THE #1 IV DRUG REFERENCE FOR 40 YEARS

2014 INTRAVENOUS MEDICATIONS

30TH EDITION

BETTY L. GAHART
ADRIENNE R. NAZARENO

ELSEVIER

http://evolve.elsevier.com

General Dilution Chart (Gm to mg)							
Amount of Drug Required in Grams	Amount of Diluent						
	1,000 mL	500 mL	250 mL	125 mL	100 mL	50 mL	25 mL
	mg/mL	mg/mL	mg/mL	mg/mL	mg/mL	mg/mL	mg/mL
20 Gm	20	40	80	160	200	400	800
19 Gm	19	38	76	152	190	380	760
18 Gm	18	36	72	144	180	360	720
17 Gm	17	34	68	136	170	340	680
16 Gm	16	32	64	128	160	320	640
15 Gm	15	30	60	120	150	300	600
14 Gm	14	28	56	112	140	280	560
13 Gm	13	26	52	104	130	260	520
12 Gm	12	24	48	96	120	240	480
11 Gm	11	22	44	88	110	220	440
10 Gm	10	20	40	80	100	200	400
9 Gm	9	18	36	72	90	180	360
8 Gm	8	16	32	64	80	160	320
7 Gm	7	14	28	56	70	140	280
6 Gm	6	12	24	48	60	120	240
5 Gm	5	10	20	40	50	100	200
4.5 Gm	4.5	9	18	36	45	90	180
4 Gm	4	8	16	32	40	80	160
3.5 Gm	3.5	7	14	28	35	70	140
3 Gm	3	6	12	24	30	60	120
2.5 Gm	2.5	5	10	20	25	50	100
2 Gm	2	4	8	16	20	40	80
1.5 Gm	1.5	3	6	12	15	30	60
1 Gm	1	2	4	8	10	20	40
0.5 Gm	0.5	1	2	4	5	10	20
0.25 Gm	0.25	0.5	1	2	2.5	5	10

To use chart:

1. Find mg/mL desired, track to amount of diluent desired and amount of drug in Grams required.
2. Find amount of drug in Grams required, track to diluent desired and/or mg/mL desired.
3. Find amount of diluent required, track to amount of drug in Grams and/or mg/mL desired.

Formula: Substitute any number for X

X Grams diluted in 1,000 mL = X mg/mL (1 Gram in 1,000 mL = 1 mg/mL)
X Grams diluted in 500 mL = 2 X mg/mL (1 Gram in 500 mL = 2 mg/mL)
X Grams diluted in 250 mL = 4 X mg/mL (1 Gram in 250 mL = 4 mg/mL)
X Grams diluted in 125 mL = 8 X mg/mL (1 Gram in 125 ml = 8 mg/mL)
X Grams diluted in 100 mL = 10 X mg/mL (1 Gram in 100 mL = 10 mg/mL)
X Grams diluted in 50 mL = 20 X mg/mL (1 Gram in 50 mL = 20 mg/mL)
X Grams diluted in 25 mL = 40 X mg/mL (1 Gram in 25 mL = 40 mg/mL)

Some variation occurs from manufacturer's overfill or if the drug is in liquid form. If absolute accuracy is required, these variations can be avoided by withdrawing an amount in mL from the diluent equal to manufacturer's overfill and/or an amount equal to the amount in mL of the drug. Consult the pharmacist for specific information on manufacturer's overfill of infusion fluids used in your facility.

General Dilution Chart (mg to mcg)							
Amount of Drug Required in Grams	Amount of Diluent						
	1,000 mL	500 mL	250 mL	125 mL	100 mL	50 mL	25 mL
	mcg/mL	mcg/mL	mcg/mL	mcg/mL	mcg/mL	mcg/mL	mcg/mL
20 mg	20	40	80	160	200	400	800
19 mg	19	38	76	152	190	380	760
18 mg	18	36	72	144	180	360	720
17 mg	17	34	68	136	170	340	680
16 mg	16	32	64	128	160	320	640
15 mg	15	30	60	120	150	300	600
14 mg	14	28	56	112	140	280	560
13 mg	13	26	52	104	130	260	520
12 mg	12	24	48	96	120	240	480
11 mg	11	22	44	88	110	220	440
10 mg	10	20	40	80	100	200	400
9 mg	9	18	36	72	90	180	360
8 mg	8	16	32	64	80	160	320
7 mg	7	14	28	56	70	140	280
6 mg	6	12	24	48	60	120	240
5 mg	5	10	20	40	50	100	200
4.5 mg	4.5	9	18	36	45	90	180
4 mg	4	8	16	32	40	80	160
3.5 mg	3.5	7	14	28	35	70	140
3 mg	3	6	12	24	30	60	120
2.5 mg	2.5	5	10	20	25	50	100
2 mg	2	4	8	16	20	40	80
1.5 mg	1.5	3	6	12	15	30	60
1 mg	1	2	4	8	10	20	40
0.5 mg	0.5	1	2	4	5	10	20
0.25 mg	0.25	0.5	1	2	2.5	5	10

To use chart:

1. Find mcg/mL desired, track to amount of diluent desired and amount of drug in mg required.
2. Find amount of drug in mg required, track to diluent desired and/or mcg/mL desired.
3. Find amount of diluent required, track to amount of drug in mg and/or mcg/mL desired.

Formula: Substitute any number for X

X mg diluted in 1,000 mL = X mcg/mL (1 mg in 1,000 mL = 1 mcg/mL)
X mg diluted in 500 mL = 2 X mcg/mL (1 mg in 500 mL = 2 mcg/mL)
X mg diluted in 250 mL = 4 X mcg/mL (1 mg in 250 mL = 4 mcg/mL)
X mg diluted in 125 mL = 8 X mcg/mL (1 mg in 125 ml = 8 mcg/mL)
X mg diluted in 100 mL = 10 X mcg/mL (1 mg in 100 mL = 10 mcg/mL)
X mg diluted in 50 mL = 20 X mcg/mL (1 mg in 50 mL = 20 mcg/mL)
X mg diluted in 25 mL = 40 X mcg/mL (1 mg in 25 mL = 40 mcg/mL)

Some variation occurs from manufacturer's overfill or if the drug is in liquid form. If absolute accuracy is required, these variations can be avoided by withdrawing an amount in mL from the diluent equal to manufacturer's overfill and/or an amount equal to the amount in mL of the drug. Consult the pharmacist for specific information on manufacturer's overfill of infusion fluids used in your facility.

