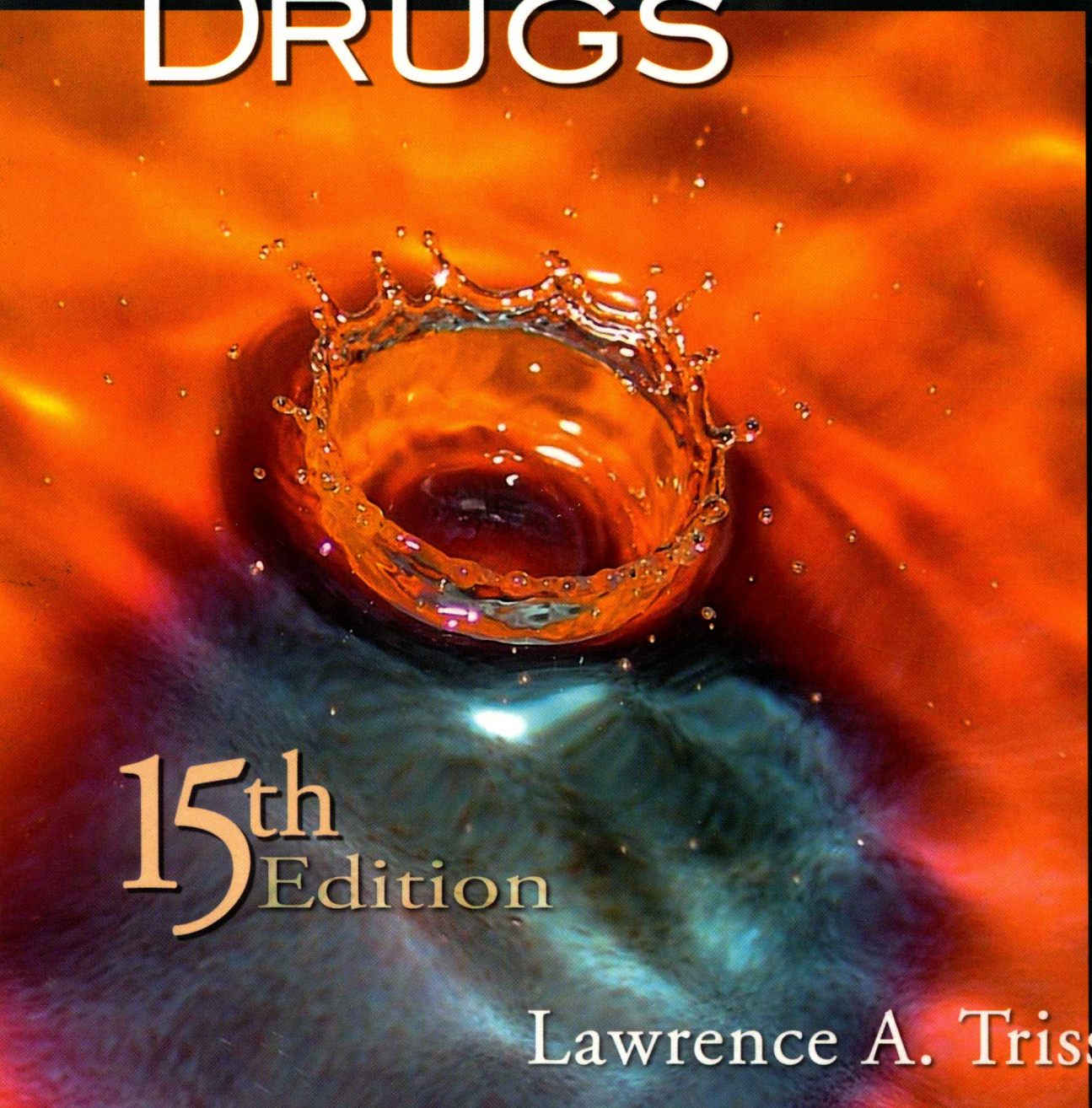
Handbook on INJECTABLE DRUGS



15th Edition

Lawrence A. Trissel

American Society of Health-System Pharmacists®

Handbook on INJECTABLE DRUGS

15th Edition

American Society of Health-System Pharmacists®

Bethesda, Maryland

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To those pharmacists who understand that research
is *part of the mission of pharmacy,*
and, as always,
To Pam, for her love, forbearance, and continuing support

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PREFACE

The *Handbook on Injectable Drugs*, 15th edition, is the most recent contribution in this continuing series. With its publication, all previous editions are considered out of date.

For proper use of this reference work, the reader must review the *How to Use the Handbook* section that immediately follows this preface. This section will acquaint the user of the *Handbook* with its organization, content, structure, summarization strategy, interpretation of the information presented, and limitations of the published literature on which the *Handbook* is based. Without a good working knowledge of these points, the *Handbook* may not be used to its best advantage or even interpreted correctly.

