Bortezomib, Erlotinib/Gefitinib, Imatinib [Dasatinib, Nilotinib], Lapatinib, Vorinostat

**Red labels: Angiogenesis inhibitors**

**ON PINK CARDS:** Bevacizumab, Interleukin 12

**ON PURPLE CARDS:** Everolimus, Temsirolimus

**ON WHITE CARDS:** Pazopanib / Sorafenib / Sunitinib, Thalidomide  
(note that there was a mistake: use the single label, rather than the 2 labels)

**Brown labels: Differentiating agents**

**ON WHITE CARDS:** Arsenic trioxide, Bexarotene, Tretinoin

### Grey labels: Supporting Agents:

**ON ORANGE CARDS:** Allopurinol, Leucovorin

**ON WHITE CARD:** MESNA

**ON PINK CARDS:** Erythropoietin [Darbepoietin, PEGEpoietin], Filgrastim [PEGFilgrastim], Interleukin 11, Romiplostim, Sargramostim

1. At this point, the cards should be organized according to mechanism of action (9 groups based on label colour). Cut the other stickers apart, and put like things together. Put the antigens (light blue rectangles) and enzymes (dark blue ovals) into alphabetical order.

### **Step 2: Apply Chemical Subclass stickers** (~20 minutes)

#### ANTIMETABOLITES and related drugs (orange labels)

2. Folate analogues: Leucovorin, Methotrexate /Pemetrexed/Pralatrexate
3. Pyrimidine analogues: 5-Fluorouracil [Capecitabine], Cytarabine, Gemcitabine
4. Purine analogues: 6-Mercaptopurine [Azothioprine], 6-Thioguanine, Allopurinol, Cladribine, Fludarabine

#### DRUGS THAT DAMAGE DNA (blue labels)

5. Nitrogen mustards: Chlorambucil, Cyclophosphamide [Ifosfamide], Mechlorethamine, Melphalan
6. Nitrosoureas: Carmustine (BCNU), Lomustine (CCNU)
7. Anthracycline antibiotics: Doxorubicin [Daunorubin, Epirubicin, Idarubicin, Mitoxantone]
8. (not anthracycline) Antibiotics: Bleomycin, Mitomycin
9. Plant alkaloids: Etoposide, Irinotecan/Topotecan

#### ANTIMITOTICS (green labels)

10. (not anthracycline) Antibiotics: Bleomycin, Cyclosporine/Tacrolimus, Everolimus/Temsirolimus, Ixabepilone, Mitomycin

11. Plant alkaloids: Paclitaxel [Docataxel, Cabazitaxel], Vinblastine [Vinorelbine], Vincristine

DRUGS THAT SUPPRESS THE IMMUNE SYSTEM (purple labels)

12. (not anthracycline) Antibiotics: Cyclosporine/Tacrolimus

13. Glucocorticoids: Prednisone/Dexamethasone

14. Fusion protein: Denileukin diftitox

DRUGS THAT STIMULATE THE IMMUNE SYSTEM (pink labels)

15. Cytokines: Interleukin 2, Interferon  $\alpha$ , Tumor necrosis factor  $\alpha$

ANGIOGENESIS INHIBITORS (red labels)

16. (not anthracycline) Antibiotics: Everolimus/Temsirolimus

17. Cytokines: Interleukin 12

DIFFERENTIATING AGENTS (brown labels)

18. Retinoid: Tretinoin

19. Rexinoid: Bexarotene

SUPPORTING AGENTS (grey labels)

20. Cytokines: Erythropoietin [Darbepoietin, Mpegepoietin], Filgrastim [Pegfilgrastim], Interleukin 11, Sargramostim, Tumor necrosis factor  $\alpha$

### **3. Apply Mechanism Subclass stickers** (~60 minutes)

DRUGS THAT DAMAGE DNA (blue labels)

21. Crosslink DNA: Busulfan, Carmustine (BCNU)/Lomustine (CCNU), Chlorambucil, Cisplatin [Carboplatin, Oxaloplatin], Cyclophosphamide [Ifosfamide], Dacarbazine, Mechlorethamine, Melphalan, Mitomycin, Procarbazine, Temozolamide

22. Intercalate DNA: Doxorubicin [Daunorubicin, Idarubicin, Epirubicin, Mitoxantone]

23. Cause strand breaks: Bleomycin, Etoposide, Irinotecan/Topotecan, Procarbazine

ANTIMITOTICS (green labels)

24. Halt spindle assembly: Vinblastine [Vinorelbine], Vincristine
25. Promote spindle assembly: Ixabepilone, Paclitaxel [Docataxel, Cabazitaxel]

