

Chemotherapy

Chemotherapy literally means using chemicals to treat disease, but it usually refers to medications that fight cancer. Cytotoxic (also known as antineoplastic) chemotherapy halts cell division and kills rapidly growing cells. Unfortunately, it affects not only cancer cells but also fast-growing healthy cells, which can lead to side effects such as nausea, hair loss and susceptibility to infections.

In contrast to traditional chemotherapy, which has been used since the 1940s, a newer type of treatment known as [targeted therapy](#) works more specifically against cancer cells with certain gene mutations or other characteristics, while [immunotherapy](#) helps the immune system fight cancer. Chemotherapy is often tried first before targeted therapy or immunotherapy, but these types of treatment may also be used together.

How does chemotherapy work?

Chemotherapy works by interfering with cancer cell multiplication. Normal cells undergo a regular cycle of growth, division and resting phases, but cancer cells grow out of control. Some chemotherapy drugs only affect only actively dividing cells, while others are most effective during the resting phase.

Many chemotherapy drugs interfere with DNA, the cell's genetic blueprint. Medications known as alkylating agents cause cross-links in DNA strands that prevent copying and repair of genetic material. These include drugs derived from mustard gas (for example, cyclophosphamide and mechlorethamine) and platinum (for example, cisplatin and carboplatin).

Drugs known as antimetabolites (for example, capecitabine and methotrexate) inhibit enzymes needed to produce DNA or RNA or act as defective DNA building blocks. Others interfere with microtubules, tiny structures that play a role in cell division. Several cancer medications (for example, vincristine and paclitaxel) are alkaloids derived from plants. Some antibiotics have antitumor activity (for example, doxorubicin and bleomycin). Certain steroids (for example, dexamethasone and prednisone) both have anticancer activity and are used to help manage side effects.

How is chemotherapy used?

Usually, the chemotherapy medications that have been shown to offer the best balance of effectiveness and tolerability are tried first, known as first-line therapy. If this doesn't work or if the cancer becomes resistant or relapses, second-line drugs may be tried. Sometimes older and sicker

patients start with less intense chemotherapy to minimize side effects.

Chemotherapy may be given as the first treatment to shrink cancer before surgery or radiation therapy. This is known as neoadjuvant chemotherapy. It may also be used after surgery to kill any remaining cancer cells and reduce the risk of recurrence. This is known as adjuvant chemotherapy. Chemotherapy that delays disease progression or shrinks tumors can help relieve symptoms even if it is not expected to lead to a cure or prolong survival. This is known as palliative therapy.

Often, a combination of chemotherapy drugs works better than a single medication used alone, and this can reduce the development of drug resistance. Sometimes additional medications are administered before, during or after chemotherapy to help prevent or manage side effects.

Chemotherapy may be given in a variety of ways, including pills, injections and intravenous (IV) infusions. Infusions are usually administered at a medical facility while pills can be taken at home. People who receive ongoing infusions may get a catheter inserted into a vein (such as a PICC line) or a port inserted under the skin to allow treatment to be administered without puncturing a vein each time. In some cases, chemotherapy drugs may be injected directly into a tumor or administered to a specific part of the body—for example, into the abdominal cavity or the fluid surrounding the brain and spinal cord. Some medications are topical, or applied to the skin.

Chemotherapy is typically given in cycles—for example, one week of treatment followed by three weeks off. The timing of cycles is based on cancer cell growth rates and other factors. This allows breaks from side effects and give normal cells a chance to recover. Chemotherapy is often given for a set period (for example, six months or a year), but sometimes it is continued as long as it is still working.

Chemotherapy Side Effects

Because chemotherapy harms rapidly dividing healthy cells along with cancer cells, it can cause side effects throughout the body. These include cells in the mouth lining, hair follicles and bone marrow, leading to side effects such as mouth sores, hair loss and low blood cell counts. Loss of germ-fighting white blood cells can leave you more susceptible to infections, and loss of platelets can lead to easy bleeding.

Other common chemotherapy side effects include fatigue, nausea and vomiting, loss of appetite, diarrhea, headaches, cognitive problems (chemo brain or brain fog), muscle or joint pain, heart damage and peripheral neuropathy (nerve damage in the hands and feet). Because some drugs can [impair fertility](#), younger people may wish to discuss ways to preserve their reproductive options.