The 15th edition of the *Handbook on Injectable Drugs* brings together a wealth of information on 359 parenteral drugs commercially available in the United States and in other countries. The information in the 15th edition is accumulated from 2723 references, including 100 new to this edition. As for each previous edition, the monographs have been completely updated. In addition to the updated monographs, 13 additional monographs on parenteral drugs that are new to this edition are presented. These include the following drugs:

Anidulafungin
Aripiprazole
Atosiban acetate
Bortezimib
Caspofungin acetate
Levothyronine sodium
Micafungin sodium
Nesiritide
Pralidoxime chloride
Tetracaine hydrochloride
Tigecycline
Voriconazole
Ziconatide acetate

Heritage of the Handbook

The involvement of the pharmacy profession with the issues surrounding parenteral drug compatibility extends back over 50 years. The first research paper published on this topic appeared in 1955 in the old *Bulletin of the American Society of Hospital Pharmacists*. Robert C. Bogash, then Director of the Pharmacy Department at Lenox Hill Hospital in New York City, wrote a paper entitled "Compatibilities and Incompatibilities of Some Parenteral Medications." In this groundbreaking paper, Mr. Bogash presented compatibility results on an array of parenteral drug combinations. This paper constitutes the earliest effort to compile such information for pharmacists to use. Mr. Bogash also noted the following obligation: "It is, therefore, the responsibility of the hospital pharmacist to be as fully aware of these [compatibility] phenomena as possible."

In subsequent years, a number of articles on drug compatibility and stability appeared, from both pharmacists and the pharmaceutical industry. In 1967, *Intravenous Therapy* by Jon T. Williams and Daniel F. Morovec was published. This book was the first compilation of parenteral drug compatibility in book form and the first to include tables of compatibility information along with text discussions.

Other early efforts at compiling parenteral drug stability and compatibility information included *Intravenous Additive Incompatibilities* in 1970 from the National Institutes of Health, Clinical Center, *Cutter* (now *King*) *Guide to Parenteral Admixtures* in 1971, and the *Parenteral Drug Information Guide* in early 1974.

The experience of being the principal author on the *Parenteral Drug Information Guide* was valuable to me, although not for the excellence of the work. Indeed, reviews were mixed. Rather, the faults of this work served as a valuable learning experience, providing an understanding of problems and a focus on things to avoid.

In early 1975, I started over and began work on a new compilation that would become the *Handbook on Injectable Drugs*. The goal was to create the most comprehensive and complete compilation possible summarizing the original published research literature into a new concise, standardized format. The succeeding 20 months were spent compiling the text and tables for the first edition of the *Handbook*. I estimate that over 2400 hours of evenings, weekends, holidays, and vacation went into preparing the manuscript. In this pre-computer era, the manuscript had to be written in long hand (both text and tables) and then typed, corrected, and re-typed. My wife, Pam, had the unenviable job of typing all of those thousands of manuscript pages. The first four editions of the *Handbook* were prepared in this time-consuming and laborious manner—a process unimaginable in this computerized age. The first edition of the *Handbook* was prepared from the information in 297 references, was composed of 430 pages of material, and—at 6 inches by 9 inches— was truly handbook size. The first edition of the *Handbook on Injectable Drugs* appeared in January 1977. Thankfully, it received good reviews from journal editors and book reviewers, and, most importantly, approval by the pharmacists who were using it.

In my initial conceptualization of the project, I did not foresee in any way the vast growth of this work or its enduring nature. I could not have imagined that within a few years the *Handbook* would be found in most hospital and home care pharmacies in the United States and in much of the rest of the world as well. And I certainly did not think this project would become a life's work. But the *Handbook* has now been in continuous publication for three decades. It has grown to incorporate the information from more than 2723 references based principally on laboratory research but also including observations from practice when the observations can be verified. Throughout the *Handbook's* publication history, the intent of this work has remained unchanged: to organize and summarize in a concise, standardized format the results of the primary research in parenteral drug stability and compatibility to facilitate its use in clinical practice settings for the benefit of our patients.

Note of Appreciation

I want to thank a number of individuals who have helped in the creation of the 15th edition of the *Handbook on Injectable Drugs*. Mary Baker, Todd Canada, John Iazzetta, William Dana, Yanping Zhang, and especially N. Pauline Thomas Parks contributed their time and talents to the challenging review process of a difficult manuscript. Their input helps to make the *Handbook* a better resource. In addition, Johnna Hershey and Luan Corrigan undertook and conducted the process that makes a book from a difficult manuscript and have done so in exemplary form, as always. Thanks for all your help.

And of course my wife, Pam, has again had to endure the enormous time commitment that the *Handbook* represents. I recognize that I have spent much of our lives together with papers, proofs, and publishing deadlines that might have otherwise been spent with her. I have the deepest gratitude for her forbearance, tolerance, and support over many decades that have made my contribution to this work possible.

