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CHPAMS

China Health Review (CHR), published quarterly, is the official online magazine of the China Health Policy and Management Society (CHPAMS). The CHR is intended to promote health research, policy, practice, and education related to China and the general population health sciences by providing research and policy updates, topical reviews, and other appropriate information. Targeted audience includes (1) academic researchers within and outside of China; (2) policymakers within China; (3) other interested parties including nonprofit organizations and business leaders as appropriate.

October 2011

EDITORIAL INTRODUCTION

In this issue of China Health Review, we start a new section "Research Article" to showcase original research as well as works on analytical methods. Professor Zhehui Luo contributes a thoughtful examination of the comparative effectiveness research (CER), which is to develop and disseminate evidence-based information about *which* interventions are most effective for *which* patients under *what* circumstances. She concludes, to achieve the goal of CER, it is crucial that researchers in methodology development find appropriate methods to detect the presence and sources of heterogeneity in treatment effect.

In the Topical Review section, Dr. YAO Hongyan, Deputy Director, Office of Epidemiology at the Chinese Center for Disease and Prevention, and her colleagues describe the evidence concerning agricultural injury in China documented in the scientific literature in both Chinese and English. The authors conducted an extensive literature search, which yielded 89 papers related to agricultural injury. The research team's review and analysis suggests that further research efforts are needed in order to gather sufficient evidence base for policymaking. Interested readers might find, in addition to the paper itself, the list of 94 references in the review very useful.

Research Twitter section provides brief summaries of eight studies that cover topics including antibiotic use in China, environmental health issues, production efficiency among Chinese hospitals, New Cooperative Medical Scheme, and many others.

Policy and Practice Updates section summarizes recent policy debates, innovations, and developments surrounding China's health system, as well as perspectives from Chinese officials.

Congratulations to Dr. Xuezheng Qin, Peking University, on receiving a research grant from the National Science Foundation of China!

RESEARCH ARTICLE

HETEROGENEITY IN TREATMENT EFFECT AND COMPARATIVE EFFECTIVENESS RESEARCH

Zhehui Luo, PhD, Michigan State University

ABSTRACT

The ultimate goal of comparative effectiveness research (CER) is to develop and disseminate evidence-based information about which interventions are most effective for which patients under what circumstances. To achieve this goal it is crucial that researchers in methodology development find appropriate methods for detecting the presence and sources of heterogeneity in treatment effect (HTE). Comparing with the typically reported average treatment effect (ATE) in randomized controlled trials and non-experimental (i.e., observational) studies, identifying and reporting HTE better reflect the nature and purposes of CER. Methodologies of CER include meta-analysis, systematic review, design of experiments that encompasses HTE, and statistical correction of various types of estimation bias, which is the focus of this review.
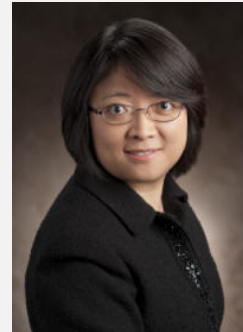
Zhehui Luo, M.S., Ph.D.
Assistant Professor of Epidemiology, Division of Biostatistics, Michigan State University,
Department of Epidemiology
B601 West Fee Hall,
East Lansing, Michigan 48824,
Tel: 517.353.8623x161 Email: zluo@msu.edu

INTRODUCTION—THE RELEVANCE OF CER IN HEALTH CARE REFORM

The American Reinvestment and Recovery Act boosts the funding for Comparative effectiveness research (CER), which is deemed to hold significant promise to improve health care quality. Nevertheless, it faces some significant methodological challenges in fulfilling this promise. By definition, CER is "the conduct and synthesis of research comparing the benefits and harms of different interventions and strategies to prevent, diagnose, treat and monitor health conditions in 'real world' settings" (Federal Coordinating Council 2009). The objective of CER is to aid decision-makers to make evidence-based decisions to improve health care at both the *population* and *individual* levels. Thus, as a tool for CER, traditional randomized controlled trials (RCTs) are limited by poor generalizability. Observational studies in "real world" settings suffer from unmeasured confounding bias. Meta-analyses are complicated by heterogeneity of study populations and interventions. Some efforts have been made to overcome these methodological limitations of CER, such as innovative trial designs, propensity scores or instrumental variables methods for observational data analyses, and Bayesian meta-analyses.

The ultimate goal of CER is to predict "which interventions are most effective for which patients under specific circumstances", which coincides with the goal of the federal initiative for personalized health care. A broad definition of personalized medicine includes "all factors that distinguish an individual's health characteristics and risks, including family history, clinical data, behavioral factors, and genomics when applicable" (Snyderman and Dinan 2010). In the era of personalized medicine, to directly address the goal of CER, there is a call for CER methodologies that can estimate the treatment effect at the individual patient level (Basu 2009).

The need for individualized CER (*i*CER) is most prominent for diseases with heterogeneous treatment effect (HTE). The development of *i*CER methodology will help to clarify which forms of evidence are sufficiently informative for a specific patient (Garber and Tunis 2009).

A Framework for Causal Inference

The main problem with empirical analyses of treatment response, in RCTs or observational studies, is the non-observability of counterfactual outcomes. Studies of CER aim to predict outcomes that would occur if different treatment strategies were applied to a population. The Neyman-Rubin-Holland tradition, or the Rubin Causal Model (RCM), is becoming the mainstay of causal inference in both RCTs and observational studies. Denote the potential outcome by $Y_i(A)$ if individual i is exposed to treatment alterative A. In a two-arm RCT, an intervention (A=1) is compared with placebo or control condition (A=0). A person is randomly assigned to one of the alternatives so that one of the $Y_i(A)$ is not observed. Individual level causal effects are defined by $Y_i(1) - Y_i(0)$. Random assignment leads to the direct estimate of $E[Y_i(0)]$ for the treated group using observed outcomes in the control group. The RCM allows for general heterogeneity in treatment responses and for direct handling of complications, such as noncompliance with assigned treatment. The treatment assignment mechanism is a stochastic rule governing the actual receipt of an alternative. It can be a known or an unknown function independent of potential outcomes, or a function dependent on potential outcomes. Different treatment assignment mechanisms require different analytical methods for estimating treatment effects.

In observational studies, treatments are rarely randomly assigned. Thus corrections for overt and hidden biases have to be made under certain assumptions to produce valid inference on causal effects. Much of the recent development in the statistics literature for estimating average treatment effects (ATE) and bias correction builds on the work by Rubin, Rosenbaum and others (Rubin 1973; Rosenbaum and Rubin 1983; Heckman, Ichimura et al. 1998). Applicable in a special case, variously referred to as unconfoundedness, exogeneity, ignorability, or selection on observables, these methods can be grouped into five categories: (i) estimating the unknown regression functions of the outcome; (ii) matching on covariates; (iii) propensity score methods; (iv) combination of the above; and (v) Bayesian methods (Imbens 2004).

A parallel literature in econometrics for program evaluation was developed, with a focus on issues of endogeneity, or self-selection, when the unconfoundedness assumption is violated. Individuals who choose to enroll in a program are, by definition, different from those who choose not to enroll. Without unconfoundedness, five general categories of estimation methods have been summarized by Imbens and Wooldridge (2009). These methods are: (a) sensitivity analyses; (b) bound analyses; (c) instrumental variables (IV) with exogeneity and exclusion restrictions; (d) regression discontinuity designs; and (e) a set of methods referred to as difference-in-differences.

Estimand and Hypothesis Testing

In any evaluation study, the primary objective of estimation must be made explicit. Table 1 summarizes the estimands of traditional CER in the simple case with two treatment options. Well-conducted RCTs estimate average treatment effects (ATEs) between treated and control groups. If ATEs can be generalized to the population it becomes the population ATEs (PATEs, τ_{PATE}). The PATE provides answers to policy questions such as "what would happen if entire population was subject to the intervention as compared to what would happen if the entire population was not subject to the intervention?" Such global estimates may not always be of interest. A second quantity of interest that has received much recent attention is the average treatment effect on the treated (ATT), which is the mean effect for those who actually were treated. Population ATTs (PATTs, τ_{PATT}) are useful when an intervention is not applicable to the entire population. When estimates are adjusted by persons' characteristics (X_i), such as women aged 65 and above with histories of depression, ATEs and ATTs become conditional ATEs (CATEs) and conditional ATTs (CATTs). When a pre-specified subgroup is the target of interest, estimates are CATEs in a subpopulation (CATE-S). Marginal q-th quantile treatment effect (MQTE-q, τ_q) is the difference between $Y_i(1)$ and $Y_i(0)$ at the

q-th quantile of the marginal distributions $F_{Y(1)}^{-1}(q)$ and $F_{Y(0)}^{-1}(q)$. This quantity is particularly useful for continuous measures with varying treatment effects by the level of the outcome. Imbens and Woodridge (2009) point out issues of interpretation for this estimate. First, unless there is perfect rank correction between the potential outcomes, the two marginal distributions will not be the same. Second, the MQTE-*q* will not be the same as unit level *q*-th quantile treatment effect (UQTE-*q*, $\tilde{\tau}_q$), which is based on the joint distribution of the potential outcomes $F_{Y(1)-Y(0)}^{-1}(q)$. The problem with UQTE-q is that $\tilde{\tau}_q$ is not point identified without assumption of the rank correlation between the potential outcomes even in RCTs. Imbens and Angrist (1994) define a local ATE (LATE, τ_{LATE}) that is estimable using IV under very weak conditions. For example, in the case where the treatment indicator, A_i, is binary and a valid instrument, Z_i, is binary, they show that, under the assumption of monotonicity, the estimated treatment effect, τ_{LATE}, is for the subpopulation that is affected by the instrument. However, this subpopulation is generally not identifiable. In this example, potential treatment options received, $A_i(0)$ and $A_i(1)$, depends on the particular instruments used for estimation ("compliers" in their nomenclature, whose treatment choice can be "manipulated" based on the values of the instrument).

