New Technologies for Preventing Drug Name Confusion Errors

Bruce L. Lambert, Ph.D.[a, b]

Ken-Yu Chang, B.Pharm., M.P.H.[a]

Swu-Jane Lin, B.Pharm., M.S.[a]

Sanjay Gandhi, B.Pharm., Ph.D.[a, c]

Department of Pharmacy Administration[a]

Department of Pharmacy Practice[b]

University of Illinois at Chicago

G. D. Searle & Co.[c]

Skokie, IL

Abstract

One out of every four medication errors reported in the United States is a name-confusion error. New technologies have recently been developed that should reduce the rate of such errors. These technologies are based on an analysis of the human factors involved in prescribing, dispensing, and administering drugs. In particular, our group has developed computerized measures of similarity that can identify in advance which pairs of drug names are most likely to be involved in confusion errors. This poster describes three related investigations. The first was a case-control study involving 1127 pairs of names known to have been confused in practice. This study did a comparative evaluation of 22 different computerized measures of similarity, eventually identifying trigram similarity as the best predictor of confusion potential. The other two studies involved short term memory for visually presented drug names. These studies showed that increasing similarity improved recall while worsening recognition. The theory and methods developed through these investigations have led to the implementation of a computerized, drug name search and retrieval system that is currently used for pre-approval screening of proposed new drug names by the United States Adopted Names Council and the Institute for Safe Medication Practices.

Learning Objectives

1. Define drug name confusion errors and correctly state the known incidence of this type of error.
2. Define orthographic and phonetic similarity, and give an example of each type of similarity measure.
3. Describe how computerized measures of similarity can be used to do pre-approval screening of proposed new drug names.

Acknowledgments

This project has, at various times, been supported by the U. S. Pharmacopeia Fellowship Program, the Drug Information Association, The Institute for Safe Medication Practices, the National Patient Safety Foundation, the Latiolais Leadership Fund of Ohio State University, the U. S. Food and Drug Administration, and the Campus Research Board of the University of Illinois at Chicago. The authors are grateful for the assistance they received from John Anderson, Alan Baddeley, Dan Boring, Bill Brewer, Mike Cohen, Diane Cousins, Gary Dell, Ruta Freimanis, Prahlad Gupta, Keith Johnson, David and Eric Lambert, Don Rucker, Gordon Schiff, William Wallace, and Justin Zobel.

Study 1

Similarity as a Risk Factor in Drug Name Confusion Errors

Lambert, B. L., Lin, S.-J., Chang, K.-Y., & Gandhi, S. K. (1999). Similarity as a risk factor in drug name confusion errors: The look-alike (orthographic) and sound-alike (phonetic) model. Medical Care, 37(12), 1214-1225.

Objectives: To evaluate several prognostic tests of drug name confusion, alone and in combination, with respect to their sensitivity, specificity, and overall accuracy.

Research Design: Case-control study. Twenty-two different computerized measures of orthographic similarity, orthographic distance, and phonetic similarity were used to compute similarity/distance scores for $N = 1127$ cases (i.e., pairs of names that appeared in published error reports or national error databases) and $N = 1127$ controls.

Study 1

Main Outcome Measures

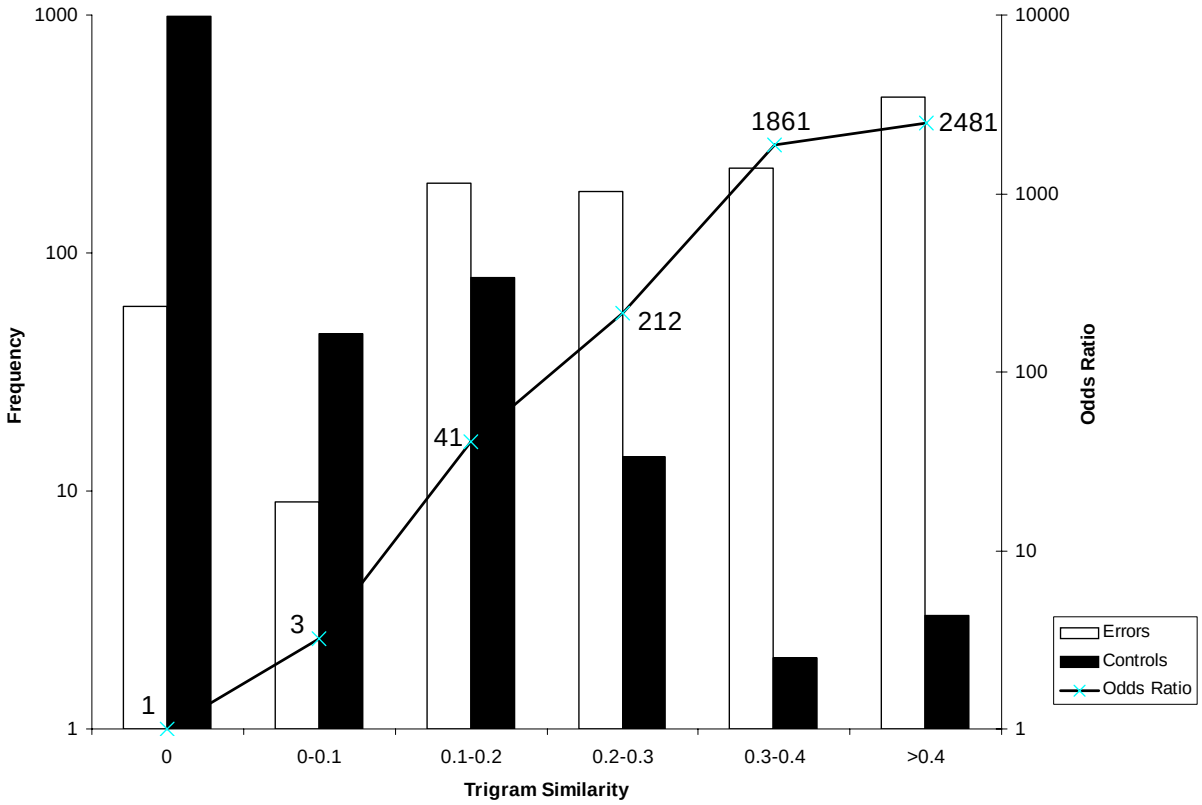
Mean similarity/distance scores were compared across cases and controls. The performance of each measure at distinguishing between cases and controls was evaluated by 10-fold cross-validation. Dose-response relationships were examined. Univariate and multivariate logistic regression models were formed and evaluated by 10-fold cross-validation.