To help prepare for chemotherapy, ask your doctor or nurse about the kinds of side effects you can expect during and after treatment. But remember that people respond differently; side effects may range from mild to severe, and not everyone will experience all of them.

There are many steps you can take to [lessen chemotherapy side effects](#). Sometimes symptoms

can be managed by adjusting your dose or treatment schedule. [Chilling the scalp](#) or hands and feet during treatment can reduce hair loss and neuropathy. Additional medications (such as anti-nausea drugs) and complementary therapies (such as acupuncture) may be used to manage side effects. Management is often easier if started early, and this may help prevent long-term effects. Let your medical team know if you experience side effects so they can help you find ways to cope with them.

Below is a list of commonly used chemotherapy medications. They are used to treat a wide variety of cancer types and are often used in combination regimens (see next table).

Generic name	Brand and other names
alitretinoin	Panretin
altretamine	Hexalen, hexamethylmelamine
amifostine	Ethyol
aminoglutethimide	Cytadren
anagrelide	Agrylin
arsenic trioxide	Trisenox
asparaginase	Elspar, Erwinase, Kidrolase, erwinia L-asparaginase
azacitidine	Vidaza, 5-azacitidine
bendamustine	Treanda, Bendeka
bexarotene	Targretin
bleomycin	Blenoxane
busulfan	Busulfex, Myleran
cabazitaxel	Jevtana
calaspargase pegol-mknl	Asparlas
capecitabine	Xeloda
carboplatin	Paraplatin
carmustine	Gliadel wafer implant, BiCNU
chlorambucil	Leukeran
cisplatin	Platinol, Platinol-AQ, CDDP
cladribine	Leustatin, 2-chlorodeoxyadenosine, 2-CDA
clofarabine	Clolar
cyclophosphamide	Cytoxan, Neosar
cytarabine	Ara-C, Cytosar-U, DepoCyt (liposomal), arabinosylcytosine
dacarbazine	DTIC, DTIC-Dome, imidazole carboxamide
dactinomycin	Cosmegen, actinomycin-D
daunorubicin	Cerubidine, DaunoXome (liposomal), daunomycin, rubidomycin hydrochloride
decitabine	Dacogen
dexamethasone	Decadron, Dexasone, Diodex, Hexadrol, Maxidex
dexrazoxane	Zinecard
docetaxel	Taxotere
doxorubicin	Adriamycin, Rubex, Doxil (liposomal), hydroxydaunomycin
epirubicin	Ellence
eribulin	Halaven

Generic name	Brand and other names
estramustine	Emcyt
etoposide	Etopophos, Toposar, VePesid, etoposide phosphate, VP-16
floxuridine	FUDR
fludarabine	Fludara
fluorouracil	Adrucil, Carac, Efudex, Fluoroplex, Tolak, 5-fluorouracil, 5-FU
flouxymesterone	Halotestin
gemcitabine	Gemzar
hydroxyurea	Droxia, Hydrea, Mylocel
idarubicin	Idamycin, Idamycin PFS
ifosfamide	Ifex
irinotecan	Camptosar, Onivyde, camptothecin-11, CPT-11
ixabepilone	Ixempra
lanreotide	Somatuline Depot
lomustine	CeeNu, Gleostine, CCNA
mechlorethamine	Mustargen, Valchlor, mustine, nitrogen mustard, HN2
melphalan	Alkeran, L-PAM, L-sarcolysin, phenylalanine mustard
mercaptopurine	Purinethol, 6-mercaptopurine, 6-MP
methotrexate	Otrexup, Rasuvo, Rheumatrex, Trexall, amethopterin, MTX
methylprednisolone	Duralone, Medrol, Medralone, M-Prednisol, Solu-Medrol
mitomycin	Jelmyto, Mutamycin, mitomycin-C, MTC
mitotane	Lysodren
mitoxantrone	Novantrone, DHAD
nab-paclitaxel	Abraxane, albumin-bound paclitaxel
omacetaxine	Synribo
oxaliplatin	Eloxatin
paclitaxel	Onxal, Taxol
pegaspargase	Oncaspar, PEG-L-asparaginase
pemetrexed	Alimta
pentostatin	Nipent
prednisone	Deltasone, Meticorten, Orasone
pralatrexate	Folotyn
procarbazine	Matulane
rasburicase	Elitek
streptozocin	Zanosar
temozolomide	Temodar
temsirolimus	Torisel, CCI-779
teniposide	Vumon, VM-26
thalidomide	Thalomid
thioguanine	6-thioguanine, 6-TG, 2-amino-6-mercaptopurine
thiotepa	Thioplex, thiophosphoamide, TSPA
topotecan	Hycamtin
trabectedin	Yondelis
tretinoin	Vesanoid, Atralin, ATRA