Hypothesis testing in CER concentrates on the null hypothesis that the estimand of interest is zero. In cases where τ_{PATE} is zero, it may be of interest to test whether there is positive treatment effect in a subpopulation, by observable covariates, or by the quantiles of the potential outcomes. This is highly relevant to *i*CER because, to make a treatment decision for a specific patient, a clinician needs to have evidence of the efficacy of alternative options based on a sample of other individuals for whom both outcome and covariate information are available before s/he can apply it to a new patient. Such information is not summarized by τ_{PATE}. Addressing the uncertainty of such decision rules is a new and growing literature.

Table 1. Estimands of Interest in CER	
Estimand	**Definition**
Population Average Treatment Effect (PATE)	$\tau_{\text{PATE}} = E\big[Y_i(1) - Y_i(0)\big]$
PATE on the Treated (PATT)	$\tau_{\text{PATT}} = E\big[Y_i(1) - Y_i(0)\big|A_i=1\big]$
Conditional Average Treatment Effect in the sample (CATE)	$\tau_{\text{CATE}} = \frac{1}{N}\sum_{i=1}^{N} E\big[Y_i(1) - Y_i(0)\big|X_i\big]$
CATE on the Treated in the sample (CATT)	$\tau_{\text{CATT}} = \frac{1}{N_1}\sum_{i|A_i=1} E\big[Y_i(1) - Y_i(0)\big|A_i=1, X_i\big]$
CATE in a subpopulation (CATE-S)	$\tau_{\text{CATE-S}} = \frac{1}{N_s}\sum_{i:X_i\in S} E\big[Y_i(1) - Y_i(0)\big|X_i\big]$
CATE on the Treated in a subpopulation (CATT-S)	$\tau_{\text{CATT-S}} = \frac{1}{N_s}\sum_{i|A_i=1:X_i\in S} E\big[Y_i(1) - Y_i(0)\big|A_i=1, X_i\big]$
Marginal *q*-th quantile treatment effect	$\tau_q = F_{Y(1)}^{-1}(q) - F_{Y(0)}^{-1}(q)$
Unit level *q*-th quantile treatment effect	$\tilde{\tau}_q = F_{Y(1)-Y(0)}^{-1}(q)$
Local Average Treatment Effect (LATE)	$\tau_{\text{LATE}} = E\big[Y_i(1) - Y_i(0)\big|A_i(0)=0, A_i(1)=1\big]$

Sources of Heterogeneity in Treatment Effect (HTE)

Responses to treatment for an individual or a group may depart from the population average due to differences in susceptibility, vulnerability to adverse side effects and utilities for different outcomes (Kravitz et al, 2004). Heterogeneity in treatment responses is the magnitude of the variation of individual or group treatment effects across a population. By estimating this variation, a clear distinction can be drawn on whether one treatment is superior to the other for everybody in

the population or whether one treatment is superior to the other for an *average* or typical person in the population.

Adaptive Treatment Strategy and Time-varying Covariate

Robins pioneered estimation of causal effect of a time-varying treatment in observational studies (Robins 1986). He and his colleagues introduced three methods under sequential ignorability: the inverse-probability-of-treatment weighted (IPTW) estimator, g-estimation of structural nested models, and the iterative conditional expectations estimator (Hernán, Brumback et al. 2001). Extensions of these estimators to cases with unmeasured confounder or censoring have been proposed (Brumback, Hernán et al. 2004; Bryan, Yu et al. 2004). In recent years, attention has shifted to identifying optimal treatment sequence in an adaptive experiment. Murphy developed an iterative minimization method based on the dynamic programming or backwards induction principle (Murphy 2003). Robins does so using g-estimation in structural nested mean models (Robins 2004). Moodie et al. demonstrate that these two methods are closely related (Moodie, Richardson et al. 2007) and Dawson and Lavori argue that a sequential Bayesian predictive inference method is more efficient than the marginal mean approach (Dawson and Lavori 2008).

Counterfactual Choice Probabilities and Decision Theories

McFadden initiated the parametric random utility models to describe observed discrete-choice behavior and to predict the choices that a person would make in counterfactual choice settings (McFadden 1974). Since then much work was done to advance the field to include more tractable models with less severe preference assumptions (Train 2003). A distinct and innovative literature builds on the basic structure of discrete choice models using observed choice probabilities to partially infer the distribution of types of persons in the population (Manski 2007; Hirano and Porter 2009). The results are then used to predict behaviors in unrealized choice settings. This literature is very much in progress and relevant to *i*CER because it studies the problem faced by a clinician or an experimental designer: a clinician or patient has to make a choice given limited information derived from another population.

Pragmatic Clinical Trial

Clinical trials for which "the hypothesis and study design are developed specifically to answer the questions faced by decision makers are called pragmatic or practical clinical trials (PCTs)" (Tunis, Stryer et al. 2003). Different from RCTs, PCTs compare practical interventions, include diverse populations in diverse practice settings, and collect data on a broad range of health outcomes. The former is explanatory to aid our understanding of an intervention; and the latter is pragmatic to aid our decision on preferred intervention for a patient, i.e., PCTs are designed to meet the needs of decision makers. NIMH funded several large-scale PCTs, including STAR*D for depression, STEP-BD for bipolar disorder, and CATIE for schizophrenia and Alzheimer's disease (Insel 2006).

After two international meetings on PCT design issues, a new tool, PRECIS, to assist trialists in making design decisions that are consistent with their stated purpose has been developed (Thorpe, Zwarenstein et al. 2009). PRECIS evaluates 10 domains of trial design with graphics to determine how generalizable results of a trial are. These 10 domains are: participants, flexibility of the intervention under evaluation, intervention practitioner expertise, comparison intervention, comparison intervention provider expertise, follow-up intensity, primary outcome, participant compliance/adherence, practice fidelity, and analysis of outcome. We believe the tool can also be used to evaluate the generalizability of an observational study.

DISCUSSION

Not all methodologies in CER are relevant to *i*CER because the two frameworks take on different perspectives: the former of a population and the latter of an individual. However, the methods

reviewed above are related to *i*CER. Many challenges for CER are germane to *i*CER because many of the threats to external validity in CER are due to individual unobserved confounders. In the future, researchers need to build on these methods and address (a) how to predict treatment responses while taking into consideration the patient's preference and choice; and (b) what the empirical use of the *i*CER framework is in real world practice.

More fundamental, perhaps, is the issue of appropriate theoretical framework for *i*CER. Most medical research on treatment response has been focused on testing the null hypothesis of zero average treatment effect (even in pre-specified subgroup analysis, the idea is the same). If researchers, clinicians and policy makers wish to inform treatment choice for a given individual or group, they should not view statistical insignificance as a reason to refrain from studying heterogeneity in treatment response. In other words, they should not treat the null and alternative hypothesis asymmetrically, fixing the probability of a type I error and seeking to minimize the probability of a type II error. Instead, they must be concerned with the quantitative variation of outcomes with treatments and covariates. Hypothesis testing simply does not address this problem.

REFERENCES

Basu, A. (2009). "Individualization at the Heart of Comparative Effectiveness Research: The Time for i-CER Has Come." Medical Decision Making 29(6): NP9-NP11.

Brumback, B. A., M. A. Hernán, et al. (2004). "Sensitivity analyses for unmeasured confounding assuming a marginal structural model for repeated measures." Statistics in Medicine 23(5): 749-767.

Bryan, J., Z. Yu, et al. (2004). "Analysis of longitudinal marginal structural models." Biostatistics 5(3): 361-380.

Dawson, R. and P. W. Lavori (2008). "Sequential causal inference: Application to randomized trials of adaptive treatment strategies." Statistics in Medicine 27(10): 1626-1645.

Federal Coordinating Council (2009). Report to the President and the Congress on Comparative Effectiveness Research. Washiongton DC.