Study 1

Conclusions

A sensitive and specific test of drug name confusion potential can be formed using objective measures of orthographic similarity, orthographic distance, and phonetic distance.

Dose-Response Relationship Between Similarity and Probability of Error



Study 2

Stimulus Materials for Recognition Memory Task (Orthographic Similarity)

Log Frequency	Bigram Similarity	Names	
5.94	0.78	Prolixin®	Procolin®
5.94	0.47	Tenuate®	Trilisate®
5.93	0.21	Zithromax®	Capitrol®
5.93	0.13	Rogenic®	Benylin®
5.93	0.00	Aclovate®	Nicobid®
3.94	0.75	Aramine®	Anamine®
3.92	0.47	Trantoin®	Triacin®
3.91	0.21	Nephramine®	Sinophen®
3.92	0.13	Dialose®	Pinoval®
3.92	0.00	Paraflex®	Otrivin®
4.86	0.74	Hydrocort®	Hydrocet®
4.86	0.47	Antiminth®	Timentin®
4.86	0.21	Minizide®	Allergine®
4.86	0.13	Hexalol®	Temaril®
4.86	0.00	Belexal®	Marazide®
5.75	0.71	Urisep®	Urised®
5.75	0.44	Exelderm®	Eldepryl®
5.75	0.21	Dermatop®	captopril
5.75	0.13	Mylicon®	Empirin®
5.75	0.00	Senokot®	Efudex®
5.20	0.71	rifampin	Rifadin®
5.20	0.44	Choledyl®	Cholybar®
5.20	0.21	Trinsicon®	Atabrine®
5.20	0.13	Genora®	Desferal®
5.20	0.00	Claforan®	Merital®
5.34	0.67	Pramasone®	Orasone®
5.35	0.47	Drixoral®	Fluoral®
5.35	0.21	Enduron®	dantrolene
5.35	0.13	Glucola®	Talacen®
5.35	0.00	Rowasa®	Ferralet®
6.58	0.67	Isordil®	Isomil®
6.59	0.40	Indocin®	doxepin
6.56	0.21	Antivert®	Ascriptin®
6.58	0.13	Zoladex®	Relafen®
6.58	0.00	Lotensin®	Nizoral®
5.12	0.67	Panadol®	nadolol
5.13	0.44	halothane	Loxitane®
5.11	0.21	Theraplex®	Hexadrol®
5.12	0.13	Estinyl®	Vepesid®
5.12	0.00	Betalin®	Rynatuss®

Stimulus Materials for Recognition Task (Phonological Similarity)

Log Frequency	Similarity	Names	
4.55	0.75	chloroform	chloroquine
4.76	0.42	glycerin	tolmetin
4.41	0.25	cisapride	urea
4.67	0.00	benzoin	filgrastim
5.84	0.71	acyclovir	ganciclovir
5.84	0.38	felodipine	nifedipine
5.91	0.17	isosorbide	oxytocin
5.81	0.00	aminophylline	baclofen
5.86	0.67	betamethasone	dexamethasone
5.55	0.43	mephobarbital	metronidazole
5.52	0.19	griseofulvin	riboflavin
5.72	0.00	cyclosporine	nitrofurantoin
4.98	0.67	tolazamide	tolbutamide
5.02	0.42	mannitol	sorbitol
5.00	0.17	melphalan	propofol
4.97	0.00	phenol	probenecid
5.83	0.58	atropine	loxapine
5.78	0.42	calamine	phentermine
5.80	0.17	captopril	ipecac
5.79	0.00	dapsone	meprobamate
4.97	0.58	digitalis	digitoxin
4.91	0.38	didanosine	dienestrol
4.93	0.17	glucagon	ichthammol
4.91	0.00	flutamide	pentoxifylline
6.25	0.50	amikacin	bacitracin
6.40	0.38	ceftazidime	cephalexin
6.31	0.21	methotrexate	ofloxacin
6.18	0.00	indomethacin	nystatin
5.19	0.58	cefaclor	cephradine
5.27	0.42	carbachol	carmustine
5.26	0.17	lactulose	succimer
5.23	0.00	estrone	misoprostol