Generic name	Brand and other names
trifluridine/tipiricil	Lonsurf
valrubicin	Valstar
vinblastine	Alkaban-AQ, Velban, vincalrestatin
vincristine	Oncovin, Vincasar PFS, Leurocristine, Marqibo (liposomal)
vinorelbine	Navelbine

Generic name: alitretinoin

Brand and other names Panretin

Generic name: altretamine

Brand and other names Hexalen, hexamethylmelamine

Generic name: amifostine

Brand and other names Ethyol

Generic name: aminoglutethimide

Brand and other names Cytadren

Generic name: anagrelide

Brand and other names Agrylin

Generic name: arsenic trioxide

Brand and other names Trisenox

Generic name: asparaginase

Brand and other names Elspar, Erwinase, Kidrolase, erwinia L-asparaginase

Generic name: azacitidine

Brand and other names Vidaza, 5-azacitidine

Generic name: bendamustine

Brand and other names Treanda, Bendeka

Generic name: bexarotene

Brand and other names Targretin

Generic name: bleomycin

Brand and other names Blenoxane

Generic name: busulfan

Brand and other names Busulfex, Myleran

Generic name: cabazitaxel	
Brand and other names	Jevtana
Generic name: calaspargase pegol-mknl	
Brand and other names	Asparlas
Generic name: capecitabine	
Brand and other names	Xeloda
Generic name: carboplatin	
Brand and other names	Paraplatin
Generic name: carmustine	
Brand and other names	Gliadel wafer implant, BiCNU
Generic name: chlorambucil	
Brand and other names	Leukeran
Generic name: cisplatin	
Brand and other names	Platinol, Platinol-AQ, CDDP
Generic name: cladribine	
Brand and other names	Leustatin, 2-chlorodeoxyadenosine, 2-CDA
Generic name: clofarabine	
Brand and other names	Clolar
Generic name: cyclophosphamide	
Brand and other names	Cytoxan, Neosar
Generic name: cytarabine	
Brand and other names	Ara-C, Cytosar-U, DepoCyt (liposomal), arabinosylcytosine
Generic name: dacarbazine	
Brand and other names	DTIC, DTIC-Dome, imidazole carboxamide
Generic name: dactinomycin	
Brand and other names	Cosmegen, actinomycin-D
Generic name: daunorubicin	
Brand and other names	Cerubidine, DaunoXome (liposomal), daunomycin, rubidomycin hydrochloride
Generic name: decitabine	
Brand and other names	Dacogen

Generic name: dexamethasone	
Brand and other names	Decadron, Dexasone, Diodex, Hexadrol, Maxidex
Generic name: dexrazoxane	
Brand and other names	Zinecard
Generic name: docetaxel	
Brand and other names	Taxotere
Generic name: doxorubicin	
Brand and other names	Adriamycin, Rubex, Doxil (liposomal), hydroxydaunomycin
Generic name: epirubicin	
Brand and other names	Ellence
Generic name: eribulin	
Brand and other names	Halaven
Generic name: estramustine	
Brand and other names	Emcyt
Generic name: etoposide	
Brand and other names	Etopophos, Toposar, VePesid, etoposide phosphate, VP-16
Generic name: floxuridine	
Brand and other names	FUDR
Generic name: fludarabine	
Brand and other names	Fludara
Generic name: fluorouracil	
Brand and other names	Adrucil, Carac, Efudex, Fluoroplex, Tolak, 5-fluorouracil, 5-FU
Generic name: fluoxymesterone	
Brand and other names	Halotestin
Generic name: gemcitabine	
Brand and other names	Gemzar
Generic name: hydroxyurea	
Brand and other names	Droxia, Hydrea, Mylocel
Generic name: idarubicin	
Brand and other names	Idamycin, Idamycin PFS