One Last Word

I have spent over 30 years compiling, writing, revising, and proofing the various editions of *Handbook on Injectable Drugs*. To me, the *Handbook* has been a calling, a bedrock professional activity that I have always made paramount, and a true labor of love. From my original conception and design throughout the tens of thousands of hours spent preparing the many editions of this work, I have always wanted to continue providing this resource for the benefit of the members of our profession and the patients they serve.

I have thought of the *Handbook* as the principal professional undertaking and contribution that I was here to perform. Though much sacrifice of time and other life goals was required, I have been willing, indeed eager, to continue this difficult and demanding undertaking over all these years in the knowledge that my efforts were providing a useful and valuable tool in patient care. For those many individuals, colleagues, and friends who have expressed their gratitude for my efforts over three decades, it is I who am grateful. I am grateful for those kind words that have encouraged me throughout the endless procession of late nights and early mornings, weekends, holidays, and vacations, all seemingly countless in number, spent on this undertaking. And to the members of the profession of pharmacy, especially those "in the trenches" of patient care who have found the *Handbook* useful, I am glad I could help. Thank you for this opportunity to serve.

LAT
January 2008

HOW TO USE THE HANDBOOK

What Is the Handbook?

The *Handbook on Injectable Drugs* is a collection of summaries of information from the published literature on the pharmaceutics of parenteral medications as applied to the clinical setting. The *Handbook* is constructed from information derived from 2723 references with the information presented in the standardized structure described below. The purpose of the *Handbook* is to facilitate the use of this clinical pharmaceutics research by knowledgeable health care professionals for the benefit of patients. The summary information from published research is supplemented with information from the labeling of each product and from other references.

The information base summarized in the *Handbook on Injectable Drugs* is large and highly complex, requiring thoughtful consideration for proper use. The *Handbook* is not, nor should it be considered, elementary in nature or a primer. A single quick glance in a table is not adequate for proper interpretation of this highly complex information base. Proper interpretation includes the obvious need to consider and evaluate all relevant research information and results. Additionally, information on the formulation components, product attributes (especially pH), and the known stability behaviors of each parenteral drug, as well as the clinical situation of the patient, must be included in a thoughtful, reasoned evaluation of clinical pharmaceutics questions.

Who Should Use the Handbook?

The *Handbook on Injectable Drugs* is designed for use as a professional reference and guide to the literature on the clinical pharmaceutics of parenteral medications. The intended audience consists of knowledgeable health care professionals, particularly pharmacists, well versed in the formulation and clinical use of parenteral medications and who have the highly specialized knowledge base, training, and skills set necessary to interpret and apply the information. Practitioners who are not well versed in the formulation, essential properties, and clinical application of parenteral drugs should seek the assistance of more knowledgeable and experienced health care professionals to ensure patient safety.

Users of the *Handbook* must recognize that no reference work, including this one, can substitute for adequate decision-making by health care professionals. Proper clinical decisions must be made considering all aspects of the patient's condition and needs, with particular attention to the special demands imposed by parenteral medications. The *Handbook* cannot make decisions for its users. However, in knowledgeable hands, it is a valuable tool for the proper use of parenteral medications.

Organization of the Handbook

The *Handbook on Injectable Drugs* has been organized as a collection of monographs on each of 359 drugs. The monographs are arranged alphabetically by nonproprietary name. The names of the drugs follow the style of *USAN and the USP Dictionary of Drug Names*. Also included are some of the trade names and manufacturers of the drug products; this listing is not necessarily comprehensive and should not be considered an endorsement of any product or manufacturer.

All of the information included in the *Handbook* is referenced so that those who wish to study the original sources may find them. In addition, the *American Hospital Formulary Service* Classification System numbers have been included to facilitate the location of therapeutic information on the drugs.

The monographs have been divided into the subheadings described below:

Products—lists many of the sizes, strengths, volumes, and forms in which the drug is supplied, along with other components of the formulation. Instructions for reconstitution (when applicable) are included in this section.

The products cited do not necessarily constitute a comprehensive list of all available products. Rather, some common representative products are described. Furthermore, dosage forms, sizes, and container configurations of parenteral products may undergo significant changes during the lifespan of this edition of the *Handbook*.

Following the product descriptions, the pH of the drug products, the osmotic value(s) of the drug and/or dilutions (when available), and other product information such as the sodium content and definition of units are presented.

Practitioners have not always recognized the value and importance of incorporating product formulation information into the thought process that leads to their decision on handling drug compatibility and stability questions. However, consideration of the product information and formulation components as well as the properties and attributes of the products, especially pH, is essential to proper interpretation of the information presented in the *Handbook*.

Administration—includes route(s) by which the drug can be given, rates of administration (when applicable), and other related administration details.