Garber, A. M. and S. R. Tunis (2009). "Does comparative-effectiveness research threaten personalized medicine?" New England Journal of Medicine 360(19): 1925-1927.

Heckman, J. J., H. Ichimura, et al. (1998). "Matching as an econometric evaluation estimator." Review of Economic Studies 65(2): 261-294.

Hernán, M. A., B. Brumback, et al. (2001). "Marginal structural models to estimate the joint causal effect of nonrandomized treatments." Journal of the American Statistical Association 96(454): 440-448.

Hirano, K. and J. R. Porter (2009). "Asymptotics for statistical treatment rules." Econometrica 77(5): 1683-1701.

Imbens, G. W. (2004). "Nonparametric estimation of average treatment effects under exogeneity: A review." Review of Economics and Statistics 86(1): 4-29.

Imbens, G. W. and J. D. Angrist (1994). "Identification and estimation of local average treatment effects." Econometrica 62(2): 467-475.

Imbens, G. W. and J. M. Wooldridge (2009). "Recent Developments in the Econometrics of Program Evaluation." Journal of Economic Literature 47(1): 5-86.

Insel, T. R. (2006). "Beyond efficacy: the STAR*D trial." Am J Psychiatry 163(1): 5-7.

Kravitz, R. L., Duan, N. and J. Braslow (2004). "Evidence-based medicine, heterogeneity of treatment effects, and the trouble with averages." The Milbank Quarterly 82(4): 661-687.

Manski, C. F. (2007). "Partial identification of counterfactual choice probabilities." International Economic Review 48(4): 1393-1410.

McFadden, D. (1974). Conditional logit analysis of qualitative choice behavior. Frontiers in Econometrics. P. Zarembka. New York, NY, Academic Press.

Moodie, E. E. M., T. S. Richardson, et al. (2007). "Demystifying optimal dynamic treatment regimes." Biometrics 63(2): 447-455.

Murphy, S. A. (2003). "Optimal dynamic treatment regimes." Journal of the Royal Statistical Society Series B-Statistical Methodology 65: 331-355.

Robins, J. M. (1986). "A new approach to causal inference in mortality studies with a sustained exposure period - application to control of the healthy worker survivor effect." Mathematical Modelling 7(9-12): 1393-1512.

Robins, J. M. (2004). Optimal structural nested models for optimal sequential decisions. Proceedings of the Second Seattle Symposium on Biostatistics. K. Y. Lin and P. Haeagerty. New York, NY, Springer.

Rosenbaum, P. R. and D. B. Rubin (1983). "The Central Role of the Propensity Score in Observational Studies for Causal Effects." Biometrika 70(1): 41-55.

Rubin, D. B. (1973). "Matching to Remove Bias in Observational Studies." Biometrics 29(1): 159-183.

Snyderman, R. and M. A. Dinan (2010). "Improving health by taking it personally." JAMA 303(4): 363-364.

Thorpe, K. E., M. Zwarenstein, et al. (2009). "A pragmatic-explanatory continuum indicator summary (PRECIS): a tool to help trial designers." J Clin Epidemiol 62(5): 464-475.

Train, K. (2003). Discrete Choice Methods with Simulation. Cambridge, UK, Cambridge University Press.

Tunis, S. R., D. B. Stryer, et al. (2003). "Practical clinical trials: increasing the value of clinical research for decision making in clinical and health policy." JAMA 290(12): 1624-1632.

TOPICAL REVIEW

Documented Evidence of Agricultural Injury in China[*]

LIU Jianjun[1], YAO Hongyan[1], ZHENG Wenjing[1] , XIANG Huiyun [2],
[1] Chinese Center for Disease Control and Prevention, Beijing, China
[2] Center for Injury Research and Policy, The Research Institute at Nationwide Children's Hospital, The Ohio State University, Columbus, Ohio, USA

ABSTRACT

Background: Up until 2010, there were more than 1600 peer-reviewed articles on agriculture related injuries around the world. However, relatively few literature reviews existed concerning China's agricultural injuries.

Objective: To describe the documented evidence concerning agricultural injury in China and to identify topics for future research.

Method: Literature search and review were conducted to collect publications that were relevant to agricultural injury in China. The process included defining agricultural injury for the purpose of this study, selecting articles according to inclusion criteria and extracting data from each paper. Descriptive methods were used to analyze the contents, research approaches, distribution of authors, and cooperation percentage of agricultural injury studies.

Results: After applying the inclusion criteria, 89 articles were included in this study. The author collaboration percentage (number of articles with more than one author divided by number of total articles) and the institutional collaboration percentage (number of articles with more than one organization divided by number of total articles) among the 89 articles were 85.4% and 42.7%, respectively. Most of the authors are affiliated with a Center for Disease Control and Prevention (CDC) or an academic institution located in 10 of the 31 provinces in mainland China. Among the 89 articles, only 6 were on injuries related to agricultural work, the rest (83) dealt with injuries among rural residents with or without clarifying occupations or ongoing activities.

Conclusions: Research on agricultural injuries in China is currently in its early stage. More research is needed to obtain evidence that can be used in policy making for agricultural injury control. Our study is the first to describe the documented evidence on agricultural injuries in China and identify topics for future research.

Dr. YAO Hongyan
Deputy Director, Office of Epidemiology,
Chinese Center for Disease Control &
Prevention
No.155 Changbai Road Changping District
Beijing 102206, China
Email: 2003tb@163.com

INTRODUCTION

Worldwide, agricultural injury has been a significant occupational hazard. Because of the agricultural industry's high mortality rate and high risk for disability, agriculture is considered one of the most dangerous occupations in the world [1]. According to the National Safety Council in America, there were more than 700 agricultural fatalities and 80,000 agricultural disabling injuries occurring in 2007 in the U.S.[1] The recent report of Canada's Agricultural Injury Surveillance System

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[*] Authors' contribution: All authors took part in the planning, executing, and reporting of the work described in this article, including the project's conceptualization and study design, analysis and interpretation of data, critical revision of the draft manuscript, and approval of the final version.

(CAISP) stated there were 1,769 agricultural fatalities in Canada from 1990 to 2005, an average of 111 per year [2]. In 2000, a study in Hubei, China, showed that a total of 33% of farmers reported at least one worked-related injury in the 24 months prior to the survey [3].Besides physical impairment, agricultural injuries lead to large economic burdens. In America, the cost of therapy and rehabilitation for agricultural injuries and the subsequent productivity loss due to agricultural injury totaled more than $10 billion annually [4].

China is a vast country with 1.3 billion people, 57% of which live in rural areas. More than half of people living in rural areas either fully or partially engage in agricultural work [5]. The rural setting and lack of emergency care in remote areas leave rooms for health and safety improvement. By the end of 2010, there were more than 1600 agriculture injury related articles published around the world according to the search engine PubMed. Research data on agricultural injuries has focused on developed countries, particularly Canada, the United States, and Australia. In China there were limited number of publications on agricultural injuries within Chinese research databases when the term "agricultural injury" was used in the searches.

The purpose of this study is to describe the characteristics of Chinese agricultural injury related articles published and analyze the current status of research progress to aid future research in agricultural injury control and prevention in China.

METHODS

Definition of agricultural Injury and Inclusion Criteria
There was no consistent definition of agricultural injury commonly used in the agriculture-related injury control and prevention. While determining what constitutes agricultural injury, several priority factors were considered. These included the injury setting, occupation, and outcomes. In this study, agricultural injury was defined as "injuries that occurred during the agricultural working process or during activities related to the agricultural working environment, injuries among farmers or injuries that occurred in rural areas." The reason for selecting a broad definition was that few articles of agricultural injury were found in the main Chinese research database when using "agricultural injury" as the keyword. Data collected for our study were limited to mainland China. In this study, agricultural injury and farm injury are interchangeable.

Data collection methods
We searched the major Chinese databases, such as WANFANG Database（1982-2010）, WEIPU database (1984-2010), CHKD（1993-2010）and so on by using key words of 'agriculture', 'rural area,' and 'farmer' respectively matched with 'injury'†. We did not specify dates of publication.

As for the English database, 'agricultural/farm injury' and 'China/Chinese', 'rural', 'injury,' and 'China/Chinese' were used as key search terms in the MEDLINE database. Publication date was not included as part of the search criteria. After collecting the citation information of the articles, we then read the titles and abstracts and deleted those that were duplicate and irrelevant.

In addition to the aforementioned database, we also conducted searches at Google Scholar and file.baidu.com.

Summary record sheet
One summary record sheet was used per article. The criteria included title, date published, authors' full name, author's affiliation, content, number of authors, number of affiliated institutions, number

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† Note: 中文检索式：“农业”、“农村”或“农民”分别与“伤害”进行逻辑“与”的组合。

of references, number of references within last five years, categories/language of references, site/population where the injury took place, type of study design, and type of the journal.