Generic name: ifosfamide	
Brand and other names	Ifex
Generic name: irinotecan	
Brand and other names	Camptosar, Onivyde, camptothecin-11, CPT-11
Generic name: ixabepilone	
Brand and other names	Ixempra
Generic name: lanreotide	
Brand and other names	Somatuline Depot
Generic name: lomustine	
Brand and other names	CeeNu, Gleostine, CCNA
Generic name: mechlorethamine	
Brand and other names	Mustargen, Valchlor, mustine, nitrogen mustard, HN2
Generic name: melphalan	
Brand and other names	Alkeran, L-PAM, L-sarcolysin, phenylalanine mustard
Generic name: mercaptopurine	
Brand and other names	Purinethol, 6-mercaptopurine, 6-MP
Generic name: methotrexate	
Brand and other names	Otrexup, Rasuvo, Rheumatrex, Trexall, amethopterin, MTX
Generic name: methylprednisolone	
Brand and other names	Duralone, Medrol, Medralone, M-Prednisol, Solu-Medrol
Generic name: mitomycin	
Brand and other names	Jelmyto, Mutamycin, mitomycin-C, MTC
Generic name: mitotane	
Brand and other names	Lysodren
Generic name: mitoxantrone	
Brand and other names	Novantrone, DHAD
Generic name: nab-paclitaxel	
Brand and other names	Abraxane, albumin-bound paclitaxel
Generic name: omacetaxine	
Brand and other names	Synribo

Generic name: oxaliplatin	
Brand and other names	Eloxatin
Generic name: paclitaxel	
Brand and other names	Onxal, Taxol
Generic name: pegaspargase	
Brand and other names	Oncaspar, PEG-L-asparaginase
Generic name: pemetrexed	
Brand and other names	Alimta
Generic name: pentostatin	
Brand and other names	Nipent
Generic name: prednisone	
Brand and other names	Deltasone, Meticorten, Orasone
Generic name: pralatrexate	
Brand and other names	Folotyn
Generic name: procarbazine	
Brand and other names	Matulane
Generic name: rasburicase	
Brand and other names	Elitek
Generic name: streptozocin	
Brand and other names	Zanosar
Generic name: temozolomide	
Brand and other names	Temodar
Generic name: temsirolimus	
Brand and other names	Torisel, CCI-779
Generic name: teniposide	
Brand and other names	Vumon, VM-26
Generic name: thalidomide	
Brand and other names	Thalomid
Generic name: thioguanine	
Brand and other names	6-thioguanine, 6-TG, 2-amino-6-mercaptopurine

Generic name: thiotepa
Brand and other names Thioplex, thiophosphoamide, TSPA

Generic name: topotecan
Brand and other names Hycamtin

Generic name: trabectedin
Brand and other names Yondelis

Generic name: tretinoin
Brand and other names Vesanoid, Atralin, ATRA

Generic name: trifluridine/tipiricil
Brand and other names Lonsurf

Generic name: valrubicin
Brand and other names Valstar

Generic name: vinblastine
Brand and other names Alkaban-AQ, Velban, vincal leukoblastine

Generic name: vincristine
Brand and other names Oncovin, Vincasar PFS, Leurocristine, Marqibo (liposomal)

Generic name: vinorelbine
Brand and other names Navelbine

Below is a list of acronyms for some combination chemotherapy regimens. It is not a complete list of all possible combinations.