DRUGS THAT PREVENT PROTEIN FUNCTION (black labels)

26. Signal transduction inhibitors (STIs): Erlotinib/Gefitinib, Imatinib/Dasatinib/Nilotinib], Lapatinib, Pazopanib/Sorafenib/Sunitinib
27. Enzyme targets (blue ovals with white letters):

ANTIMETABOLITES and related drugs (orange labels)

DHFR	Methotrexate [Pemetrexed, Pralatrexate]
Thymidylate synthase	5-Fluorouracil [Capecitabine]
PNP, HGPRT	6-Mercaptopurine, 6-Thioguanine
DNA polymerase	Cladribine, Cytarabine, Fludarabine, Gemcitabine
Ribonucleotide reductase	Cytarabine, Fludarabine, Gemcitabine, Hydroxyurea
Xanthine oxidase	Allopurinol

DRUGS THAT DAMAGE DNA (blue labels)

Topoisomerase I	Irinotecan/Topotecan
Topoisomerase II	Etoposide

DRUGS THAT SUPPRESS THE IMMUNE SYSTEM (purple labels)

Cyclophilin	Cyclosporine
FK-binding protein	Tacrolimus

DRUGS THAT PREVENT PROTEIN FUNCTION (black labels)

26S Proteasome	Bortezomib
BCR-ABL	Imatinib [Dasatinib, Nilotinib]
EGFR	Erlotinib/Gefitinib, Lapatinib

HER2	Lapatinib
mTOR	Everolimus/Temsirolimus
Multiple kinase	Pazopanib/Sorafenib/Sunitinib
HDAC	Vorinostat

ANGIOGENESIS INHIBITORS (red labels)

FGF	Interferon $\alpha$
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28. Antigens (Light blue rectangles):

DRUGS THAT SUPPRESS THE IMMUNE SYSTEM (purple labels)

CD52:	Alemtuzumab
CD33:	Gemtuzumab
CD20:	Rituximab [Ibritumomab, Tositumomab]
IL-2 receptor:	Denileukin diftitox

DRUGS THAT PREVENT PROTEIN FUNCTION (black labels)

EGFR:	Cetuximab / Panitumomab
HER2:	Trastuzumab

ANGIOGENESIS INHIBITORS (red labels)

VEGF	Bevacizumab
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22. Put the cards into the order that they'll be used in lectures (primarily on the basis of mechanism of action (i.e., drug card labels):

For Antineo II: "B12/folate and Antimetabolites" (orange + some grey labels):  
Methotrexate [Pemetrexed, Pralatrexate], Leucovorin, 5-Fluorouracil [Capecitabine], 6-Mercaptopurine [Azothioprine], 6-Thioguanine, Allopurinol, Cladarabine, Cytarabine, Fludarabine, Gemcitabine, Hydroxyurea

- For Antineo III: “Drugs that Disrupt DNA and Antimitotics” (blue/green labels + some grey):  
Mechlorethamine, Cyclophosphamide [Ifosfamide] MESNA, Carmustine (BCNU)/Lomustine (CCNU), Cisplatin [Carboplatin, Oxaloplatin], Busulfan, Chlorambucil, Dacarbazine, Melphalan, Mitomycin, Procarbazine, Temozolamide, Doxorubicin/Daunorubicin/Idarubicin/Epirubicin/Mitoxantone, Bleomycin, Etoposide, Irinotecan/Topotecan, Vinblastine/Vinorelbine, Vincristine, Paclitaxel, Ixabepilone, Erythropoietin [Darbepoietin, Mpegepoietin], Filgrastim [Pegfilgrastim], Sargramostim, Interleukin 11, Romiplostim
- For Antineo IV: “Immune system modifiers and Drugs that target altered protein function” (purple, pink, black and brown labels):  
Prednisone/Dexamethasone, Cyclosporine/Tacrolimus, Alemtuzumab, Denileukin diftitox, Gemtuzumab, Rituximab/Ibritumomab/Tositumomab, Interleukin 2, Interferon  $\alpha$ , Tumor necrosis factor  $\alpha$ , L-asparaginase, Cetuximab/Panitumomab, Trastuzumab, Bortezomib, Vorinostat,
- For Antineo V: “CML Module (black labels): Imatinib/Dasatinib/Nilotinib, Erlotinib/Gefitinib, Lapatinib
- For Antineo VI: “Differentiating Agents, Angiogenesis Inhibitors and Combination Chemotherapy” (red labels): Arsenic trioxide, Tretinoin, Bexarotene Interferon  $\alpha$ , Interleukin 12, Bevacizumab, Pazopanib/Sorafenib/Sunitinib, Everolimus/Temsirolimus, Thalidomide