Evolve
learning system

ELSEVIER

YOU'VE JUST PURCHASED MORE THAN A REFERENCE BOOK

ACTIVATE THE COMPLETE EXPERIENCE
THAT COMES WITH YOUR BOOK BY REGISTERING AT

http://evolve.elsevier.com/IVMeds

- **Before You Begin**
- **Alerts/Content Updates**
- **Do Not Confuse Drug Names**
- **New Drug Updates**
- **Format and Content**
- **Selected Agents Not Included in the Book**

Agalsidase Beta
Alglucerase
Alglucosidase Alfa
Ammonium Chloride
Amobarbital Sodium
Antivenin (Micrurus fulvius)
Arginine Hydrochloride
Benztropine Mesylate
Caffeine and Sodium Benzoate
Cefotetan Disodium
Chlorothiazide Sodium
Colchicine
Colistimethate Sodium
Corticorelin Ovine Triflutate
Daclizumab
Dextran 1
Diazoxide
Dimenhydrinate
Diphtheria Antitoxin
Doxapram Hydrochloride
Ephedrine
Ethacrynic Acid
Galsulfase
L-Hyoscyamine Sulfate
Idursulfase
Inamrinone
Indium In-111 Pentetreotide
Itraconazole
Kanamycin
Laronidase
Levocarnitine
Lincomycin Hydrochloride
Mechlorethamine
Methoxy Polyethylene Glycol-Epoetin Beta
Methocarbamol
Methyldopate
Methylene Blue
Minocycline Hydrochloride
Orphenadrine Citrate
Piperacillin Sodium
Pyridostigmine Bromide
Remifentanil
Rocuronium Bromide
Samarium SM 153 Lexidronam Injection
Secretin
Sermorelin Acetate
Sincalide
Sodium Lactate
Sodium Nitrite and Sodium Thiosulfate
Streptokinase
Strontium-89 Chloride Injection
Succinylcholine
Theophylline in D5W
Thiopental Sodium
Tranexamic Acid
Treprostinil
Urokinase

- **General Dilution and Solution Compatibility Charts (Printable)**
- **Tutorial: Step-by-Step Examples for Calculating IV Drug Dosages**
- **Calculators and Interactive IV Drug Dosage Examples**
- **Appendixes**
- **Drug Information and Safety Weblinks**

REGISTER TODAY!

HOW TO USE THIS BOOK

STEP 1

Refer to the index at the back of the book. You can find any drug by any name in less than 5 seconds. All drugs are cross-indexed by generic and all known trade names. The index is easily distinguished by a printed blue bar at the edge of the pages. Drugs are also indexed by pharmacologic action. With one turn of the page, all drugs included in the text with similar pharmacologic actions and their page numbers are available to you. Everything is strictly alphabetized; you will never be required to refer to additional pages to locate a drug.

STEP 2

Turn to the single page number given after the name of the drug. All information about the drug is included as continuous reading. You will rarely be required to turn to another section of the book to be completely informed. Specific breakdowns of each drug (Usual Dose, Pediatric Dose, Dose Adjustments, Dilution, Compatibility, Rate of Administration, Actions, Indications and Uses, Precautions, Contraindications, Drug/Lab Interactions, Side Effects, and Antidote) are consistent in format and printed in boldface type. Subheadings under these categories are in boldface. Scan quickly for a Usual Dose check, Dose Adjustment, Drug/Lab Interaction, Side Effect, or Antidote or carefully read all included information. The choice is yours. A quick scan will take 5 to 10 seconds. Even the most complicated drugs will take less than 2 minutes to read completely. Read each monograph carefully and completely before administering a drug to a specific patient for the first time and review it any time a new drug is added to the patient's drug profile.

That's it! A fast, complete, and accurate reference for anyone administering intravenous medications. The spiral binding is specifically designed to lie flat, leaving your hands free to secure needed supplies, prepare your medication, or even ventilate a patient while you read the needed information.

Develop the "look it up" habit. Clear, concise language and simplicity of form contribute to quick, easy use of this handbook. Before your first use, read the preface; it contains lots of helpful information.

Check out the *Intravenous Medications* website for monographs no longer included in this text and for other useful IV medication information:

http://evolve.elsevier.com/IVMeds

This page intentionally left blank

INTRAVENOUS MEDICATIONS

A Handbook for Nurses and Health Professionals

BETTY L. GAHART, RN
Nurse Consultant in Education
Napa, California
Former Director, Education and Training
Queen of the Valley Medical Center
Napa, California

ADRIENNE R. NAZARENO, PharmD
Clinical Manager, Pharmacist in Charge
Queen of the Valley Medical Center
Napa, California

THIRTIETH EDITION

ELSEVIER

ELSEVIER
MOSBY

3251 Riverport Lane
St. Louis, Missouri 63043

INTRAVENOUS MEDICATIONS ISBN: 978-0-323-08478-9

Copyright © 2014 by Mosby, an imprint of Elsevier Inc.

No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or any information storage and retrieval system, without permission in writing from the publisher. Details on how to seek permission, further information about the Publisher's permissions policies and our arrangements with organizations such as the Copyright Clearance Center and the Copyright Licensing Agency, can be found at our website: www.elsevier.com/permissions.

This book and the individual contributions contained in it are protected under copyright by the Publisher (other than as may be noted herein).

Notices

Knowledge and best practice in this field are constantly changing. As new research and experience broaden our understanding, changes in research methods, professional practices, or medical treatment may become necessary.