Data management and analysis

First, the articles were read one by one and detailed data for each article was extracted and recorded on the summary record sheet. Second, variables including collaboration percentage of authors and organizations, geographical distribution of the authors, and number of quotations were used in statistical analysis. An EXCEL spreadsheet was used to organize the data. Frequency tabulates were used to describe the variable distribution.

RESULTS

Results of literature search

Figure 1 presents the selection process for including studies in the review. A total of 89 articles [3, 7-94] were selected which were published between 1993 and 2010. Most of these articles were published between the years of 2003-2010. Articles published between 2003 and 2010 accounted for 92.1% (82/89) of the total. The full texts were obtained and read through. The bibliometric parameters and research characteristics were analyzed and described.

Author and institutional collaboration

The majority of the articles involved multiple authors. Among the 89 articles, there were 13 with a single author and the rest had more than one author. The percentage of author collaboration was 85.4% (See Table 1).The average number of authors per article was 4.8 (425/89). There were 38 articles published by authors from two or more institutions. The institutional collaboration percentage was 42.7% (See Table 1).

Characteristics of first authors

Number of published articles and regional distribution of the first author showed the diversity of research levels throughout different institutions and regions. Table 2 showed that only 8 out of 81 (9.9%) authors published more than one paper. These articles accounted for 18% of total articles (16/89).

Table 3 displayed institutional distribution of first authors. Most of the first authors came from the China CDC, a provincial or local CDC, or an academic institution.

Citation analysis

Number of citations refers to the reference literature for each article. This could potentially affect the usefulness of information and distribution capacities. A total of 603 sources were quoted by the 89 articles, at an average of 6.8 sources quoted per article. The Price Index was 56.4% which was more than the average value (50%) [6] for general science articles(Price Index refers to the percentage of references published in the last five years compared with the total quoted number).

Research characteristics

Among a total of 89 articles, only 6 contained injuries related to the agricultural working process, the remaining 83 articles included rural residents with or without clarifying occupations or ongoing activities. There was no article that specially focused on the agricultural working environment or farmers. This shows that more "agricultural injury"-related information is included in injury-related surveys of rural areas. Many of the study designs were surveys (95.5%) based on population or surveillance systems such as National Disease Surveillance Points System (NDSPS). Most of the articles were published in Chinese journals (97.75%) and about 64% were from the Chinese core journals (See table 5).

Figure 1 Flow diagram of study selection
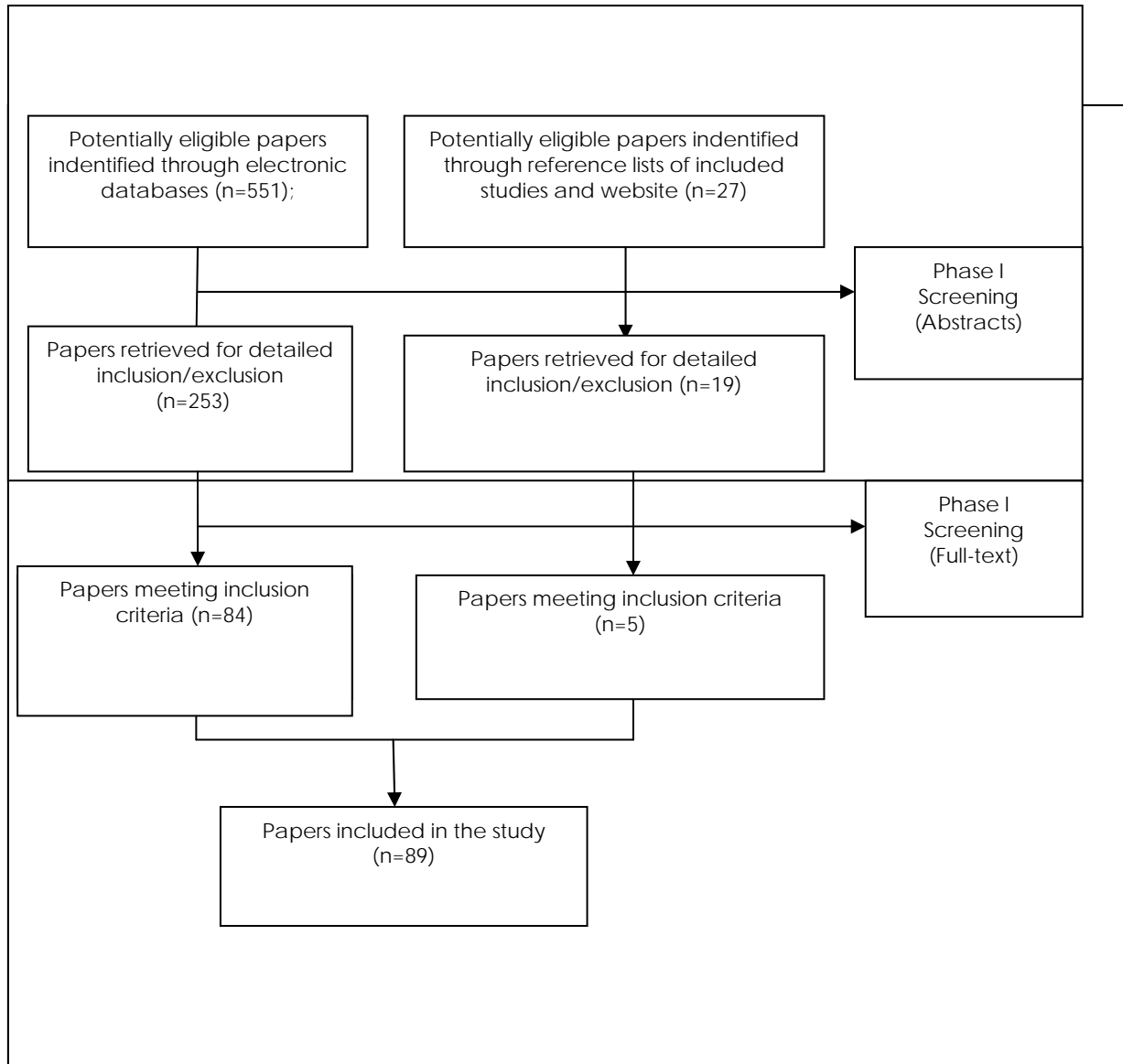
Table1 Frequency of author collaboration and institutional collaboration

No. of authors per article	No. of articles (%)	Person-time of author	No. of institutions per article	No. of articles (%)
1	13 (14.6)	13	1	51 (57.3)
>1	76 (85.4)	412	>1	38 (42.7)
total	89 (100.0)	425	Total	89 (100.0)

Table 2 Number of articles published by the first author in the 89 articles

No. of articles published	No. of first author (%)
1	73（90.1）
2	8（9.9）
>2	0（0.0）
Total	81（100）

Note: 'first author' means that they were the first author out of the many authors that contributed to the article.

Table 3 Distribution of first author's Affiliation

Affiliation category	Number of first authors Number (%)	Number of articles Number (%)
CDC	44 (54.32)	49 (55.06)
College/university	25 (30.86)	27 (30.34)
hospital	6 (7.41)	6 (6.74)
academe	4 (4.94)	5 (5.62)
other	2 (2.47)	2 (2.2)
total	81 (100)	89 (100)

Note: CDC refers to various levels of China's Center for Disease Control and Prevention. They could be at the national, provincial, city, or county levels.

Table 4 Distribution of first author's region

Province	Number of first authors Number (%)	Number of articles Number (%)
Zhejiang	11 (13.58)	13(14.61)
Shandong	10 (12.35)	10 (11.24)
Guangdong	8 (9.88)	10 (11.24)
Beijing	8 (9.88)	8 (8.99)
Guangxi	6 (7.41)	8 (8.99)
Hubei	7 (8.64)	7 (7.87)
Henan	5 (6.17)	7 (7.87)
Anhui	5 (6.17)	5 (5.62)
Jiangsu	4 (4.94)	4 (4.49)
Others	3 (3.70)	3 (3.37)
Total	81 (100)	89 (100)

Note: Others include 8 provinces that have one or two first authors.

DISCUSSIONS

Scientific publication is the main channel for disseminating research findings. It is also the key indicator for evaluating research productivities. Results of bibliometrics analysis of published scientific articles could provide evidence for current status of research in some areas.

From this study we can see that there are two main problems in the field of agricultural injury in China. First, our study indicated that research priorities on farm-related injury in China were specific to injuries occurring in rural areas rather than agriculture-specific injuries. Most of these publications specify neither the injured person's occupation nor the activities that caused the injury. Some studies defined occupations such as 'farmers' or 'workers.' We could not discern whether they meant to include agricultural work-related injuries or not. Second, there is a substantial gap between China and developed nations for reported cases of agricultural injuries. There is not yet a clear definition of 'agricultural injury' in China. It is necessary to propose an operational definition of agricultural injury for use in China by considering China's cultural and socioeconomic factors.

Most of the research considered in this review included descriptive statistics which focused on the investigation of epidemiologic characteristics of the injuries or the risk factors for injury. There was a lack of the research on intervention and prevention of injuries.

