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A commentary on the use of mixed methods in chiropractic research. Part 2: findings and recommendations for improving future chiropractic mixed methods studies

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In part 1 of this commentary, we presented an overview of mixed methods research and the rationales for using this methodology with examples from the chiropractic literature. We also introduced readers to the three core mixed methods study designs, as well as the advantages and challenges of employing a mixed methods approach. In part 2 of this series, we provide a summary of the primary and secondary findings from our doctoral work involving mixed methods research and make

Commentaire sur l'utilisation de méthodes mixtes dans la recherche en chiropratique. Partie 2: résultats et recommandations pour améliorer les futures études sur les méthodes mixtes en chiropratique.

Dans la première partie de cette étude, nous avons présenté un aperçu de la recherche par méthodes mixtes et les raisons d'utiliser cette méthodologie à l'aide d'exemples provenant des ouvrages sur la chiropratique. Nous avons également présenté aux lecteurs les trois principaux modèles d'étude des méthodes mixtes, ainsi que les avantages et les difficultés liés à l'utilisation de ces méthodes. Dans la deuxième partie de cette série, nous présentons un résumé des résultats primaires et secondaires de notre travail de doctorat concernant les méthodes mixtes de recherche et nous formulons des recommandations pour améliorer les rapports et la

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recommendations for improving the reporting and conduct of future chiropractic mixed methods studies.

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KEY WORDS: Mixed Methods Research; Methodological Quality; Chiropractic

conduite des futures études sur les méthodes mixtes en chiropratique.

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MOTS CLÉS : méthodes mixtes de recherche, qualité méthodologique, chiropratique

Introduction

The Good Reporting of A Mixed Methods Study (GRAMMS) guideline, published in 2008 by O'Cathain *et al*.[1], is a commonly used reporting guideline in mixed methods research. In 2009, the Mixed Methods Appraisal Tool (MMAT) was developed and published by Pluye *et al*.[2], and later validated by Pace *et al*.[3], as a risk of bias tool for primary mixed methods research and systematic reviews of mixed studies (i.e., quantitative, qualitative, and mixed methods studies). Recently, there has been a dramatic increase in the conduct of primary mixed methods research across health care professions, including within the chiropractic profession.[4-6] However, little was known about the methodological quality (i.e., conduct or reporting) of chiropractic studies using mixed methods. As such, the aim of our work on the use of mixed methods in chiropractic research was two-fold: (1) to examine the methodological reporting quality of published chiropractic mixed methods studies; and (2) provide recommendations for improving chiropractic mixed methods research.

These recommendations were also applied by Emary *et al*.[7] in a mixed methods health services evaluation of chiropractic integration and prescription opioid use for chronic pain, and by Stuber *et al*.[8] in a mixed methods assessment of patient-centred care in chiropractic patients with chronic health conditions. In the Discussion that follows, we will summarize the findings from this work and provide recommendations and directions for future chiropractic mixed methods research.

Discussion

Summary of findings

Our body of work on the quality and application of mixed methods in chiropractic research included eight papers (three protocols[4,7,8], two methodological reviews[5,6], and three published mixed methods studies[9-11]). We will summarize the findings from six of these papers[5,6,9-11] in this commentary and discuss their implications for clinical practice and chiropractic mixed methods research.

In 2018, Stuber *et al*.[9] conducted a sequential explanatory, mixed methods study involving two private chiropractic clinics in Calgary, Alberta, Canada where follow-up individual and focus group interviews of patients and chiropractors (qualitative) were conducted to help explain initial survey results (quantitative). The primary objective was to determine the feasibility of conducting a definitive mixed methods study on the extent that patients with chronic health conditions perceive chiropractic care to be patient-centred. Ninety participants were recruited over three weeks, with enrollment and data completion rates of 96% and 87% respectively, thereby demonstrating feasibility. This study also provided preliminary results that suggested the degree of patient-centredness reported by patients with chronic health conditions receiving care from chiropractors compared favourably to similar studies in primary medical care. For instance, pilot study participants reported an average overall Patient Assessment of Chronic Illness Care (PACIC) score of 3.29 (95% CI, 3.21 to 3.46) out of five (i.e., higher scores indicate care is more patient-centred), which was higher than that seen in most other studies.[9] The highest PACIC scores among participants were seen on the 'patient activation,' 'delivery system design/decision support,' and 'problem solving/contextual' subscales, with lower scores seen on the 'goal-setting/tailoring' and 'follow-up/coordination' subscales. These data were corroborated by qualitative findings from among the nine patients who were interviewed (six in individual interviews and three in a mini-focus group interview), and integration was achieved using contiguous narrative and weaving approaches (i.e., the quantitative and qualitative results were organized and presented in sections one after the other and discussed in

terms of how they were similar or dissimilar).[9] Results of the full-scale mixed methods study from this work will be provided in future publications.