The administration information is a condensation derived primarily from the product's official labeling and the *American Hospital Formulary Service*. For complete information, including dosage information sufficient for prescribing, the reader should refer to the official labeling and therapeutically comprehensive references such as the *American Hospital Formulary Service*.

Stability—describes the drug's stability and storage requirements. The storage condition terminology of *The United States Pharmacopeia*, 30th ed., is used in the *Handbook on Injectable Drugs*.

The United States Pharmacopeia defines controlled room temperature as "A temperature maintained thermostatically that encompasses the usual and customary working environment of 20 ° to 25 °; that results in a mean kinetic temperature calculated to be not more than 25 °; and that allows for excursions between 15 ° and 30 ° that are experienced in pharmacies, hospitals, and warehouses."[1] (All temperatures are Celsius.)

Protection from excessive heat is often required; excessive heat is defined as any temperature above 40 °C. Similarly, protection from freezing may be required for products that are subject to loss of strength or potency, or destructive alteration of their characteristics in addition to the risk of container breakage.[1]

Some products may require storage at a cool temperature, which is defined as any temperature between 8 and 15 °C, or a cold temperature, which is defined as any temperature not exceeding 8 °C. A refrigerator is defined as a cold place in which the temperature is maintained thermostatically between 2 and 8 °C. Freezer storage refers to a place in which the temperature is maintained thermostatically between −25 and −10 °C.[1]

In addition to storage requirements, aspects of drug stability related to pH, freezing, and exposure to light are presented in this section. Also presented is information on repackaging of the drugs or their dilutions in container/closure systems other than the original package (e.g.,

Table 1.
Solution Compatibility

Monograph drug name

Solution	*Mfr*	*Mfr*	*Conc/L*	*Remarks*	*Ref*	*C/I*
(1)	(2)	(3)	(4)	(5)	(6)	(7)

1. Solution in which the test was conducted.
2. Manufacturer of the solution.
3. Manufacturer of the drug about which the monograph is written.
4. Concentration of the drug about which the monograph is written.
5. Description of the results of the test.
6. Reference to the original source of the information.
7. Designation of the compatibility (C) or incompatibility (I) of the test result according to conventional guidelines.

Table 2.
Additive Compatibility

Monograph drug name

Drug	*Mfr*	*Conc/L*	*Mfr*	*Conc/L*	*Test Soln*	*Remarks*	*Refs*	*C/I*
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)

1. Test drug.
2. Manufacturer of the test drug.
3. Concentration of the test drug.
4. Manufacturer of the drug about which the monograph is written.
5. Concentration of the drug about which the monograph is written.
6. Infusion solution in which the test was conducted.
7. Description of the results of the test.
8. Reference to the original source of the information.
9. Designation of the compatibility (C) or incompatibility (I) of the test result according to conventional guidelines.

Table 3.
Drugs in Syringe Compatibility

Monograph drug name

Drug (in syringe)	*Mfr*	*Amt*	*Mfr*	*Amt*	*Remarks*	*Ref*	*C/I*
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)

1. Test drug.
2. Manufacturer of the test drug.
3. Actual amount of the test drug.
4. Manufacturer of the drug about which the monograph is written.
5. Actual amount of the drug about which the monograph is written.
6. Description of the results of the test.
7. Reference to the original source of the information.
8. Designation of the compatibility (C) or incompatibility (I) of the test result according to conventional guidelines.

Table 4.
Y-Site Injection Compatibility (1:1 Mixture)

Monograph drug name

Drug	*Mfr*	*Conc*	*Mfr*	*Conc*	*Remarks*	*Ref*	*C/I*
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)

1. Test drug.
2. Manufacturer of the test drug.
3. Concentration of the test drug prior to mixing at the Y-site.
4. Manufacturer of the drug about which the monograph is written.
5. Concentration of the drug about which the monograph is written prior to mixing at the Y-site.
6. Description of the results of the test.
7. Reference to the original source of the information.
8. Designation of the compatibility (C) or incompatibility (I) of the test result according to conventional guidelines.

prefilling into syringes or in ambulatory pumps). Sorption and filtration characteristics of the drugs are provided as well when this information is available. The information is derived principally from the primary published research literature and is supplemented by the product labeling and the *AHFS Drug Information*.

Compatibility Information—tabulates the results of published reports from primary research on the compatibility of the subject drug with infusion solutions and the other drugs. The various citations are listed alphabetically by solution or drug name; the information is completely cross-referenced among the monographs.

Four types of tables are utilized to present the available information, depending on the kind of test being reported. The first type is for information on the compatibility of a drug in various infusion solutions and is depicted in Table 1. The second type of table presents information on two or more drugs in intravenous solutions and is shown in Table 2. The third type of table is used for tests of two or more drugs in syringes and is shown in Table 3. The fourth table format is used for reports of simulated or actual injection into Y-sites and manifolds of administration sets and is shown in Table 4.