The percentage of author collaboration is high throughout the publications reviewed. Our study showed that while the percentage of author collaboration was high, the percentage of organization collaboration was low in the agriculture-related injury articles. This might imply that most research involves necessary collaboration between different people or organizations in order to achieve common goals. On the other hand, the lower percentage of organization collaboration suggest that the breadth and depth of the research related to farm injuries in China was not enough to support this type of cooperation.

Our study found that most of the primary authors came from the various levels of CDC, colleges, or universities. This implied that more disease control units and universities are involved in agricultural injury research, perhaps because injuries have been gradually recognized as a public health issue in recent years in China.

Generally for individual researchers, more published papers equates to greater scientific progress. Our study indicated that only 8 out of 81 (9.9%) authors published more than one paper which accounted for 18% of the total articles (16/89). From this, we can infer that a core group of authors devoting research to Chinese agricultural injuries has not yet emerged. It is necessary to attract more injury researchers and public health professionals to this understudied area.

Our study found that the geographic locations of the 79 Chinese authors covered 18 out of the total 31 provinces in mainland China. The majority were concentrated in 10 provinces (80% or more). This shows a geographical disparity in author distribution. There were 13 provinces that had no articles published on farm related injuries.

As China is changing rapidly and moving towards an industrialized country, China's occupational health programs should evaluate injuries to identify the need for additional research on national occupational safety and injury prevention, as other developed and developing countries have done. Though the study on agricultural injuries in China is only beginning, this information can provide some reference for future work. What we currently need most is more convincing data for issue awareness and policy making. We must first conduct more investigations to gain a better understanding of the problem, identify the main causes and risk factors associated with agricultural injury, and give suggestions on prevention and control measures.

Due to a lack of resources to describe the agricultural injury profiles in China, there is little scientific evidence for the prevention and control of agriculture injuries. Our study describes the agricultural injury research in China by bibliometrics analysis. This information can be used as evidence to support future studies and policy making, and will hopefully bring empirical and long-term significance of this public health problem.

CONCLUSION

The ultimate objective of our study is to provide information that can help the officials in Ministries of Health and Agriculture address the serious impact of farm-related injuries and death. Our study described the status of the agricultural injury research in China. We hope to provide information for injury researchers and public health professionals for future research activities on agricultural injury and safety. Some concrete conclusions from our study include the research priorities on farm-related injuries in China were those occurring in rural areas rather than agriculture-specific injuries. There was a lack of research on the intervention of injuries and the research related to farm injury in China lacked breadth and depth. Finally, there was a noticeable geographical disparity in author distribution throughout all publications.

REFERENCES

1. Peter E. Saar, Helen Dimich-Ward, Karen D, Donald C. Voaklander. Farm injuries and fatalities in British Columbia, 1990-2000. Can J Public Health 2006; 97 (2):100-104.
2. The Canadian Agricultural Injury Surveillance Program. Agricultural fatalities in Canada 1990-2005.The reports of the Canada agricultural injury surveillance system (CAISP). Available at http://cair-sbac.ca/natrep2.html. Accessed March 15, 2011.
3. Huiyun Xiang, ZengZhen Wang, Lorann Stallones etc. Agricultural work-related injuries among farmers in Hubei, People's Republic of China. Am J Public Health 2000; 90(8):1269-1276.
4. Leigh, JP, McMurdy SA, Schenker MB. Costs of occupational injuries in Agriculture. Public Health Rep 2001; 116:235-248.
5. National Bureau of Statistics of China. Results of a sample survey conducted among one percent of the total population in 2005. Beijing, National Bureau of Statistics of China, 2005.
6. Zhang XM, Chen WB. Analysis of paper numbers, authors and literature sources in the journal of "Chinese Journal of Clinical Pharmacy". Chinese Journal of Clinical Pharmacy 2002; 11(4):256~258.
7. Chang J, Liu ZH, Zhang QH , et al. Analysis of death caused by injury among rural residents in Gao Tang County from 2003 to 2005.Preventive Medicine Tribune 2007; 13(8): 693-695.
8. Liu J, Yu H, Zhuang FM, et a l. Analysis on injury cases in Miyi County. Journal of Preventive Medicine Information2009; 25(2):110-112.
9. Zhang DQ. An epidemiologic study on injury in rural Tongzhou, Beijing during 2006~2008. Capital Journal of Public Health 2010; 4(4): 156-159.

10. Diao WL, Wang GL, Tian JC, et al. Analysis of injury surveillance in Fuxin Mongolia autonomous county, L iaoning province , 2006 – 2008. Disease Surveillance 2010; 25(1): 68- 71.

11. Xia Zichen，Du Liqun，Li Huanlong. A Study of epidemic characteristics on injuries in residents in Fuyang County. Science of Travel Medicine 2002; 8(2): 11-13.

12. Ren ZP, Wang XY. Analytic report of injury surveillance in rural areas of Shanxi province in 2007. Disease Surveillance 2008; 23(9): 584- 585.

13. Wang Y, Ma JS, Ruan SM, et al. Analytic report of injury surveillance in rural areas of Jinan in 2008. Modern Preventive Medicine 2010; 37(11):2092-2095.

14. Wang BR. Analysis of death from unintentional injury in Zhou Chen city, 1995~2000. Occupation and Health 2002; 18(5): 93-94.

15. Yan L, Su HC, Yang JE, et al. Analysis of death caused by injury in Enshi autonomous prefecture. Chinese Journal of Preventive Medicine 2001; 35(6): 400.

16. Yu XM, Zhang JC, Wang M, et al. Study on the behavior status and countermeasure about the campus and home injury of middle school students in the suburb county in Beijing. Chinese Journal of Behavioral Medical Science 2004; 13(4): 454-456.

17. Zheng ZX, Qin TZ, Tu BJ, et al. Survey on the agricultural machine related injury in Henan Province, 1990~1992. The Academic Journal of Xinxiang Medical College 1993; 10(4): 295-297.

18. Sun J, Yang XZ. An epidemiological study and the direct economic burden study on the agricultural work related injury in the Henan Province. Modern Preventive Medicine 2010; 37(1): 23-28.

19. Wang LM, Sun YW, Han YF, et al. Epidemiological study on alcohol consumption and agricultural profession-related injuries among Minority Residents from the Northern parts of China. Chinese Journal of Epidemiology2009; 30(12): 1252-1257.

20. Meng J, Geng WK, Zhou JT, et al. Survey of knowledge level of rural adult inhabitants to injury in four counties of Guangxi. China Tropical Medicine 2006; 6(2): 366.

21. Chang X, He JR, Zhong ZH, et al. A cross-sectional study of injury among the residents in a rural community, Guangzhou. Modern Hospital 2010; 10(1): 152-154.

22. Yin XL, Xie ZP, Dong YM, et al. Farm related injuries among rural residents of Daur ethnic minority group in Qiqihar, Heilongjiang province, China. Chinese Journal of Public Health 2010; 26(5): 627-629.

23. Xie YH, Chen NY, Geng WK, et al. A study on the injury knowledge, attitude and behavioral of residents in the rural areas in Chuangxi. Guangxi Journal of Preventive Medicine 2004; 10(3): 139-141.

24. Yan RT, Liu WQ, Xie HR,et al. Analysis on the status of traffic injury happened in the primary and middle schools students in Lianping county. South China Journal of Preventive Medicine 2009; 35(2): 53-54.

25. Pu YH, Zhuang FM, Huang JA, et al. Injury surveillance of children at the age of 0~14 years in rural areas in Miyi county. Modern Preventive Medicine 2008; 135(4): 678-680.

26. Zheng WG, Zhao ZT, Xu LZ. Analysis on the economic burden of hospitalization between injury and non-injury inpatients. Chinese Health Economics 2006; 25(6): 22-24.

27. Zhang XW, Liu LQ, Cai CL. Baseline survey report of the advancement program on the prevention of the primary scholar injury in the rural area of Zhejiang. Available at http://www.exam8.com/lunwen/yiyao/yixue/200607/1066847.html. Accessed March 15, 2011.

28. Xu YQ. Analysis on the 244 cases of childhood accident injury. Journal of Yunang Medical College 2007; 4: 249-250.

29. Li H, Zhu JQ, Sun JX, et al. An investigation on the clinical injuries among patients in hospital in Gaocheng city in 2004. Chinese Journal of Prevention Control Chronic Non-communicable Diseases 2005; 13(5): 214-216.

30. Huang LF, Du GM, Yao MF. Survey of injuries behavioral risk factor in the residents in the rural area of Zhangjiagang in 2004. Preventive Medicine Tribune 2006; 12(2):168-169.

31. Sun Y, Tao FB, Xu SJ, et al. Self-injuries behaviors and psychosocial factors among rural middle school students in Anhui province. Chinese Journal of School Health 2008; 29(5): 424-427.

