Contents…

- [Meeting the challenge of accurate TCM syndrome-pattern evaluation](#)
- [What is AutoSage-TCM?](#)
- [Overview of components](#)
- [Proposal for future applications](#)
- [References](#)

❋Meeting the challenge of accurate TCM syndrome-pattern evaluation

Traditional Chinese herbology is a system of clinical analysis and decision making that has evolved gradually over a period of several thousand years. One of its core principles in designing individualized herbal formulas is that one must counteract or relieve a patient's chief complaint only within a context of the total pattern of symptoms and clinical signs associated with it. One's goal always should be to improve overall health and resolve those factors contributing to the chief complaint rather than merely to suppress primary symptoms at the risk of creating side effects. During the several decades the authors have practiced Chinese herbology, their worst mistakes were invariably due to choosing an herbal formula based solely on a provided medical diagnosis or a single symptom complaint, without doing a thorough analysis of the symptom-sign *patterns* manifesting in an individual's health history.

To advance our understanding of TCM clinical assessment methods and treatment protocols, these basic principles must constitute the foundation of clinical training, herbal product development, and research studies. However, to do so requires overcoming a number of obstacles:

- TCM (traditional Chinese medicine) herbal practice frequently falls short of its potential when many if its practitioners revert to simplistic and often ineffective biomedical criteria for choosing herbs and herbal formulas. •[1]•

- Clinical experimental designs that are adapted to the often highly individualized treatment strategies of TCM herbology have their own unique difficulties. Perhaps the most difficult obstacle is verifying the accuracy of the pattern assessments for each clinical subject. Ferreira, in his review of TCM expert systems •[2]•, reveals that agreement and consistency even among expert practitioners may be low.

- As modern health problems become increasingly complex, due to multiple dietary and environmental toxicity factors, an accurate TCM analysis becomes even more challenging to achieve. Patients experiencing multiple simultaneous syndrome-patterns have become increasingly common.

Due to these difficulties of incorporating TCM pattern-assessment principles into clinical research studies, the vast majority of biomedical research studies of Chinese herbs revert to the simplistic protocol of evaluating an herb's effectiveness for a specific biomedically diagnosed disease. Consequently, such studies are not really studies of the effectiveness of traditional Chinese medical protocols but of an herbal substance used within an entirely western allopathic medical context.

Declines in TCM educational standards within the US have resulted from a shift away from skills in TCM pattern-assessment toward a curricula weighted heavily in biomedical courses. RMHI has observed a steady trend of deterioration in practitioners' abilities in performing accurate TCM pattern analysis, and a disconcerting percentage of practitioners revert to simplistic biomedical criteria for choosing herbs and herbal formulas.

The remainder of this article outlines the working principles of **AutoSage-TCM**, an expert system for automated TCM pattern analysis that has been developed over a 25-year period *and completed in January 2016*. It solves the preceding problems and creates new opportunities, which are outlined in the last section of this proposal. **AutoSage-TCM** is now being used as a clinical evaluation tool by practitioners and has been incorporated into the clinical curriculum and internship program at RMHI.

⬦What is AutoSage-TCM?
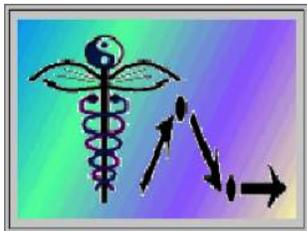
AutoSage-TCM is expert-system software for automated pattern recognition of the clinical syndromes constituting traditional Chinese medical (TCM) pathophysiology theory, including quantitative assessment of complex cases characterized by multiple simultaneous syndrome-patterns. This software has been developed at RMHI for use by individuals, students, healthcare practitioners, and clinical researchers.

CaseQuery, a simple case-history interface for end users (runs on Mac OS X, Windows, and Linux systems), allows the creation of standardized data files of symptoms and signs that may be submitted to RMHI for processing by **AutoSage-TCM**; **CaseQuery** is designed to allow quick and easy input of the symptoms and clinical signs that are important in TCM pattern assessment, including tongue appearance and palpated pulse parameters.