Practitioners and researchers must always rely on their own experience and knowledge in evaluating and using any information, methods, compounds, or experiments described herein. In using such information or methods they should be mindful of their own safety and the safety of others, including parties for whom they have a professional responsibility.

With respect to any drug or pharmaceutical products identified, readers are advised to check the most current information provided (i) on procedures featured or (ii) by the manufacturer of each product to be administered, to verify the recommended dose or formula, the method and duration of administration, and contraindications. It is the responsibility of the practitioners, relying on their own experience and knowledge of their patients, to make diagnoses, to determine dosages and the best treatment for each individual patient, and to take all appropriate safety precautions.

To the fullest extent of the law, neither the Publisher nor the authors, contributors, or editors, assume any liability for any injury and/or damage to persons or property as a matter of products liability, negligence or otherwise, or from any use or operation of any methods, products, instructions, or ideas contained in the material herein.

Previous editions copyrighted 1973, 1977, 1981, 1984, 1988, 1989, 1990, 1991, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013

ISBN: 978-0-323-08478-9
ISSN: 1556-7443

Executive Content Strategist, Nursing: Lee Henderson
Senior Content Development Specialist: Rae Robertson
Publishing Services Manager: Deborah L. Vogel
Senior Project Manager: Jodi M. Willard
Design Direction: Ashley Eberts

Printed in the United States of America

Last digit is the print number: 9 8 7 6 5 4 3 2 1

Working together to grow
libraries in developing countries

www.elsevier.com | www.bookaid.org | www.sabre.org

ELSEVIER BOOK AID International Sabre Foundation

NURSING AND PHARMACOLOGY CONSULTANTS

KIM HUBER, PharmD
Clinical Pharmacist
Memorial Medical Center
1700 Coffee Rd.
Modesto, California

MEGHAN McELWAIN ORTEGA, RN, BSN
Continuum Pediatric Nursing
Schaumburg, Illinois

GREGORY D. NAZARENO, PharmD
Staff Pharmacist
John Muir Medical Center
Walnut Creek, California

MERRILEE NEWTON, RN, MSN
Administrative Director of Quality, Service, and Clinical Resource Management
Alta Bates/Summit Medical Center
Berkeley, California

REVIEWERS

DANA H. HAMAMURA, PharmD, RPh
Clinical Pharmacist
Emergency Department
University of Colorado Hospital
Aurora, Colorado

JOSHUA J. NEUMILLER, PharmD, CDE, CGP, FASCP
Assistant Professor of Pharmacotherapy
Washington State University
College of Pharmacy
Spokane, Washington

CHRISTOPHER T. OWENS, PharmD, BCPS
Associate Professor and Chair
Department of Pharmacy Practice
College of Pharmacy
Idaho State University
Pocatello, Idaho

RANDOLPH E. REGAL, BS, PharmD, RPh
Clinical Associate Professor
Adult Internal Medicine
University of Michigan Hospital, College of Pharmacy
Ann Arbor, Michigan

TRAVIS E. SONNETT, PharmD, FASCP
Clinical Assistant Professor
College of Pharmacy
Washington State University;
Clinical Pharmacy Specialist
Veteran Administration Medical Center of Spokane
Spokane, Washington

This page intentionally left blank

To my husband,
Bill,
for his patience, support, and many hours of much needed and appreciated assistance, and to our children, ***Marty, Jeff, Debbie, Rick,*** *and* ***Teresa;*** *their spouses,* ***Sally, Terri, Jim,*** *and* ***Bill;*** *and our grandchildren,* ***Meghan, Laurie, Alex, Anne, Kathryn, Lisa, Benjamin, Matthew, Claire, Neil, Scott,*** *and* ***Alan*** *for their encouragement and understanding.*

BLG

To my husband,
Greg,
for his loving support and encouragement, and to my children, ***Danielle, Bryan, Emily,*** *and* ***Mark,*** *for allowing me the freedom to pursue my professional practice.*

ARN

This page intentionally left blank

PREFACE

This Year 2014 edition marks the forty-first year of publication of *Intravenous Medications*.

In this thirtieth edition, a total of 8 new drugs approved by the FDA for intravenous use have been incorporated. These new drugs are presented in individual monographs and include ado-trastuzumab emtansine (Kadcyla) for the treatment of patients with HER2-positive breast cancer; carfilzomib (Kyprolis) for the treatment of multiple myeloma; 6% hydroxyethyl starch 130/0.4 in sodium chloride (Voluven), a plasma volume substitute; pertuzumab (Perjeta) for the treatment of late-stage breast cancer; pooled plasma, human (Octaplas) for the replacement of multiple coagulation factors; raxibacumab (ABthrax) for the treatment of anthrax; and ziv-aflibercept (Zaltrap) for the treatment of metastatic colon cancer. Prothrombin complex concentrate, human (Kcentra) for the urgent reversal of acquired coagulation factor deficiency induced by vitamin K antagonists has recently been approved by the FDA and can be found in Appendix E.

Many new uses have been approved for established drugs, and numerous safety issues have been identified by the FDA. All of these changes are incorporated so our readers have the most current information available. All **Compatibilities** in this edition have been updated.

We continually strive to make information in this handbook informative and easier to access. **We continue to identify drugs with a Black Box Warning BBW in the main heading of the monograph.** In addition, **Black Box Warning statements are shaded** in light gray **and a different typeface is used** for instant identification wherever they appear in the text. ***Blue-screened text*** emphasizes a special circumstance not covered by a Black Box Warning. The FDA is now identifying **Limitations of Use** of drugs under Indications. Previously this information has been placed in Precautions.

In the past, we have incorporated the Common Toxicity Criteria (CTC) provided by the U.S. Department of Health and Human Services, the National Institutes of Health, and the National Cancer Institute. This listing has been expanded and updated by these organizations and is too expansive to be included in an appendix. Web access to this material is available at **www.cancer.gov**. Search for CTCAE (Common Terminology Criteria for Adverse Events Version 4.0). Printed copies are available free of charge; call 1-800-4-CANCER (1-800-422-6237).