32. Peng L. Survey analysis and prevention on the risk factors of the junior school student injury. Journal of Medical Forum 2006; 27(23):53-55.

33. Li J, Zhao FH, Wu SX, et al. Injury among rural residents in Fengtai district, Beijing, and relevant interference. Chinese Journal of Health Education 2008; 24(4): 247-249.
34. Geng WK, Meng XY, Cheng YN, et al. Investigation on injury incidence and safety knowledge level of people in Guangxi rural areas. Chinese Journal of Public Health 2005; 21(9): 1048-1049.
35. Xu LR. Study on accidental injuries of residents in rural areas. Strait Journal of Preventive Medicine 2003; 9(3): 37-39.
36. Wang LJ, Ma JM. Analysis of injury incidence rate in countryside of 4 counties. Disease Surveillance 2005; 20(8): 437-439.
37. Yang GH, Ma JM, Wang LJ. Survey on injury in four rural communities in China. Chinese Journal of Epidemiology 2004; 25(3): 204-208.
38. Duan LX. Survey on the epidemiological characteristics of farmer injuries in Xintian county. Practical Preventive Medicine 2005; 12(5): 1137-1138.
39. Chai CL, Yu Z. An epidemiological study on injury knowledge and behaviors among rural pupils in north areas of Zhejiang Province. Chinese Journal of Health Education 2007; 23(8): 584-586.
40. Chai CL, Zhang XW, Xu SY,et al. An epidemiology study on injury among rural pupils in Zhejiang Province. Chinese Primary Health Care 2003; 17(11):34-36.
41. Tang J, Su SH, Wang SY, et al. Effect evaluation of health promotion for injury prevention among preschool children in a rural community of Zhuhai City. Chinese Journal of Health Education 2006; 22(6):411-415.
42. Tang J, Huang H, Wang SY, et al. Injuries of children in kindergartens in rural community of Guangdong province and the relevant knowledge among the parents and teachers; a study in Zhuhai. Chinese Journal of Health Education 2005; 21(3): 175-178.
43. Zhang PB, Deng JY, Chen RH, et al. Analysis on the causes of accidental suffocation and drowning among children aged 0~4 in countryside of Jiangsu. Chinese Journal of Disease control and Prevention 2001; 5(3): 243.
44. Dong HM, Wang Y, Yan CK, et al. Evaluation on the effect of intervention measures for injuries in the rural residents of Shijizhuang city. Chinese Journal of Disease Control and Prevention 2001; 5(3): 261- 262.
45. Zhang SY, Dong HM, Yan CK, et al. Case-control study on risk factors for injured in Shijiazhuang region. Chinese Journal of Disease Control and Prevention 2001; 5(3): 270.
46. Li ZH, Zhao ZT, Guo YX, et al. The burden caused by injury in countryside residents in Dongying , Shandong Province. Chinese Journal of Preventive Medicine 2005; 39(4): 273-276.
47. Li SH, Yu YL, Tang ZR, et al. Cross-sectional study on injury among rural children in Pucheng. Chinese Journal of School Health 2009; 30(12): 1118- 1120.
48. Wu WF, Mai CZ, Sun LM, et al. A survey on present situation of injuries among rural residents. Chinese Journal of Disease Control and Prevention 2004; 8(6): 586- 587.
49. Li HL, Du LQ, Xia ZC. Survey on the epidemiological characteristics of rural childhood injury. Chinese Journal of School Health 2003; 17(2): 140-141.
50. Meng XY. The study on the status of rural injuries. Anthology of Medicine. 2005; 24(1): 117-119.
51. Si MD, Liu XX, Li J. A case-control study on the related factors of injuries among children aged 7～14 in a rural community of Macheng city. Chinese Journal of Child Health Care2001; 9(6): 391- 394.
52. Zhang NJ, Zhao XM, Xu XH, et al. The epidemiological survey of the rural residents' injury in Laizhou city. Chinese Journal of Pest Control 2004; 20(12): 732-734.
53. Zhang MR, Yang Z, Chen L, et al. A study on the epidemiological characteristics of injuries among the rural residents in Kunming. Chinese Primary Health Care 2006; 20(9): 57-59.
54. Huang MX, Huang L, Du SK, et al. Survey of the death resulting from the injury in the rural residents in Jimo city. Literature and Information on Preventive Medicine 2000; 6(1): 92
55. Lv JB, Zhao XH. Analysis on the trend of the accident mortality rate of the rural residents in Zhengding(Hebei), 1974~2000. Hebei Medical Journal 2003; 25(9): 679-680.
56. Chen YN, Geng WK, Zhuo JT, et al. Analysis on injury in rural areas in Guangxi. South China Journal of Preventive Medicine 2005; 31(2): 21-23.
57. Zhao H, Xu WM, Zhang Z, et al. Survey on injuries among the residents in rural areas of Dawa county. Chinese Journal of Disease Control and Prevention 2007; 11(3): 301-302.

58. Yu Y, Xie XH, Fan CY, et al. Analysis of 0~6 year - old child injury in rural area of Beijing. Chinese Journal of Nature Medicine 2007; 19(3): 211- 214.

59. Li H, Wang LN, Zhu JQ, et al. An investigation for the injuries among the countryside residents in Gaocheng city in 2005. Modern Preventive Medicine 2006; 133(7):1133-1135.

60. Mo XC. Analysis and countermeasures on the condition of intentional injury crime cases in Guangxi Rural areas. Guangxi Social Sciences 2005; (6): 119-120.

61. Bai YH. The causes and protective measures of the injuries in the rural middle school students. Kexue Shidai 2010; (9):273.

62. Chen SC. Study on the sports injuries in the rural areas of Yudong. Heilongjiang Science and Technology Information 2008; (36): 257.

63. Shi DH, Fang WM, Liu XX. Prevalence and risk factors of unintentional injuries among children aged 0 - 6 in rural community of Macheng city. Journal of Huazhong University of Science and Technology 2003; 32(3): 336-339.

64. Xie YH, Chen YN, Geng WK, et al. A study on the injury knowledge, attitude and behavioral of residents in the rural areas in Guangxi. Guangxi Journal of Preventive Medicine 2004; 10(3): 139-141.

65. Yu T. An analysis on the accidental injury compensation of NRCMS in Nanzhang County. Chinese Health Resources 2010; 13(1): 17-18.

66. Lu LY. Analysis on the medical records of 210 cases rural children accidental injuries. Medical Information 2010; 23(8): 329-331

67. Xu HF, Ma WJ, Nie SP, et al. Study on intervention effects of traffic injury education on rural students. Chinese Journal of School Health. 2008; 29(10): 904-906.

68. Xia ZC, Du LQ, Li HL. Comparison of the epidemiological characteristics between the children and the aged in the rural areas in Fuyang city. Chinese Journal of Public Health Management 2004; 20(2): 175-176.

69. Yu HF, Chen ZW, Zhou ZH, et al. Epidemiological study on injury among rural pupils in Jiaxing. Chinese Journal of School Health 2006; 27(2): 107-108.

70. Cheng ZW, Yu HF, Zhou ZH, et al. Effect assessment on the health promotion project of injury prevention of the rural primary school students in Jiaxing city. Chinese Journal of School Health 2005; 26(11): 964-965.

71. Ge XJ, Tang GH, Li SJ, et al. An epidemiological survey on injury among rural residents of Gaomi. Chinese Journal of Disease Control and Prevention 2004; 8 (6): 584-585.

72. Shen M, Yang SP, Guo Y, et al. Study on nonfatal injuries among home—stranded children in rural environment of Hubei province. Chinese Journal of Epidemiology 2008; 29(4): 333- 337.

73. Ye YR, Li LP, Lu YG, et al. Determinants of bicycle injury among school—aged children in rural China：a qualitative study. Chinese Journal of Epidemiology 2010; 31(10): 1094- 1097.

74. Xue L, Pang SL, Yang YS, et al. An investigation on unintentional injuries of 1223 pupils. Maternal and Child Health Care of China 2007;22(35): 5066-5068.

75. Zhao KF, Su H, Fang XH, et al. Study on the distribution and risk factors of injuries among home—stranded children in rural area of Anhui province. Chinese Journal of Epidemiology 2008; 29(4): 338- 342.

76. Han YB, Qian YJ, Gao HJ, et al. Retrospective study on injury Incidence among residents in Tongxiang City. Zhejiang Preventive Medicine 2010; 22(5):16-18.

77. Guo XL, Xu AQ, Zhang JY, et al. Study on the epidemiological survey and economic burden of injuries among rural residents in Shandong province. Modern Preventive Medicine 2007; 34(5): 866-869.

78. Cheng DJ, Tao FB, Chen Q, et al. Incidence of injuries among rural boarding school students in Anhui Province. Chinese Journal of School Health 2008; 29(9): 782-784.

79. Zhong JM, Cong LM, Yu M, et al. Analysis of the surveillance data on injuries in a certain rural village in western Zhejiang. Disease Surveillance 2008; 23(4): 255-257.