The **AutoSage-TCM** inference engine generates detailed analysis reports that allow users to examine the reasoning behind each conclusion. As such, this system is useful as:

- An **educational** aid for learning TCM syndrome-pattern differentiation and its underlying logic during internship and beginning practice
- A **clinical** tool for producing accurate, detailed, multi-pattern assessment of complex cases
- A **research** tool for automatically generating *quantitative*, standardized analyses of individual cases

that may be incorporated into clinical study protocols and statistical analyses for the health sciences generally (e.g.: epidemiology; environmental health monitoring of human populations; general systemic effects of drugs, herbs, and nutritional supplements)

The *User's Guide to AutoSage-TCM* doubles as a textbook that explores and clarifies fundamental theory and principles of TCM syndrome-pattern-recognition logic, including common mistakes made by students and practitioners, how to recognize and overcome them, and strategies for handling complex cases with multiple syndrome-patterns. Another purpose of this textbook is to examine the practical consequences of automated TCM syndrome assessment from the perspective of diverse professional groups and health organizations:

- Existing expert practitioners can verify that **AutoSage-TCM** is based on widely established principles of traditional Chinese herbal practice rather than on radical and untested ideas not in harmony with this tradition.

- Health professionals and other interested users gain an understanding of what the process of "TCM syndrome assessment" ideally should achieve, how this might be useful both clinically and in general medical research, and how an accurate assessment protocol might interface with existing medical diagnostic standards.

- It will become evident from the logic of TCM analysis methods and a mathematical perspective of their implementation that these methods are applicable not only to Chinese herbs but to healthcare generally; they provide a foundation for a more rational, systems-oriented perspective than either the typical narrow focus of Western scientific biomedicine or the overly simplistic, remedy-X-for-disease-Y or remedy-X-for-symptom-Y approaches often attempted by both lay consumers and health professionals.

❀Overview of components

The **AutoSage-TCM** system is comprised of three primary components:

1. The *AutoSage-TCM User's Guide* •[3]•.
2. **CaseQuery**, a simple utility program with a graphical user interface that helps users create case-history data files in standardized format, which then may be submitted to **AutoSage-TCM** for analysis.
3. The **AutoSage-TCM** processor modules:
   - **Knowledge acquisition tool** — used by TCM domain experts to create and refine the set of defining rules for the syndrome-patterns.
   - **Knowledge base** — the formatted, syntax-corrected database of rules that are applied to individual clinical cases by the inference engine.
   - **Inference engine** — applies the knowledge-base rules to individual case-history data files and produces detailed analysis results, incorporating multiple expert-systems methodologies, including ideas from neural nets, fuzzy logic, Bayesian inference algorithms, and archetypal pattern matching •[4]• •[5]•
   - **Report formatter** — compiles the results of each case analysis into an indexed, cross-referenced, multi-part HTML document that can be emailed to the end user and viewed within a single window of any current Internet browser. Each analysis report also serves as a teaching tool: the self-explanatory, cross-referenced report allows users to trace the reasoning steps behind each conclusion and calculated value.

The following webpage overview of the **AutoSage-TCM** system includes a link to a sample

pattern-analysis report:

http://www.rmhiherbal.org/herbalthink/autosage.html

The following diagram summarizes the role of each module within the **AutoSage-TCM** system:
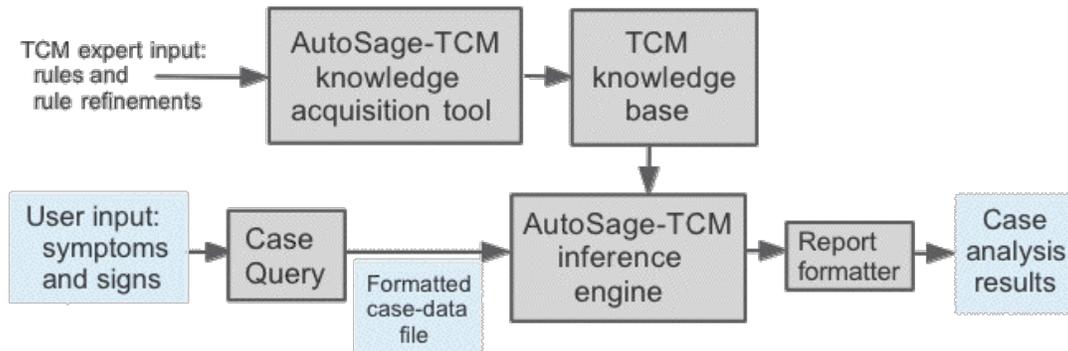
Proposal for future applications