We are all aware that **The Joint Commission** and the **Institute for Safe Medication Practices (ISMP)** have strongly emphasized various ways to reduce errors in drug ordering and administration. One of their suggestions is to refer to a drug by both its generic and its trade name. ***Intravenous Medications*** is the only reference that has consistently used both names since its first publication. They also recommend that symbols (e.g., $<$, $>$, $\leq$, $\geq$,) be spelled out. **Although we have always spelled out most of them, they are now all spelled out. The only exception is in charts, where there isn't room for the spelled out version.** The symbols are included in the Key to Abbreviations (p. xxi) if you need a refresher. **Some of the other ways we assist in safe administration** is to spell out the word *units;* we use Gm instead of gm so it is not confused with mg, use mcg instead of μg, and drop all trailing 0s (as in 1.0) to prevent overdoses. **The Joint Commission, ISMP, the American Pharmaceutical Association, and several other organizations have identified "High-Alert Medications" (a list of medications with the highest risk of injury when misused).** The websites of these organizations contain considerable information and identify common risk factors and suggested strategies. From the authors' viewpoint, **all drugs given by the IV route should be considered high-alert medications.** They have an immediate effect, are irretrievable, and can cause life-threatening side effects with incorrect usage.

We join The Joint Commission in urging you to pay special attention to **how tubes and catheters are connected to patients.** The Joint Commission challenges the manufacturers of these devices to redesign them in ways that will make dangerous misconnection much

less possible. Look up The Joint Commission suggestions. A preventive measure not mentioned by The Joint Commission is the **simple practice of labeling every line at the point of entry into the patient.** This should be done whenever more than a single piece of tubing (IV or other) is connected to a patient. Multiple-lumen catheters, 3-way stopcocks, chest tubes, nasogastric tubes, and any other tubing entering the patient should be labeled with its contents or use at the connection closest to the patient. In today's health care settings, patients frequently have multiple tubes inserted into their bodies. Correct labeling takes only a few seconds at the time of insertion and saves many moments of precious time every time the line needs to be accessed. Misconnection errors may be fatal; establish all of these suggestions as a standard of practice, and misconnection errors will be avoided.

Elsevier has an electronic version of *Intravenous Medications* for personal digital assistants (PDAs). This "handheld" electronic version is a convenient and portable supplement to the book. In addition, all drugs presently on the Evolve IV Meds website (**http://evolve.elsevier.com/IVMeds**) for *Intravenous Medications* (because of space limitations for the print version) are incorporated in this electronic version. Although the handheld version is easy to carry, keep in mind that only a few lines of text are available at any one time. It is the user's responsibility to be familiar with the complete monograph and ***all*** aspects of each drug before administration.

Health care today is an intense **environment.** The speed of change is overwhelming, but the authors and publisher of *Intravenous Medications* have a commitment to provide all health care professionals who have the responsibility to administer IV medications with annual editions that incorporate complete, accurate, and current information in a clear, concise, accessible, and reliable tool. FDA websites are monitored throughout the year and provide many important updates, such as dose changes, new pediatric doses, additional disease-specific doses, refinements in dosing applications, new indications, new drug interactions, additional precautions, updates on post-marketing side effects, and new information on antidotes. Most drugs currently approved for intravenous use are included. Exceptions are opaque dyes used in radiology, some general anesthetics used only in the OR, and a few rarely used drugs. To stay within the confines of the spiral binding, selected diagnostic agents, muscle relaxants intended for use only in the OR, and several other rarely used drugs have been moved to the Evolve IV Meds website: **http://evolve.elsevier.com/IVMeds**. (See p. ii for a listing.) Helpful charts for dilution and/or rate of administration are incorporated in selected monographs. A General Dilution Chart to simplify calculations is found on the inside front cover. Front matter material provides a Key to Abbreviations and Important IV Therapy Facts.

Intravenous Medications is designed for use in critical care areas, at the nursing station, in the office, in public health and home care settings, and by students and the armed services. Pertinent information can be found in a few seconds. Take advantage of its availability and quickly review every intravenous medication before administration.

The nurse is frequently placed in a variety of difficult situations. While the physician verbally requests or writes an order, the nurse must evaluate it for appropriateness, prepare it, administer it, and observe the effects. Intravenous drugs are instantly absorbed into the bloodstream, leading, it is hoped, to a prompt therapeutic action, but the risk of an inappropriate reaction is a constant threat that can easily become a frightening reality. It will be the nurse who must initiate emergency measures should adverse effects occur. This is an awesome responsibility.

If, after reviewing the information in *Intravenous Medications,* you have any questions about any order you are given, clarify it with the physician, consult the pharmacist, or consult your supervisor. The circumstances will determine whom you will approach first. If the physician thinks it is imperative to carry out an order even though you have unanswered questions, never hesitate to request that the physician administer the drug, drug combination, or dose himself or herself. In this era of constant change, the physician should be very willing to supply you, your supervisor, and/or the pharmacist with current studies documenting the validity and appropriateness of orders.

All information presented in this handbook is pertinent only to the intravenous use of the drug and not necessarily to intramuscular, subcutaneous, oral, or other means of administration.

Our sincere appreciation is extended to Meghan McElwain, Gregory Nazareno, Kim Huber, and Merrilee Newton for their ongoing participation in our efforts to bring you current, accurate, and relevant information; and to Lee Henderson, Rae Robertson, Deborah L. Vogel, Jodi M. Willard, and Jessica Williams at Elsevier and Joe Rekart at Graphic World, who are the editors, production staff, and design staff that make the publishing of *Intravenous Medications* happen each year. A special thank you to Betty's granddaughter Meghan McElwain Ortega, RN, BSN. She has provided much-appreciated help with the research needed to complete this edition and continues to be introduced to the process of preparing updated editions.

We also wish to thank you, the users of this reference. By seeking out this information, you serve your patients' needs and contribute to the safe administration of IV meds. We will continue to strive to earn your trust and confidence as we look forward together to an exciting future for health care.