Many published articles, especially older ones, do not include all of the information necessary to complete the tables. However, the tables have been completed as fully as possible from the original articles.

Additional Compatibility Information—provides additional information and discussions of compatibility presented largely in narrative form. In addition to primary published research, the information in this section is derived from reliable secondary sources. Examples of such sources include the product labeling and the *AHFS Drug Information*. For information from secondary sources, the research on which the information is based is not available for review. However, the sources are sufficiently reliable that inclusion in the *Handbook* is warranted.

Other Information—contains any relevant auxiliary information concerning the drug which does not fall into the previous categories.

The Listing of Concentration

The concentrations of all admixtures in intravenous solutions in the tables have been indicated in terms of concentration per liter to facilitate comparison of the various studies. In some cases, this may result in amounts of the drug that are greater or lesser than those normally administered (as when the recommended dose is tested in 100 mL of vehicle), but the listings do accurately reflect the actual concentrations tested, expressed in standardized terms.

For studies involving syringes, the amounts actually used are indicated. The volumes are also listed if indicated in the original article.

For studies of actual or simulated Y-site injection of drugs, the concentrations are cited in terms of concentration per milliliter of each drug solution prior to mixing at the Y-site. Most published research reports have presented the drug concentrations in this manner, and the *Handbook* follows this convention. For those few published reports that presented the drug concentrations after mixing at the Y-site, the concentrations have been recalculated to be consistent with the more common presentation style to maintain the consistency of presentation in the *Handbook*. Note that the Y-Site Injection Compatibility table is designed with the assumption of a 1:1 mixture of the subject drug and infusion solution or admixture. For citations reporting other than a 1:1 mixture, the actual amounts tested are specifically noted.

Designating Compatibility or Incompatibility

Each summary of a published research report appearing in the Compatibility Information tables bears a compatibility indicator (***C***, ***I***, or ***?***). A report receives a designation of ***C*** when the study results indicate that compatibility of the test samples existed under the test conditions. If the study determined an incompatibility existed under the test conditions, then an ***I*** designation is assigned for the *Handbook* entry for that study result. Specific standardized guidelines are used to assign these compatibility designations. The citation is designated as a report of compatibility when results of the original article indicated one or more of the following criteria were met:

1. Physical or visual compatibility of the combination was reported (no visible or electronically detected indication of particulate formation, haze, precipitation, color change, or gas evolution).
2. Stability of the components for at least 24 hours in an admixture under the specified conditions was reported (decomposition of 10% or less).
3. Stability of the components for the entire test period, although in some cases it was less than 24 hours, was reported (time periods less than 24 hours have been noted).

The citation is designated as a report of incompatibility when the results of the original article indicated either or both of the following criteria were met:

1. A physical or visual incompatibility was reported (visible or electronically detected particulate formation, haze, precipitation, color change, or gas evolution).
2. Greater than 10% decomposition of one or more components in 24 hours or less under the specified conditions was reported (time periods of less than 24 hours have been noted in the table).

Reports of test results that do not clearly fit into the compatibility or incompatibility definitions cannot be designated as either. These are indicated with a question mark.

Although these criteria have become the conventional definitions of compatibility and incompatibility, the reader should recognize that the criteria may need to be tempered with professional judgment. Inflexible adherence to the compatibility designations should be avoided. Instead, they should be used as aids in the exercising of professional judgment.

Therapeutic incompatibilities or other drug interactions are not within the scope of the *Handbook* and have not been included.

Interpreting Compatibility Information in the Handbook

As mentioned above, the body of information summarized in the *Handbook* is large and complicated. With the possible exception of a report of immediate gross precipitation, it usually takes some degree of thoughtful consideration and judgment to properly evaluate and appropriately act on the research results that are summarized in this book.

Nowhere is the need for judgment more obvious than when apparently contradictory information appears in two or more published reports. The body of literature in drug–drug and drug–vehicle compatibility is replete with apparently contradictory results. Except for study results that have been documented later to be incorrect, the conflicting information has been included in the *Handbook* to provide practitioners with all of the information for their consideration. The conflicting information will be readily apparent to the reader because of the content of the Remarks section as well as the ***C***, ***I***, and ***?*** designations following each citation.

Many or most of the apparently conflicting citations may be the result of differing conditions or materials used in the studies. A variety of factors that can influence the compatibility and stability of drugs must be considered in evaluating such conflicting results, and absolute statements are often difficult or impossible to make. Differences in concentrations, buffering systems, preservatives, vehicles, temperatures, and

order of mixing may all play a role. By reviewing a variety of reports, the user of the *Handbook* is better able to exercise professional judgment with regard to compatibility and stability.