AutoSage-TCM is our latest addition to **HerbalThink-TCM** •[6]•, an extensive software suite of educational references, interactive games, databases, and video simulation tools to help students and practitioners learn the art of traditional Chinese herbology. Potential future applications of **AutoSage-TCM** include:

- Analysis of complex clinical cases — provide a detailed breakdown of patterns in complex cases to end users who submit clinical case data, thus solving a formerly formidable obstacle to developing effective, individualized clinical strategies.

- Clinical research tool — classify and numerically quantify the presence of multiple syndromes in a clinical case for the purpose of evaluating statistics and experimental outcomes, thus removing dependencies on more fallible and subjective human judgments and on deficient reasoning. This application is not limited to TCM clinical research, but could potentially be applied to epidemiology studies or any type of novel therapy for which it is important to gain an understanding of its effects on whole-body patterns of symptoms. Such a system may be useful in doing clinical studies where cost is a limiting factor that prevents expensive monitoring of biomedical markers, for example, in studies of the efficacy of treatment methods used in developing nations.

- Early-warning system for environmental health monitoring — provide a more sensitive means for early detection (because symptoms may often appear well before blood or urine tests or other medical diagnostic tools reveal abnormal indicators) of emerging environmental health hazards in specific communities and for quantifying their effects — by periodic evaluation of potential shifts in population syndrome patterns and meta-patterns.

The authors are available to offer assistance to clinicians, researchers, and educators interested in any of the preceding applications.

Free trial copies of the **HerbalThink-TCM** software package, which includes access to **AutoSage-TCM**, are available for evaluation.

❀References

- [1] Wicke, Roger; "The mathematics and pattern-matching logic of Chinese herbology"; In: *HerbalThink-TCM* software, *TCHS Vol.5: Adapting Traditional Chinese Health Care to the 21st Century*, ©2013, Rocky Mountain Herbal Institute.

- [2] de Sá Ferreira, Arthur (2012); "Advances in Chinese Medicine Diagnosis: From Traditional Methods to Computational Models"; In: *Recent Advances in Theories and Practice of Chinese Medicine*, Haixue Kuang (Ed.), ISBN: 978-953-307-903-5, InTech;   Also accessible at: —{{ http://www.intechopen.com/books/recent-advances-in-theories-and-practice-of-chinese-medicine/advances-in-chinese-medicine-diagnosis-from-traditional-methods-to-computational-models }}   and at: —{{ http://cdn.intechopen.com/pdfs-wm/26161.pdf }}

- [3] Wicke, Roger and Kruse, Curtis; *Essentials of Expert-Systems Pattern Recognition for Traditional Chinese Medicine: User's Guide to AutoSage-TCM*, vol. 6 in *HerbalThink-TCM* [6]. Rocky Mountain Herbal Institute, ©2016-2017. Chapter 1 is also available at: —{{ http://www.rmhiherbal.org/herbalthink/autosage.html }}, which includes a link to a sample AutoSage-TCM case-analysis report.

- [4] Szolovits, P., Patil, R., and Schwartz, W. (1988); "Artificial Intelligence in Medical Diagnosis" In: *Annals of Internal Medicine* Vol.108; No.1, pp.80-87 (1988 January). Also accessible at: —{{ http://medg.lcs.mit.edu/ftp/psz/SchwartzAnnals.html }}

- [5] Alder, Hannes; Michel, Beat A.; et al. (2014); "Review Article: Computer-Based Diagnostic Expert Systems in Rheumatology: Where Do We Stand in 2014?";   *International Journal of Rheumatology*, Vol. 2014, ArticleID 672714. Accessible at: —{{ http://www.hindawi.com/journals/ijr/2014/672714/ }}

- [6] Wicke, Roger and Kruse, Curtis; *HerbalThink-TCM*, educational and reference software suite for Chinese herbal medicine; Rocky Mountain Herbal Institute, ©2002-2017. Description, features, and documentation at: —{{ http://www.rmhiherbal.org/herbalthink }}

⏀ — ✳ —