80. Zhu YC, Ying YY, Xu R, et al. Survey on injury and KAP level of anti-frostbite among farmers during the snowstorm disaster in Ningbo of Zhejiang province, 2008. Disease Surveillance 2008; 23(12): 777-779.

81. Nie SP, Ma WJ, Xu HF, et al. Effect of intervention on sports injury among primary and middle school students in a county in Guangdong. Chinese Journal of School Health 2009; 30(1): 63-65.

82. Wu ZP, Ral DJ. Epidemiological survey on the 1059 rural residents injuries. Practical Preventive Medicine 2007; 14(2): 430-431.

83. Han JY, Lin LF, Lu WC, et al. A survey on red imported fire ants bites in villagers and disease control in a village of Guangdong. Chinese Journal of Vector Biology and Control 2007; 18(1): 20-23.

84. Ye YR, Li LP, Lu YG, et al. Investigation on bicycle injuries of secondary school students and related factors in Chaoshan region. Chinese Journal of Disease Control and Prevention 2009; 13(5): 554-557.

85. Zhang HQ, Zhang CG, Zhao JH, et al. Survey on the death cause by injuries in the rural residents in Dongtai city, 2000~2003. Chinese Journal of Prevention and Control of Chronic Non-Communicable Diseases 2005; 13(6): 307-309.

86. Wang DJ, Zhou G. The research progress on the suicide problem of rural residents in China. Henan Journal of Preventive Medicine 2010; 21(5): 323-327.

87. Zhou LN, Ma JM, Li ZJ, et al. Comparison of data population—based and from hospital—based injuries. Chinese Journal of Epidemiology 2004; 25(11): 967-969.

88. Jia CX, Zhang JY, Bo QG, et al. An investigation on the injuries in 51l students of senior high school in rural areas of Shandong Province. Chinese Journal of Prevention and Control of Chronic Non-Communicable Diseases 2003;11(6): 263-265.

89. Xu L, Pang SL, Guang WJ, et al. Investigation of accident injury status and its disease burden of pupil in Tangshan rural area. Maternal and Child Health Care of China. 2008; 23(9):1251-1253.

90. Zhou F. Analysis and prevention of the rural electricity injuries. Available at http://scholar.ilib.cn/A-%E4%BC%9A%E8%AE%AE%E8%AE%B0%E5%BD%95ID~7145134.html. Accessed March 15, 2011.

91. Jiang JX, Ding ZY, Xu JH, et al. Childhood traffic injuries and prevention in Huailai county of Hebei Province. Chinese Journal of Child Health Care 1995; 3(4): 259-261.

92. Cao PY, Huang ML, Zhang XB. The epidemiological study of injuries of middle school students in the country of Ninghai. Chinese Journal of Disease Control and Prevention 1999; 3(4): 329.

93. Meng J, Geng WK, Zhuo JT, et al. Analysis on the awareness rate condition of the traffic injury knowledge in rural adults of four counties in Guangxi. Practical Preventive Medicine 2005; 12(5): 1127-1128.

94. Postel MW, Jaung MS, Chen G, et al. Farm work-related injury among middle school students in rural China. Journal of Agricultural Safety and Health 2009; 15(2): 129-142.

RESEARCH TWITTER

Janet Currie, Wanchuan Lin, Wei Zhang. "**Patient Knowledge and Antibiotic Abuse: Evidence from an Audit Study in China**." *Journal of Health Economics*, 2011, 30(5): 933-49.
The authors conduct an audit study in which a pair of simulated patients with identical flu-like complaints visits the same physician. Simulated patient A is instructed to ask a question that showcases his/her knowledge of appropriate antibiotic use, whereas patient B is instructed to say nothing beyond describing his/her symptoms. The authors find that a patient who displays knowledge of appropriate antibiotics use reduces both antibiotic prescription rates and drug expenditures. Such knowledge also increases physicians' information provision about possible side effects, but has a negative impact on the quality of the physician–patient interactions. The results suggest that antibiotics abuse in China is not driven by patients actively demanding antibiotics, but is largely a supply-side phenomenon.

Zhiwen Li, Le Zhang, Rongwei Ye, Lijun Pei, Jianmeng Liu, Xiaoying Zheng and Aiguo Ren. "**Indoor Air Pollution from Coal Combustion and the Risk of Neural Tube Defects in a Rural Population in Shanxi Province, China**." *American Journal of Epidemiology*, 2011, 174(4): 451-8.
This paper evaluated indoor air pollution from coal combustion (IAPCC) as a potential risk factor for neural tube defects (NTDs) in a rural population in Shanxi Province, China. The studied rural population has both high IAPCC exposure and a high prevalence of NTDs. A population-based case-control study was used to identify 610 NTD cases and 837 normal controls between November 2002 and December 2007. Compared with women with no IAPCC exposure, women with any exposure at all had a 60% increased risk of having a child with an NTD. An increased NTD risk was linked to both residential heating and cooking. The risk increased with increases in the exposure index, showing a dose-response trend.

Qi-Qiang He, Tze-Wai Wong, Lin Du, Zhuo-Qin Jiang, Tak-sun Ignatius Yu, Hong Qiu, Yang Gao, Andromeda H.S. Wong, Wei-Jia Liu, Jia-Gang Wu. "**Environmental Tobacco Smoke Exposure and Chinese Schoolchildren's Respiratory Health: A Prospective Cohort Study**." *American Journal of Preventive Medicine*, 2011, 41(5): 487-93.
This study examined the relationship between exposure to ETS and respiratory health in Chinese schoolchildren. The study subjects included 1718 children, who were never-smokers, aged 10.05±0.86 years and asthma-free at baseline. The children performed spirometric tests in 2006 and 18 months later. Significant exposure–response relationships were found between ETS exposure and coughing at night; sneezing; and sneezing with itchy, watery eyes in the first survey, and coughing at night; phlegm without a cold; and sneezing in the second survey. Compared with those who reported no ETS exposure in either survey, children who had a high ETS exposure level in either survey had lower growth rates in forced expiratory flow between 25% and 75% of forced vital capacity and forced expiratory flow at 25% of forced vital capacity. This study concluded that exposure to ETS increased the risks of respiratory symptoms in Chinese school-aged children and was associated with impaired lung function growth.

Chi Pang Wen, Jackson Pui Man Wai, Min Kuang Tsai, Yi Chen Yang, Ting Yuan David Cheng, Meng-Chih Lee, Hui Ting Chan, Chwen Keng Tsao, Shan Pou Tsai, Xifeng Wu. "**Minimum amount of physical activity for reduced mortality and extended life expectancy: a prospective cohort study**." *The Lancet*, 2011, 378(9798): 1244-53.
The authors assessed the health benefits of a range of volumes of physical activity in a Taiwanese population. In this prospective cohort study, 416 175 individuals (199 265 men and 216 910 women) participated in a standard medical screening programme in Taiwan between 1996 and 2008. On the basis of the amount of weekly exercise, participants were placed into one of five categories of exercise volumes: inactive, or low, medium, high, or very high activity. The authors found that compared with individuals in the inactive group, those in the low-volume activity group, who exercised for an average of 92 min per week or 15 min a day, had a 14% reduced risk of all-cause

mortality, and had a 3 year longer life expectancy. Every additional 15 min of daily exercise beyond the minimum amount of 15 min a day further reduced all-cause mortality by 4% and all-cancer mortality by 1%. These benefits were applicable to all age groups and both sexes, and to those with cardiovascular disease risks. Individuals who were inactive had a 17% increased risk of mortality compared with individuals in the low-volume group.

Ying Chu Ng. **The Productive Efficiency of Chinese Hospitals**. *China Economic Review*, 2011, 22(3): 428-39.
Based on five years' data on the implementation of health care reforms, this study provided empirical evidence on inefficiency of hospitals in China. Using the data envelopment analysis, the sources of inefficiency were examined. Echoing the unnecessary care, over-prescription of drugs and the adoption of high-tech treatments since the implementation of health care reforms, the sampled hospitals were found quite inefficient and pure technical inefficiency played a dominant role in driving the inefficiency of hospitals. Hospitals had experienced productivity growth between 2004 and 2008. Mirroring the behavior of hospitals, technological progress was the underlying force for the growth and the deterioration in efficiency change was found. Regional results revealed that the stage of economic development and the efficiency performance of hospital did not necessarily go hand in hand.

Zhihua Yan, Dai Wan and Li Li. "**Patient Satisfaction in two Chinese Provinces: Rural and Urban Differences**." *International Journal for Quality in Health Care*, 2011, 23(4): 384-9.
This study examined what factors were associated with level of patient satisfaction and how such satisfaction might differ across rural and urban populations in China. This study also served as an evaluation of the recent healthcare reforms in China, which were expected to equalize satisfaction between rural and urban patients. Study participants consisted of twenty-five patients from each of the 40 county-level hospitals in two provinces of China. This study showed that perceived convenience was significantly associated with patient satisfaction among all participants. The new rural cooperative medical insurance scheme (NRCMIS) was associated with higher overall satisfaction among the rural residents. Age and income were significantly related to satisfaction only among rural patients.