The reader must guard against misinterpretation of research results, which may lead to extensions of compatibility and stability that are inappropriate. As an example, a finding of precipitate formation two hours after two drugs are mixed does not imply nor should it be interpreted to mean that the combination is compatible until that time point, when a sudden precipitation occurs. Rather, it should be interpreted to mean that precipitation occurred at some point between mixing and the first observation point at two hours. Such a result would lead to a designation of incompatibility in the *Handbook*.

Precipitation reports can be particularly troublesome for practitioners to deal with because of the variability of the time frames in which they may occur. Apart from combinations that repeatedly result in immediate precipitation, the formation of a precipitate can be unpredictable to some degree. Numerous examples of variable precipitation time frames can be found in the literature, including paclitaxel, etoposide, and sulfamethoxazole–trimethoprim in infusion solutions and calcium and phosphates precipitation in parenteral nutrition mixtures. Differing drug concentrations can also play a role in creating variability in results. A good example of this occurs with co-administered vancomycin hydrochloride and beta-lactam antibiotics. Users of the information in the *Handbook* must always be aware that a marginally incompatible combination might exhibit precipitation earlier or later than that reported in the literature. In many such cases, the precipitation is ultimately going to occur, it is just the timing that is in question. This is of particular importance for precipitate formation because of the potential for serious adverse clinical consequences, including death, which have occurred. Certainly, users of the *Handbook* information should always keep in mind and anticipate the possibility of precipitation and its clinical ramifications. Furthermore, all injections and infusions should be inspected for particulate matter and discoloration. If found, they should be discarded.

In addition, many research reports cite test solutions or concentrations that may not be appropriate for clinical use. An example would be a report of a drug's stability in unsterile water. Although the *Handbook* summary will accurately reflect the test solutions and conditions that existed in a study, it is certainly inappropriate to misinterpret a stability report like this as being an authorization to use the product clinically. In such cases, the researchers may have used the clinically inappropriate diluent to evaluate the drug's stability for extrapolation to a more suitable vehicle that is similar, or they may not have recognized that the diluent is clinically unsuitable. In either event, it is incumbent on the practitioner in the clinical setting to use professional judgment to apply the information in an appropriate manner and recognize what is not acceptable clinically.

Further, it should be noted that many of the citations designated incompatible are not absolute. While a particular admixture may incur more than 10% decomposition within 24 hours, the combination may be useful for a shorter time period. The concept of "utility time" or the time to 10% decomposition may be useful in these cases. Unfortunately, such information is often not available. Included in the Remarks columns of the tables are the amount of decomposition, the time period involved, and the temperature at which the study was conducted when this information is available.

Users of the *Handbook* information should always keep in mind that the information in the *Handbook* must be used as a tool and a guide to the research that has been conducted and published. It is not a replacement for thoughtfully considered professional judgment. It falls to the practitioner to interpret the information in light of the clinical situation, including the patient's needs and status. What is certain is that relying solely on the ***C*** or ***I*** designation without the application of professional judgment is inappropriate.

Limitations of the Literature

In addition to conflicting information, many of the published articles have provided only partial evaluations, not looking at all aspects of a drug's stability and compatibility. This is not surprising considering the complexity, difficulty, and costs of conducting such research. There are, in fact, some articles that do provide evaluations of both physical stability/compatibility and chemical stability. But others are devoted only to physical issues, while others examine only chemical stability. Although a finding of precipitation, haze, or other physical effect may constitute an incompatibility (unless transient), the lack of such changes does not rule out chemical deterioration. In some cases, drugs initially designated as compatible because of a lack of visual change were later shown to undergo chemical decomposition. Similarly, the determination of chemical stability does not rule out the presence of unacceptable levels of particulates and/or turbidity in the combination. In a classic case, the drugs leucovorin calcium and fluorouracil were determined to be chemically stable for extended periods by stability-indicating HPLC assays in several studies, but years later, repeated episodes of filter clogging led to the discovery of unacceptable quantities of particulates in combinations of these drugs. The reader must always bear in mind these possibilities when only partial information is available.

And, finally, contemporary practitioners have come to expect that the analytical methods used in reports on the chemical stability of drugs will be validated stability-indicating methods. However, many early studies used methods that were not demonstrated to be stability indicating.

Literature Search for Updating the Handbook

To gather the bulk of the published compatibility and stability information for updating the *Handbook*, a literature search is performed using the *International Pharmaceutical Abstracts* database. By using key terms (e.g., stability), a listing of candidate articles for inclusion in the *Handbook* is generated. From this list, truly relevant articles are selected. As a supplement to this automated literature searching, a manual search of the references of the articles is also conducted, and any articles not included previously are obtained. Although this labor-intensive approach yields a very high percentage of the relevant articles published in the world's literature, it is not 100% inclusive. Occasionally, users of the *Handbook* come across articles that were overlooked. The author encourages anyone who finds an article that has been missed to bring it to his attention.