Regimen	Component drugs
ABVD	Adriamycin (doxorubicin), bleomycin, vinblastine, dacarbazine
ABVE	Adriamycin (doxorubicin), bleomycin, vinblastine, etoposide
ACE	Adriamycin (doxorubicin), cyclophosphamide, etoposide
ADE	Ara-C (cytarabine), daunorubicin, etoposide
ADOC	cisplatin, doxorubicin (Adriamycin), Oncovin (vincristine), cyclophosphamide
BEACOPP	bleomycin, etoposide, Adriamycin (doxorubicin), cyclophosphamide, Oncovin (vincristine), procarbazine, prednisone
CAF	cyclophosphamide, Adriamycin (doxorubicin), fluorouracil
CEPP	cyclophosphamide, etoposide, procarbazine, prednisone
CFAR	cyclophosphamide, fludarabine, alemtuzumab, rituximab
CHOP	cyclophosphamide, hydroxydaunomycin (doxorubicin), Oncovin (vincristine), prednisone
CLAG-M	cladribine, Ara-C (cytarabine), mitoxantrone
COPDAC	cyclophosphamide, Oncovin (vincristine), prednisone, dacarbazine
COPP	cyclophosphamide, Oncovin (vincristine), procarbazine, prednisone

Regimen	Component drugs
CVD	cisplatin, vinblastine, dacarbazine
CVP	cyclophosphamide, vincristine, prednisone
DHAP	dexamethasone, high-dose Ara-C (cytarabine), Platinol (cisplatin)
EOX	epirubicin, oxaliplatin, Xeloda (capecitabine)
EPOCH	etoposide, prednisone, Oncovin (vincristine), cyclophosphamide, hydroxydaunomycin (doxorubicin)
ESHAP	etoposide, Solu-Medrol (methylprednisolone), Ara-C (cytarabine), Platinol (cisplatin)
FAMTX	fluorouracil, Adriamycin (doxorubicin), MTX (methotrexate)
FLAG-IDA	fludarabine, Ara-C (cytarabine), G-CSF (filgrastim), idarubicin
FOLFIRI	folinic acid, fluorouracil, irinotecan
FOLFIRINOX	folinic acid, fluorouracil, irinotecan, oxaliplatin
FOLFOX	folinic acid, fluorouracil, oxaliplatin
GEMOX	gemcitabine, oxaliplatin
Hyper-CVAD	cyclophosphamide, vincristine, Adriamycin (doxorubicin), dexamethasone
ICE	ifosfamide, carboplatin, etoposide
JEB	JM8 (carboplatin), etoposide, bleomycin
MAID	mesna, Adriamycin (doxorubicin), ifosfamide, dacarbazine
MINE	mesna, ifosfamide, Novantrone (mitoxantrone), etoposide (Etopophos, Toposar, VePesid, etoposide phosphate, VP-16)
MMM	mitoxantrone, mitomycin, methotrexate
MOPP	mechlorethamine, Oncovin (vincristine), prednisone, procarbazine
MVAC	methotrexate, vinblastine, Adriamycin (doxorubicin), cisplatin
OPPA	Oncovin (vincristine), procarbazine, prednisone, Adriamycin (doxorubicin)
PAC	Platinol (cisplatin), Adriamycin (doxorubicin), cyclophosphamide
PCV	procarbazine, CCNU (lomustine), vincristine
PEB	Platinol (cisplatin), etoposide, bleomycin
TAC	Taxotere (docetaxel), Adriamycin (doxorubicin), cyclophosphamide
TIP	Taxol (paclitaxel), ifosfamide, Platinol (cisplatin)
VAD	vincristine, Adriamycin (doxorubicin), dexamethasone
VAMP	vincristine, Adriamycin (doxorubicin), methotrexate, prednisone

Regimen: ABVD

Component drugs Adriamycin (doxorubicin), bleomycin, vinblastine, dacarbazine

Regimen: ABVE

Component drugs Adriamycin (doxorubicin), bleomycin, vinblastine, etoposide

Regimen: ACE

Component drugs Adriamycin (doxorubicin), cyclophosphamide, etoposide

Regimen: ADE

Component drugs Ara-C (cytarabine), daunorubicin, etoposide

Regimen: ADOC

Component drugs cisplatin, doxorubicin (Adriamycin), Oncovin (vincristine), cyclophosphamide

Regimen: BEACOPP

Component drugs bleomycin, etoposide, Adriamycin (doxorubicin), cyclophosphamide, Oncovin (vincristine), procarbazine, prednisone