Dan Liu and Daniel W. Tsegai. "**The New Cooperative Medical Scheme (NCMS) and its Implications for Access to Health Care and Medical Expenditure: Evidence from Rural China**." ZEF- Discussion Papers on Development Policy No. 155.
This paper investigates the impact of the New Cooperative Medical Scheme (NCMS) program on improving health care utilization and reducing medical expenditure with a focus on the endeavors to unravel the heterogeneous effects of the program for the different regions and income groups. It utilizes the China Health and Nutrition Survey data (CHNS) to provide prolific cross section and longitudinal information. Propensity score matching method and bounding approach are used to infer the causal effect of NCMS and examine the influence of unobservable factors respectively. Major findings indicate that there is a systematic adverse selection in the NCMS program, both in health- and economic-related aspects. Especially in western regions, households with high ratio of migrant workers are less attracted to the NCMS program. The NCMS program improved medical care utilization for the poor and regionally, western regions benefitted more from the program. The NCMS program also induces a moral hazard problem in western regions.

Huijun Liu and Shuzhuo Li. "**Social Change and Psychological Well-Being in Urban and Rural China**." Stanford Asia Health Policy Program Working Paper No. 23.
Using data from the Chinese General Social Survey (2005), this paper looks at the relationships between social change, social support and the psychological well-being of individuals in both urban and rural areas, as well as the role of marital status in Chinese society. The authors find that an increasing health care burden is significantly reducing individuals' psychological well-being. Perceptions of social status, especially as it changes over time and when compared against peers,

also have an effect. Social support has protective function for psychological well-being, and also compensates for the negative effect of increasing health-care burden and relative deprivation during social change on psychological well-being. Marital status is also significantly correlated with psychological well-being, and moderates the relationships between social change, other social support and psychological health, especially in rural cases.

POLICY AND PRACTICE UPDATES

Healthcare Reform: the Anhui Approach
Source: 21st Century Economic Reporter 2011-3-3
http://www.21cbh.com/HTML/2011-3-3/xMMDAwMDIyMzcxMw.html

Even though the "no mark-up" policy for drug sales has been in place, the financial burden on hospitals has been largely reduced, according to Yu Yi, director of a township hospital in Anhui province. Yu's words are testimony to the achievements of Anhui's Basic Medical Institution Reforms. With comprehensive government subsidy, a performance surveillance system and a unified drug bidding platform, the essential drug policy has been implemented smoothly in Anhui, yielding valuable experience for the rest of the country.

Financial support from local governments plays an important role in the reform. Although the markup of drug sales has been reduced from over 100% to 13%, substantial government subsidy has been provided to ensure administrative and programmatic expenses. Another important reform is for the personnel compensation system: medical workers are paid according to a comprehensive evaluation system instead of the value of medicine prescribed. By introducing this change, the policy makers hope to motivate the medical workers and eliminate over-prescription.

However, there are still many problems to be resolved. People are worried that the so-called "double envelope system" separates product quality evaluation from price competition, which may inadvertently encourage businesses with qualified products to offer the lowest prices possible, depressing the real value of the medicinal products. And the exclusive supply agreement may cause inefficiency in the form of market segmentation and protection.

Minister Chen Zhu: The Conglomeration of Primary Care Institutions and Large Public Hospitals
Source: 21st Century Economic Reporter 2011-3-4
http://finance.ifeng.com/news/20110304/3563211.shtml

The Minister of Health, Chen Zhu, made it clear in a recent interview that the ministry will explore all possible solutions to modernize the management of China's public hospitals. Ultimately, hospital presidents will be responsible for the management of hospitals, under the supervision of a board of directors.

In response to questions regarding inadequate and overly expensive medical care, Chen admitted these are challenges faced by the current system, brought by a shortage of large hospitals and a lack of high quality primary care institutions. He is currently considering a conglomeration model in which primary care institutions and large public hospitals form associations, to boost positive interactions between big hospitals and grassroots institutions, encourage two-way referrals, increase flow of medical resources, and establish a flexible personnel system.

Township Hospital as the Critical Link of New Healthcare Reforms: the Zichang Model May Be Promoted as the Preferred Model
Source: Economic Observer 2011-3-18
http://business.sohu.com/20110319/n279899415.shtml

County hospitals offer direct medical services to more than 900 million people in China and play a pivotal role in China's medical system. According to an officer from Ministry of Health, success of the county hospital reform is the key to the success of China's health care reform. However, there still exist many serious problems in county hospitals, such as imbalanced growth between eastern

and western regions, inadequate management, lack of medical professionals and insufficient government support.

To solve these problems and accelerate the reform, several pilot projects have been implemented across the country, and the Zichang project has yielded valuable experience for application nationwide. The first step of the reform was to transform hospitals into social welfare organizations and transfer debt burdens to the local government. Doctors were paid based on the number of patients given prescription instead of the value of medicines prescribed. Exclusive supply agreements were also established between hospitals and suppliers, severing the connection between doctors and pharmaceutical sales representatives. The results of the reform are promising: drug prices are significantly reduced and medical workers' salaries have been raised.

The Ups and Downs of Doctor Multisite Practicing
Source: Economic Observer 2011-3-20
http://finance.sina.com.cn/roll/20110321/00499562651.shtml

Last December, the Beijing Bureau of Public Health passed a policy allowing registered, high competency doctors to work part time at up to three medical institutions within Beijing. This policy has great impact on doctors who have been regularly 'moonlighting'--secretly seeking business opportunities with other local hospitals without advising their employers. The transparency brought by this new policy will doubtlessly reduce these doctors' income, for they now have to turn in part of the "moonlighting" income to their official employers. However, the new policy does not specify insurance liabilities in case of medical dispute, and this ambiguity might result in disputes between patients, the "moonlighting" doctors, and the hospitals. Despite the potential problems, this policy could help China's medical reform by encouraging human capital exchange within the medical system, allowing highly qualified physicians to serve a larger population. If implemented well, this policy might help achieve better medical resource allocation, diverting both patients and physicians from tertiary hospitals to secondary or even primary hospitals, easing the pressure on the top tier hospitals and providing better care for the general public.

Separation between Supervision and Operation: the Beijing Model
Source: Economic Observer 2011-4-1
http://finance.ifeng.com/news/20110401/3808325.shtml

After Shanghai, Wuxi, and Ma'anshan have experimented with the separation of management and operation of medical industry and established hospital management infrastructure, the basic structure and function of Beijing Bureau of Hospital Management have also been preliminarily defined, and is expected to be put into motion by early April.

The Beijing Bureau of Hospital Management will be part of the Beijing Bureau of Public Health, while the hospital management institutions in the other cities are set up within the local state-owned Asset Supervision and Administration Commission (SASAC). After the reform, the Bureau will be in charge of twenty two hospitals that used to fall under the direct supervision of Beijing Bureau of Public Health. Under the new management system, assets from all twenty two hospitals will be centralized and budget devised by the Bureau of Hospital Management, putting to history the days when hospital heads could arbitrarily determine budgetary issues. The right to nominate, assign, and evaluate the head of hospitals will also be transferred from the municipal government to the Bureau of Hospital Management.

The Ministry of Health hopes to establish a 'greater medical and health system' and has favorable outlook on the Beijing model. According to an Anzhen Hospital insider, it is conceivable to establish a system in which a national bureau of hospital management leads the local bureau of hospital management to implement beneficial reforms.

Nationalization May Become the Mainstream: the Speeding Up of M&A in Healthcare Business Firms
Source: Economic Observer 2011-5-14
http://finance.jrj.com.cn/industry/2011/05/1404139966853.shtml

There may be an upsurge of mergers between private drug companies, resulting from a series of recent policies aimed at increasing medicine circulation in China. This merging process might continue for two years, and could reduce the number of drug companies from the current 13,000 to about 6,500. The market could also evolve from being dominated by private companies to being led by partial state-owned enterprises.

Currently there are a huge number of drug companies in China, producing a diffused market. The three biggest companies only occupy about 20% of the market share, with the rest shared between medium and small companies. As a result of the fragmented market, the cost of medicine circulation in China is 7% of the industry profit, compared to 1%-1.5% in U.S. and Japan. This high cost of medicine circulation also cuts into the drug companies' profit margin.

The National Drug Circulation Industry Development Plan was issued on May 11 of this year, setting out regulations for drug circulation, market entry standard, and the logistic chain of cold storage drugs. The Good Supply Practice for Pharmaceutical Products (GSP) also incentivizes mergers and acquisitions of small drug companies. Local governments are generally supportive of the new wave of mergers and in favor of a drug industry led by state-owned enterprises.

ABOUT CHPAMS: MEMBERS' UPDATE

AWARDS

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