Betty L. Gahart

Adrienne R. Nazareno

This page intentionally left blank

CONTENTS

This page intentionally left blank

FORMAT AND CONTENT OF *INTRAVENOUS MEDICATIONS*

Designed to facilitate quick reference, each entry begins with the generic name of the drug in boldface type. **Drugs with a Black Box Warning are identified with a symbol BBW in the main heading.** Phonetic pronunciations appear just below the generic name. Drug categories follow. The primary category may be followed by additional ones representing the multiple uses of a drug. Associated trade names are under the generic name. Boldface type and alphabetical order enable the reader to verify correct drug names easily. The use of a Canadian maple leaf symbol (🍁) after a trade name indicates availability in Canada only. The pH is listed in the lower right-hand corner of the title section. While this information is not consistently available, it is provided whenever possible. It represents the pH of the undiluted drug, the drug after reconstitution, or the drug after dilution for administration.

Headings within drug monographs are as follows:

Usual Dose: Doses recommended are the usual range for adults unless specifically stated otherwise. This information is presented first to enable the nurse to verify that the physician order is within acceptable parameters while checking the order and before preparation. If there are any questions, much time can be saved in clarifying them. If premedication is indicated, it will be noted here.

Pediatric Dose: Pediatric doses are specifically stated if they vary from mg/kg of body weight or M^2 dose recommended for adults. Not all drugs are recommended for use in children. See Maternal/Child for information on safety and effectiveness for use in pediatric patients.

Infant and/or Neonatal Dose: Included if available and distinct from Pediatric Dose. See Maternal/Child for information on safety and effectiveness for use in pediatric patients, including infants and neonates.

Dose Adjustments: Any situation that requires increasing or decreasing a dose is mentioned here. The range covers adjustments needed for elderly, debilitated, or hepatic or renal impairment patients; adjustments required by race or gender; or adjustments required in the presence of other medications or as physical conditions are monitored.

Dilution: Specific directions for dilution are given for all drugs if dilution is necessary or permissible. Drugs, diluents, and solutions must be appropriate for IV use. Certain medications may be available in more than one form (e.g., Advantage, Duplex); follow manufacturer's directions for reconstitution and stability. The manufacturing and approval of generics seems to be accelerating. They are usually similar to the trade version but may differ slightly, so be sure to double check the dose and dilution requirements. Sadly, extreme cost-consciousness has overtaken the health care system. Nurses are being requested not to dilute drugs unless specifically required by the manufacturer, in order to save the cost of a needle, a syringe, or a small vial of diluent. Always use your best judgment and keep the safety of the patient as your priority. Appropriate diluents are listed. The Solution Compatibility Chart on the inside back cover has been expanded and updated. Diluents that are not identified in Dilution will be listed in this chart. This is the only reference that provides calculation examples to simplify dilution and accurate dose measurement. Charts are available in selected monographs. If recommendations for pediatric dilutions are available, they are listed. In some situations mcg or mg/mL dilutions partially account for this variation. If there are any doubts, consult with the pharmacist and/or pediatric specialist. Generic dilution charts for grams to milligrams and milligrams to micrograms are featured on the inside front cover and facing page.

Filters: A subheading. Content here includes information included in prescribing information and information we have requested from manufacturers. Many drugs are filtered during the manufacturing process. There are numerous variations in recommendations for filtration after the manufacturing process. Filters are single-use one-way streets and are most effective when used at the last stage of mixing or dilution or in-line as administered to the patient. Most manufacturers expect that a drug distrib-

uted in an ampule will be filtered to eliminate the possibility of glass being drawn into a syringe on withdrawal of the drug. This is always a two-needle process. One process uses a standard needle to withdraw from the ampule; that needle is then replaced with a needle filter to inject the drug into the diluent. If it will not be added to a diluent, use the needle filter to withdraw from the ampule and replace it with a new standard needle to administer. When questioned, many manufacturers suggest following a specific hospital's standard, which may recommend that a drug distributed as a powder be filtered either with a needle filter on withdrawal from the vial, after reconstitution as added to the diluent, or with an in-line filter on delivery to the patient. Some acknowledge that in selected situations (e.g., open heart surgery) everything is filtered at some point before delivery to the patient. Although these responses are helpful, none of them clarify specific information about a drug. For questions, the manufacturer's pharmacist is available.

Storage: A subheading. Content here includes such items as stability, refrigeration versus room temperature, predilution versus postdilution. Newly approved generics may have slight differences; check the manufacturer's recommendations.

COMPATIBILITIES

The focus of this section is **compatibility. Any drug not listed as compatible should be considered incompatible.** ***Incompatibilities are listed only when specifically identified by the manufacturer. No third-party incompatibilities are listed.***

Some monographs include only general information because that is all that is available. It may include the manufacturer's recommendation to administer separately from other drugs or the potential for reaction with some plastic infusion bags or tubing.
Other monographs include manufacturers' statements regarding the potential inactivation or inhibition of one drug on another.

Compatibilities listed by the manufacturer are listed first, followed by **compatibilities** listed by another source, which may be divided into **additive and Y-site.** ***Any drug not listed as compatible should be considered incompatible.*** Drugs are alphabetized by generic name for ease in locating the drugs with which you are working. To make identification easier, common trade names accompany generic names, or examples are presented for drug categories. No other reference consistently provides this helpful information.

Because compatibilities may be influenced by many factors (e.g., temperature, pH, concentration, time together in solution, a specific order of mixing), **it is imperative that you verify compatibilities with your pharmacist.** Knowledge is growing daily in this field, and your pharmacist should have current information on the pharmacy computer or access to extensive references. Many compatibility studies have been done by other parties for both additive and Y-site compatibilities. Almost all are based on specific concentrations, which may or may not relate to usual doses or recommended concentrations.

Occasionally sources disagree on compatibility. If there is conflicting information about a compatibility, you will be told that this is not recommended by the manufacturer, or ***the individual drugs that may have a conflict will be underlined.***

What steps should you consider before administering any drug?