Regimen: CAF

Component drugs cyclophosphamide, Adriamycin (doxorubicin), fluorouracil

Regimen: CEPP

Component drugs cyclophosphamide, etoposide, procarbazine, prednisone

Regimen: CFAR

Component drugs cyclophosphamide, fludarabine, alemtuzumab, rituximab

Regimen: CHOP

Component drugs cyclophosphamide, hydroxydaunomycin (doxorubicin), Oncovin (vincristine), prednisone

Regimen: CLAG-M

Component drugs cladribine, Ara-C (cytarabine), mitoxantrone

Regimen: COPDAC

Component drugs cyclophosphamide, Oncovin (vincristine), prednisone, dacarbazine

Regimen: COPP

Component drugs cyclophosphamide, Oncovin (vincristine), procarbazine, prednisone

Regimen: CVD

Component drugs cisplatin, vinblastine, dacarbazine

Regimen: CVP

Component drugs cyclophosphamide, vincristine, prednisone

Regimen: DHAP

Component drugs dexamethasone, high-dose Ara-C (cytarabine), Platinol (cisplatin)

Regimen: EOX

Component drugs epirubicin, oxaliplatin, Xeloda (capecitabine)

Regimen: EPOCH

Component drugs etoposide, prednisone, Oncovin (vincristine), cyclophosphamide, hydroxydaunomycin (doxorubicin)

Regimen: ESHAP

Component drugs etoposide, Solu-Medrol (methylprednisolone), Ara-C (cytarabine), Platinol (cisplatin)

Regimen: FAMTX

Component drugs fluorouracil, Adriamycin (doxorubicin), MTX (methotrexate)

Regimen: FLAG-IDA

Component drugs fludarabine, Ara-C (cytarabine), G-CSF (filgrastim), idarubicin

Regimen: FOLFIRI

Component drugs folinic acid, fluorouracil, irinotecan

Regimen: FOLFIRINOX

Component drugs folinic acid, fluorouracil, irinotecan, oxaliplatin

Regimen: FOLFOX

Component drugs folinic acid, fluorouracil, oxaliplatin

Regimen: GEMOX

Component drugs gemcitabine, oxaliplatin

Regimen: Hyper-CVAD

Component drugs cyclophosphamide, vincristine, Adriamycin (doxorubicin), dexamethasone

Regimen: ICE

Component drugs ifosfamide, carboplatin, etoposide

Regimen: JEB

Component drugs JM8 (carboplatin), etoposide, bleomycin

Regimen: MAID

Component drugs mesna, Adriamycin (doxorubicin), ifosfamide, dacarbazine

Regimen: MINE

Component drugs mesna, ifosfamide, Novantrone (mitoxantrone), etoposide (Etopophos, Toposar, VePesid, etoposide phosphate, VP-16)

Regimen: MMM

Component drugs mitoxantrone, mitomycin, methotrexate

Regimen: MOPP

Component drugs mechlorethamine, Oncovin (vincristine), prednisone, procarbazine

Regimen: MVAC

Component drugs methotrexate, vinblastine, Adriamycin (doxorubicin), cisplatin

Regimen: OPPA

Component drugs Oncovin (vincristine), procarbazine, prednisone, Adriamycin (doxorubicin)

Regimen: PAC

Component drugs Platinol (cisplatin), Adriamycin (doxorubicin), cyclophosphamide

Regimen: PCV

Component drugs procarbazine, CCNU (lomustine), vincristine

Regimen: PEB

Component drugs Platinol (cisplatin), etoposide, bleomycin

Regimen: TAC

Component drugs Taxotere (docetaxel), Adriamycin (doxorubicin), cyclophosphamide

Regimen: TIP

Component drugs Taxol (paclitaxel), ifosfamide, Platinol (cisplatin)

Regimen: VAD

Component drugs vincristine, Adriamycin (doxorubicin), dexamethasone

Regimen: VAMP

Component drugs vincristine, Adriamycin (doxorubicin), methotrexate, prednisone

The following resources offer more information about chemotherapy:

[American Cancer Society](#)

[American Society of Clinical Oncology](#)

[Chemocare](#)

[National Cancer Institute](#)

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<http://beta.docker.cancerhealth.com/basics/health-basics/chemotherapy>