Beyond-Use Dating for Compounded Sterile Preparations

For an overview of Beyond-Use Dating for Compounded Sterile Preparations, see Appendix II.

Reference

1. *The United States Pharmacopeia*, 31st ed. Rockville, MD: United States Pharmacopeial Convention; 2008.

Solution Abbreviations

AA	Amino acids (percentage specified)
D	Dextrose solution (percentage unspecified)
D5LR	Dextrose 5% in Ringer's injection, lactated

D5R	Dextrose 5% in Ringer's injection
D–S	Dextrose–saline combinations
D2.5½S	Dextrose 2.5% in sodium chloride 0.45%
D2.5S	Dextrose 2.5% in sodium chloride 0.9%
D5¼S	Dextrose 5% in sodium chloride 0.225%
D5½S	Dextrose 5% in sodium chloride 0.45%
D5S	Dextrose 5% in sodium chloride 0.9%
D10S	Dextrose 10% in sodium chloride 0.9%
D5W	Dextrose 5%
D10W	Dextrose 10%
DXN–S	Dextran 6% in sodium chloride 0.9%
IDCM	Ionosol DCM
IG	Ionosol G
IM	Isolyte M
IP	Isolyte P
IS	Invert sugar
LR	Ringer's injection, lactated
NM	Normosol M
NR	Normosol R
NS	Sodium chloride 0.9%
PH	Protein hydrolysate
R	Ringer's injections
REF	Refrigeration
RT	Room temperature
S	Saline solution (percentage unspecified)
½S	Sodium chloride 0.45%
SL	Sodium lactate ⅙ M
TPN	Total parenteral nutrition solution
W	Sterile water for injection

Manufacturer and Compendium Abbreviations

AB	Abbott
ABX	Abraxis
ACC	American Critical Care
AD	Adria
AGT	Aguettant
AH	Allen & Hanburys
AHP	Ascot Hospital Pharmaceuticals
ALP	Alpharma
ALT	Altana Pharma
ALZ	Alza
AM	ASTA Medica
AMG	Amgen
AMR	American Regent
AND	Andromaco
ANT	Antigen
AP	Asta-Pharma
APC	Apothecon
APO	Apotex
APP	American Pharmaceutical Partners
AQ	American Quinine
AR	Armour
ARC	American Red Cross
AS	Arnar-Stone
ASC	Ascot
ASP	Astellas Pharma
AST	Astra
ASZ	AstraZeneca
AT	Alpha Therapeutic
AVE	Aventis
AW	Asta Werke
AY	Ayerst
BA	Baxter
BB	B & B Pharmaceuticals
BAN	Banyu Pharmaceuticals
BAY	Bayer
BC	Bencard
BE	Beecham
BED	Bedford
BEL	R. Bellon
BFM	Bieffe Medital
BI	Boehringer Ingelheim
BK	Berk
BKN	Baker Norton
BM	Boehringer Mannheim
BMS	Bristol-Myers Squibb
BN	Breon
BP	British Pharmacopoeia[a]
BPC	British Pharmaceutical Codex[a]
BR	Bristol
BRD	Bracco Diagnostics
BRN	B. Braun
BRT	Britianna
BT	Boots
BTK	Biotika
BV	Ben Venue
BW	Burroughs Wellcome
BX	Berlex
BY	Bayer
CA	Calmic
CE	Carlo Erba
CEN	Centocor
CER	Cerenex
CET	Cetus
CH	Lab. Choay Societe Anonyme
CHI	Chiron
CIS	CIS US
CL	Ciba
CL	Clintec
CN	Connaught
CNF	Centrafarm
CO	Cole
CP	Continental Pharma
CPP	CP Pharmaceuticals
CR	Critikon
CSL	CSL Ltd.
CTI	Cell Therapeutics Inc.
CU	Cutter
CUB	Cubist
CUR	Curomed
CY	Cyanamid
DAK	Dakota
DB	David Bull Laboratories
DCC	Dupont Critical Care
DI	Dista
DIA	Diamant
DM	Dome
DME	Dupont Merck Pharma
DMX	Dumex
DRA	Dr. Rentschler Arzneimittel
DU	DuPont