- If the drug you wish to administer is not listed in the **Compatibility** section, ***consider it to be incompatible.*** To administer, you must turn off the infusing IV (at the stopcock or with a clamp close to the Y-site), flush the line with a solution compatible to both drugs (and/or solutions), administer the required drug, and flush the line again before turning the previously infusing IV back on. If you are unable to discontinue the infusion IV, you must have another IV access (e.g., a multi-lumen catheter, a second, IV line, or a heparin lock). Some drugs actually require separate tubing.
- If compatibilities are included in the package insert from the manufacturer, it will be so stated. If the manufacturer lists drugs as compatible by additive or Y-site and doesn't list concentrations, this is a good assurance of compatibility. If concentrations are listed, review the concentrations of both drugs to make sure they are within the defined parameters.

- If the drug you wish to administer is listed in the **Compatibility** section of the access you wish to use (e.g., **additive or Y-site),** ***you must consult with the pharmacist to confirm any specific conditions that may apply.*** After your consultation, write the results of your consultation regarding the specific directions for co-administering drugs on the patient's medication record or nursing care plan so others will not need to retrace your research steps when the medication is to be given again.
- When combining drugs in a solution (additives), always consider the required rate adjustments of each drug. Can each drug produce the desired effect at the suggested rate, or is continuous adjustment necessary for one drug, making the combination impractical?
- Y-site means that the specific drug in a specific monograph is compatible at its Y-site with an injection or an infusion containing one of the drugs listed under Y-site. The reverse Y-site compatibility may not be true.
- Although some drugs may be listed as compatible at the Y-site, some drugs can be administered at the Y-site only if they are further diluted in compatible solutions and given as an infusion (e.g., potassium concentrates [e.g., acetates, chlorides, phosphates], saline solution in concentrations greater than 0.9% or NS, amino acids, and dextrose solutions greater than 10% [unless in small amounts such as 50 mL dextrose 50% in insulin-induced hypoglycemia]).
- Because today's hospital units are very specialized (e.g., cancer care, emergency room, intensive coronary care, various intensive care units, transplant units, and orthopedic units to name just a few), nursing staff in each of these areas most likely administer similar combinations of drugs to their patients. ***Take the initiative and research the drug combinations that are most frequently used on your unit. Then consult with the pharmacist and make your own compatibility chart for additives and Y-site (if applicable).*** By creating a chart specific to your unit, you will limit the number of consults required with the pharmacist to combinations that fall outside of the parameters you have researched. This approach will save time for every nurse on your unit and will give each of you the necessary compatibility information to administer the IV drug combinations specific to your unit.
- The Solution Compatibility Chart on the inside back cover has been expanded and updated. Diluents that are not identified in Dilution will be listed in this chart.

Rate of Administration: Accepted rates of administration are clearly stated. As a general rule, a slow rate is preferred. 25-gauge needles aid in giving a small amount of medication over time. Problems with rapid or slow injection rates are indicated here. Adjusted rates for infants, children, or the elderly are listed when available. Charts are available in selected monographs.

Actions: Clear, concise statements outline the origin of each drug, how it affects body systems, its length of action, and methods of excretion. If a drug crosses the placental barrier or is secreted in breast milk, it will be mentioned here if that information is available.

Indications and Uses: Uses recommended by the manufacturer are listed. **Limitations of Use** are now being identified by the manufacturer or FDA for some drugs. Unlabeled uses are stated as such.

Contraindications: Contraindications are those specifically listed by the manufacturer. Consult with the physician if an ordered drug is contraindicated for the patient. The physician may have additional historical information that alters the situation or may decide that use of the drug is indicated in a critical situation.

Precautions: The section on precautions covers many areas of information needed before injecting any drug, including black-box warnings from the prescribing information. Most Black Box Warnings appear in this Precautions section; however, **all actual Black Box Warning statements are shaded** in light gray **and a different typeface is used** for instant identification wherever they appear in the text. The range of information in this category covers all facets not covered under specific headings. Each listing is as important as the

next. To make it easier for spot checks (after reading the entire monograph), additional subdivisions are included.

Monitor: A subheading that includes information such as required prerequisites for drug administration, parameters for evaluation, and patient assessments.

Patient Education: A subheading that addresses only specific, important issues required for short-term IV use. It is expected that the health professional will always review the major points in the drug profile with any conscious patient, side effects to expect, how to cope with them, when to report them, special requirements such as the intake of extra fluids, and an overall review of what the drug does, why it is needed, and how long the patient can anticipate receiving it. Patient Medication Guides approved by the FDA are available for most drugs, and it is recommended that the patient review the Medication Guide whenever possible before beginning treatment and repeat the review as indicated.

Maternal/Child: A subheading that addresses FDA pregnancy categories (see Appendix B for a complete explanation), any known specifics affecting patients capable of conception, safety for use during lactation, safety for use in pediatric patients, and any special impact on infants and neonates.

Elderly: A subheading that is included whenever specific information impacting this patient group is available. Always consider age-related organ impairment (e.g., cardiac, hepatic, renal, insufficient bone marrow reserve), history of previous or concomitant disease or drug therapy, and route of excretion when determining dose and evaluating side effects.

Drug/Lab Interactions: Drug/drug or drug/lab interactions are listed here. To help identify these interactions more easily, **single drugs, drug categories when there are multiple drugs, and specific tests are in boldface type.** If a conflict with the patient's drug profile is noted, consult a pharmacist immediately. Increasing or decreasing the effectiveness of a drug can be a potentially life-threatening situation. Check with the lab first on drug/lab interactions; acceptable alternatives are usually available. After this consultation, notify the physician if appropriate. To facilitate recognition, common trade names accompany generic names or examples are presented for drug categories. No other reference consistently provides this helpful information.

Side Effects: In some monographs, the most common side effects may be listed first, followed by the most serious side effects. In all monographs, alphabetical order simplifies confirmation that a patient's symptom could be associated with specific drug use. Specific symptoms of overdose are listed where available or distinct from usual doses.

Post-Marketing: Post-marketing side effects reported that have not been previously recorded in the prescribing information are listed.

Antidote: Specific antidotes are listed in this section if available. In addition, specific nursing actions to reverse undesirable side effects are clearly stated—an instant refresher course for critical situations.

Within a heading there may be references to other sections within an individual monograph (e.g., see Precautions, see Monitor, see Dose Adjustments, see Maternal/Child). These references indicate additional requirements and should be consulted before administering the drug.

KEY TO ABBREVIATIONS

<	less than
>	more than
¼NS	one-fourth normal saline (0.2%)
⅓NS	one-third normal saline (0.33%)
½NS	one-half normal saline (0.45%)
ABGs	arterial blood gases
ACE	angiotensin converting enzyme
ACT	activated coagulation time
AF	atrial fibrillation
A/G	albumin-to-globulin ratio
AIDS	acquired immunodeficiency syndrome
ALT	(SGPT) alanine aminotransferase
AMI	acute myocardial infarction
ANC	absolute neutrophil count
aPTT	activated partial thromboplastin time
ARDS	adult respiratory distress syndrome/ acute respiratory distress syndrome
AST	(SGOT) aspartate aminotransferase
AUC	area under the curve
AV	atrioventricular
BMD	bone mass density
BP	blood pressure
BSA	body surface area
BUN	blood urea nitrogen
BWFI	bacteriostatic water for injection
C	Celsius
Ca	calcium
CABG	coronary artery bypass graft
CAD	coronary artery disease
CAPD	continuous ambulatory peritoneal dialysis
CBC	complete blood cell count
CDAD	*Clostridium difficile*–associated diarrhea
CHF	congestive heart failure
Cl	chloride
CNS	central nervous system
CO2	carbon dioxide
CPK	creatine-kinase
CrCl	creatinine clearance
CRF	chronic renal failure
CRT	controlled room temperature (20° to 25° C [68° to 77° F])
CSF	cerebrospinal fluid
C/S	culture and sensitivity
CTCAE	Common Terminology Criteria for Adverse Events
CVP	central venous pressure
D10NS	10% dextrose in normal saline
D10W	10% dextrose in water
D5/¼NS	5% dextrose in one-quarter normal saline (0.2%)
D5/⅓NS	5% dextrose in one-third normal saline (0.33%)
D5/½NS	5% dextrose in one-half normal saline (0.45%)
D5LR	5% dextrose in lactated Ringer's solution
D5NS	5% dextrose in normal saline
D5R	5% dextrose in Ringer's solution
D5W	5% dextrose in water
DC	discontinued
DEHP	Diethylhexylphthalate
DIC	disseminated intravascular coagulation
dL	deciliter(s) (100 mL)
DNA	deoxyribonucleic acid
ECG	electrocardiogram
EEG	electroencephalogram
ESRD	end-stage renal disease
F	Fahrenheit
GI	gastrointestinal
GFR	glomerular filtration rate
Gm	gram(s)
gr	grain(s)
gtt	drop(s)
GU	genitourinary
Hb	hemoglobin
Hct	hematocrit
Hg	mercury
HIV	human immunodeficiency virus
hr	hour
HR	heart rate
HSCT	hematopoietic stem cell transplant
ICU	intensive care unit
IgA	immune globulin A
IGIV	immune globulin intravenous
ÍL	microliters, μL, mm^3
IM	intramuscular
INR	International Normalized Ratio
IP	intrapleural
IU	international unit(s)
IV	intravenously
IVIG	intravenous immune globulin
K	potassium
KCl	potassium chloride
kg	kilogram(s)
L	liter(s)

lb	pound(s)
LDH	lactic dehydrogenase
LR	lactated Ringer's injection or solution
M	molar
M^2	meter squared
MAO	monoamine oxidase
MAP	mean arterial pressure
mcg	microgram(s)
mCi	millicurie(s)
mEq	milliequivalent
Mg	magnesium
mg	milligram(s)
MI	myocardial infarction
min	minute
mL	milliliter
mmol	millimole(s)
mm^3	cubic millimeters, μL, ÍL
MDRSP	multidrug-resistant strains
MRI	magnetic resonance imaging
Na	sodium
NaCl	sodium chloride
NCI	National Cancer Institute; see CTCAE
ng	nanogram (millimicrogram)
NS	normal saline (0.9%)
NSAID	nonsteroidal anti-inflammatory drug
NSCLC	non–small-cell lung cancer
NSR	normal sinus rhythm
N/V	nausea and vomiting
OTC	over-the-counter
PAC	premature atrial contraction
Pao_2	arterial oxygen pressure
PCA	patient controlled analgesia
PCP	*Pneumocystis jiroveci* pneumonia
pg	picogram
pH	hydrogen ion concentration
PML	progressive multifocal leukoencephalopathy
PO	by mouth/orally
PRES	posterior reversible encephalopathy syndrome
PSVT	paroxysmal supraventricular tachycardia
PT	prothrombin time
PTT	partial thromboplastin time
PVC	polyvinyl chloride; premature ventricular contraction
R	Ringer's injection or solution
RBC	red blood cell
refrigerate	temperature at 2° to 8° C (36° to 46° F)
RNA	ribonucleic acid
RT	room temperature
RTS	room-temperature stable
SA	sinoatrial
SC	subcutaneous
SOB	shortness of breath
SCr	serum creatinine
S/S	signs and symptoms
SW or SWI	sterile water for injection
TEN	toxic epidermal necrolysis
TIA	transient ischemic attacks
TLS	tumor lysis syndrome
TNA	3-in-1 combination of amino acids, glucose, and fat emulsion
TPN	2-in-1 combination of amino acids and glucose; total parenteral nutrition
TRALI	transfusion-related acute lung injury
TT	thrombin time
μL	microliters, mm^3, ÍL
ULN	upper limits of normal
URI	upper respiratory infection
UTI	urinary tract infection
VF	ventricular fibrillation
VS	vital signs
VT	ventricular tachycardia
v/v	volume-to-volume ratio
WBC	white blood cell
WBCT	whole blood clotting time
w/v	weight-to-volume ratio
w/w	weight-to-weight ratio

IMPORTANT IV THERAPY FACTS

- Read the Preface and Format and Contents sections at least once. They'll answer many of your questions and save time.