DUR	Dura
DW	Delta West
EA	Eaton
EBE	Ebewe
ELN	Elan
EN	Endo
ENZ	Enzon
ES	Elkins-Sinn
ESL	ESI Lederle
ESP	ESP Pharma
EST	Esteve
EV	Evans
EX	Essex
FA	Farmitalia
FAU	Faulding
FC	Frosst & Cie
FED	Federa
FER	Ferring
FI	Fisons
FRE	Fresenius
FUJ	Fujisawa
GEI	Geistich Pharma
GEM	Geneva-Marsam
GEN	Genentech
GG	Geigy
GIL	Gilead
GIU	Giulini
GL	Glaxo
GNS	Gensia-Sicor
GO	Goedecke
GRI	Grifols
GRP	Gruppo
GRU	Grunenthal
GSK	GlaxoSmithKline
GVA	Geneva
GW	Glaxo Wellcome
HAE	Haemonetics
HC	Hillcross
HMR	Hoechst Marion Roussel
HO	Hoechst-Roussel
HOS	Hospira
HR	Horner
HY	Hyland
ICI	ICI Pharmaceuticals
ICN	ICN Pharmaceuticals
IMM	Immunex
IMS	IMS Ltd.
IN	Intra
INT	Intermune
IV	Ives
IVX	Ivex
IX	Invenex
JC	Janssen-Cilag
JJ	Johnson & Johnson
JN	Janssen
JP	Jones Pharma
KA	Kabi
KEY	Key Pharmaceuticals
KN	Knoll
KP	Kabi Pharmacia
KV	Kabi-Vitrum
KY	Kyowa
LA	Lagap
LE	Lederle
LEM	Lemmon
LEO	Leo Laboratories
LI	Lilly
LME	Laboratoire Meram
LY	Lyphomed
LZ	Labaz Laboratories
MA	Mallinckrodt
MAC	Maco Pharma
MAR	Marsam
MAY	Mayne Pharma
MB	May & Baker
MDI	Medimmune
ME	Merck
MG	McGaw
MGI	MGI Pharma
MI	Miles
MJ	Mead Johnson
MN	McNeil
MMD	Marion Merrell Dow
MMT	Meridian Medical Technologies
MRD	Merrill-Dow
MRN	Merrill-National
MSD	Merck Sharp & Dohme
MUN	Mundi Pharma
MY	Maney
MYR	Mayrhofer Pharmazeutika
NA	National
NAB	Nabi
NAP	NAPP Pharmaceuticals
NCI	National Cancer Institute
NE	Norwich-Eaton
NF	National Formulary[a]
NO	Nordic
NOP	Novopharm
NOV	Novo Nordisk
NVA	Novartis
NVP	Nova Plus
NYC	Nycomed
OHM	Ohmeda
OM	Omega
OMJ	OMJ Pharmaceuticals
OMN	Ortho-McNeil
ON	Orion
OR	Organon
ORT	Ortho
PAD	Paddock
PB	Pohl-Boskamp
PD	Parke-Davis
PE	Pentagone
PF	Pfizer
PFM	Pfrimmer
PH	Pharmacia
PHC	Pharmachemie
PHS	Pharmascience
PHT	Pharma-Tek
PHU	Pharmacia & Upjohn
PHX	Phoenix
PO	Poulenc

PR	Pasadena Research
PRK	Parkfields
PX	Pharmax
QLM	Qualimed Labs
QU	Quad
RB	Robins
RC	Roche
RI	Riker
RKB	Reckitt & Benckhiser
RKC	Reckitt & Colman
ROR	Rorer
ROX	Roxane
RP	Rhone-Poulenc
RPR	Rhone-Poulenc Rorer
RR	Roerig
RS	Roussel
RU	Rugby
SA	Sankyo
SAA	Sanofi Aventis
SAN	Sanofi
SC	Schering
SCI	Scios
SCN	Schein
SCS	SCS Pharmaceuticals
SE	Searle
SEQ	Sequus
SER	Servier
SGS	SangStat
SIC	Sicor
SKB	SmithKline Beecham
SKF	Smith Kline & French
SM	Smith
SN	Smith + Nephew
SO	SoloPak
SQ	Squibb
SS	Sanofi-Synthelabo
ST	Sterilab
STP	Sterop
STR	Sterling
STS	Steris
STU	Stuart
SV	Savage
SW	Sanofi Winthrop
SX	Sabex
SY	Syntex
SYN	Synergen
SYO	Synthelabo
SZ	Sandoz
TAK	Takeda
TAP	TAP Holdings
TAY	Taylor
TE	Teva
TEC	Teclapharm
TL	Tillotts
TMC	The Medicines Company
TO	Torigian
TR	Travenol
UP	Upjohn
USB	US Bioscience
USP	United States Pharmacopeiea[a]
USV	USV Pharmaceuticals
UT	United Therapeutics
VHA	VHA Plus
VI	Vitarine
VT	Vitrum
WAS	Wasserman
WAT	Watson
WAY	Wyeth-Ayerst
WB	Winthrop-Breon
WC	Warner-Chilcott
WED	Weddel
WEL	Wellcome
WI	Winthrop
WL	Warner Lambert
WOC	Wockhardt
WY	Wyeth
XGN	X-Gen
YAM	Yamanouchi
ZEN	Zeneca
ZLB	ZLB Biopharma
ZNS	Zeneus Pharma

[a]*While reference to a compendium does not indicate the specific manufacturer of a product, it does help to indicate the formulation that was used in the test.*

CONTENTS

Commercial Drug Monographs