USUAL DOSE

- Doses calculated on body weight are usually based on pretreatment weight and not on edematous weight.
- Normal renal or hepatic function is usually required for drugs metabolized by these routes.
- Formula to calculate creatinine clearance (CrCl) from serum creatinine value (Cockcroft-Gault equation):

  Males: $$\frac{\text{Weight in kg} \times (140 - \text{Age in years})}{72 \times \text{Serum creatinine (mg/dL)}} = \text{CrCl}$$

  Females: 0.85 × Male CrCl value calculated from above formula.

- Children: $$K \times \frac{\text{Linear length or height (cm)}}{\text{SCr (mg/100 mL)}}$$
  K for children >1 year of age = 0.55
  K for infants = 0.45
- Lean Body Weight (LBW)
  Males = 50 kg + 2.3 kg for each inch over 5 foot.
  Females = 45.5 kg + 2.3 kg for each inch over 5 foot.
  Children weighing 15 kg or less—Use actual body weight in kg.
- Formula to calculate body surface area (BSA):

  $$\text{BSA } (M^2) = \sqrt{\frac{\text{Height (cm)} \times \text{Weight (kg)}}{3600}}$$

DILUTION

- Check all labels (drugs, diluents, and solutions) to confirm appropriateness for IV use.
- Sterile technique is imperative in all phases of preparation.
- Use a filter needle when withdrawing IV meds from ampules to eliminate possible pieces of glass.
- Pearls: 1 Gm in 1 Liter yields 1 mg/mL
  1 mg in 1 Liter yields 1 mcg/mL
  % of a solution equals the number of grams/100 mL
  (5% = 5 Gm/100 mL)
- Pediatric dilution: If you dilute 6.0 mg/kg in 100 mL, 1 mL/hr equals 1.0 mcg/kg/min
  If you dilute 0.6 mg/kg in 100 mL, 1 mL/hr equals 0.1 mcg/kg/min
- See charts on inside front cover.
- Do not use bacteriostatic diluents containing benzyl alcohol for neonates. May cause a fatal toxic syndrome. S/S include CNS depression, hypotension, intracranial hemorrhage, metabolic acidosis, renal failure, respiratory problems, seizures.
- Ensure adequate mixing of all drugs added to a solution.
- When combining drugs in a solution (additives), always consider the required rate adjustment of each drug.
- Examine solutions for clarity and any possible leakage.
- Frozen infusion solutions should be thawed at room temperature (25° C [77° F]) or under refrigeration. Do not force by immersion in water baths or in the microwave. All ice crystals must be melted before administration. Do not refreeze.

- Syringe prepackaging for use in specific pumps is now available for many drugs. Concentrations are often the strongest permissible, but length of delivery is accurate.
- Controlled room temperature (CRT) is considered to be 25° C (77° F). Most medications tolerate variations in temperature from 15° to 30° C (59° to 86° F).

INCOMPATIBILITIES

- Some manufacturers routinely suggest discontinuing the primary IV for intermittent infusion; usually done to avoid any possibility of incompatibility. Flushing the line before and after administration may be indicated and/or appropriate for some drugs.
- The brand of intravenous fluids or additives, concentrations, containers, rate and order of mixing, pH, and temperature all affect solubility and compatibility. Consult your pharmacist with any question, and document appropriate instructions on care plan.

TECHNIQUES

- Never hang plastic containers in a series connection; may cause air embolism.
- Confirm patency of peripheral and/or central sites. Avoid extravasation.
- Avoid accidental arterial injection; can cause gangrene.

RATE OF ADMINISTRATION

- Life-threatening reactions (time-related overdose or allergy) are frequently precipitated by a too-rapid rate of injection.

PATIENT EDUCATION

- A well-informed patient is a great asset; review all appropriate drug information with every conscious patient.

SIDE EFFECTS

- Reactions may be caused by a side effect of the drug itself, allergic response, overdose, or the underlying disease process.

RESOURCES

PUBLICATIONS

The following publications have been used as a resource to assemble the information found in *Intravenous Medications.* Additional and more detailed information on drugs may be found in these publications:

American Heart Association: *Handbook of Emergency Cardiovascular Care for Health Care Providers, 2010.*

American Hospital Formulary Service Drug Information 2013, Bethesda, Md, American Society of Hospital Pharmacists (updated via website).

Drug Facts and Comparisons, St Louis, 2013, Facts and Comparisons Division, Wolters Kluwer Health.

Lexi-Comp's Drug Information Handbook, ed 20, 2011-2012, Hudson, Ohio, American Pharmacists Association.

Elsevier Guide to Oncology Drugs and Regimens, Huntington, NY, 2006, Elsevier.

The Johns Hopkins Hospital: *The Harriet Lane Handbook,* ed 19, St Louis, 2012, Mosby.

Manufacturers' literature.

Merck Manual of Diagnosis and Therapy, ed 18, Whitehouse Station, NJ, 2006, Merck Research Laboratories.

Physician's Desk Reference, ed 67, Montvale, NJ, 2012, PDR Network.

Tatro DS, editor: *Drug Interaction Facts,* St Louis, 2013, Facts and Comparisons Division, Wolters Kluwer Health, updated quarterly.

Trissel LA: *Handbook on Injectable Drugs,* ed 17, 2013, American Society of Hospital Pharmacists, Inc.

WEBSITE RESOURCES

http://www.accessdata.fda.gov/scripts/cder/drugsatfda—Drug Approvals and Updates
http://www.fda.gov/safety/medwatch/default.htm—Safety Information
http://evolve.elsevier.com/IVMeds
http://www.cancer.gov—Common Terminology Criteria for Adverse Events (CTCAE)
http://www.blackboxrx.com—A listing of all drugs with a black box warning