In 2021, we reviewed the biomedical and allied health literature and found that the quality of reporting[6] and quality of conduct[5] among chiropractic mixed methods studies were often poor. According to the GRAMMS guideline, only half (mean [SD] = 3.0 [1.5]/6) of the criteria for good reporting in mixed methods research were met across 55 eligible studies.[6] Similarly, we found that only 62% (mean [SD] = 6.8 [2.3]/11) of the criteria for risk of bias were adequately addressed in these studies according to the MMAT.[5] We found that publication in journals with an impact factor (odds ratio [OR] = 2.71; 95% CI, 1.48 to 4.95 for higher reporting quality; OR = 2.21; 95% CI, 1.33 to 3.68 for lower risk of bias) and more recent publication (OR = 2.26; 95% CI, 1.39 to 3.68 for lower risk of bias) were significant predictors of higher methodological quality. We also found a strong, positive correlation between the GRAMMS and MMAT instruments (r = 0.78; 95% CI, 0.66 to 0.87), indicating that studies with a lower risk of bias (i.e., higher MMAT scores) were strongly correlated with higher reporting quality.[6]

In 2022, Emary *et al*. undertook two mixed methods analyses[10,11] on the association between chiropractic integration at the Langs Community Health Centre (CHC) in Cambridge, Ontario, Canada[12] and opioid use among patients with non-cancer spinal pain. In-depth, one-on-one interviews (qualitative) of patients and general practitioners (GPs) (i.e., physicians and nurse practitioners) were used to further explore differences in the number and dose of opioid prescriptions between recipients and non-recipients of chiropractic services measured via electronic medical record review (quantitative). Electronic medical records were linked in the second study[11] with medical drug claims data from the Narcotics Monitoring System database at the Institute for Clinical Evaluative Sciences (ICES).[a] The objective of these studies was to determine whether providing CHC patients access to chiropractic care would result in a reduction in initiating a prescription for opioids[10] or, among those already prescribed[11], reduced opioid use. A sequential explanatory mixed methods design was used to gain a more complete understanding of whether chiropractic care was used by patients and GPs to reduce reliance on opioid prescribing for non-cancer spinal pain, or whether these services were implemented as part of a broader opioid-reducing strategy at the centre. Mixed methods quality of reporting (GRAMMS) and conduct (MMAT) standards were also incorporated into these two studies.

The main quantitative findings were that receipt of chiropractic care was associated with a decreased likelihood of receiving an opioid prescription (hazard ratio, range = 0.29 to 0.48)[10], or fewer opioid fills and refills and reduced opioid dosages among patients already receiving long-term opioid therapy for chronic spinal pain (i.e., number of opioid prescriptions: incidence rate ratio, range = 0.27 to 0.66; receipt of higher opioid doses: OR, range = 0.14 to 0.22).[11] Qualitative findings from 23 interviews of patients (n = 14) and GPs (n = 9) suggested these relationships were affected by patients' self-efficacy and concerns about opioid-related harms (n = 23), accessibility of non-pharmacological (e.g., chiropractic, physiotherapy) treatment options (n = 21), increasing stigma regarding use of prescription opioids (n = 20), and recognition of the limited effect that opioids may have on chronic pain (n = 19).[10,11] When combining the quantitative and qualitative results, the meta-inferences from these two studies were that, when accessed as a first-line treatment option, chiropractic care may have helped to delay, and in some cases prevent, the prescription of opioids.[10] In addition, patients who were referred for chiropractic services at the CHC may have been more resistant to taking opioids than patients who were not referred for chiropractic services, and access to chiropractic treatment also gave patients and their GPs another non-opioid pain management option.[10,11] This set of conclusions could not have been drawn from these studies without the use of both quantitative and qualitative methods. The integrated results and conclusions were presented in these studies using joint display tables, with a column for quotes added alongside the column reporting outcomes from the regression models, and the column on the far right-hand side of the tables displaying meta-inferences.

When combined with the results of other researchers[13-23], the findings from Emary *et al*.[10,11] suggest that fur-

[a] ICES is an independent, non-profit research organization that maintains a data repository of publicly funded administrative health service records for all Canadian citizens in the province of Ontario.

ther integration of chiropractic services into primary care centres may positively impact the opioid crisis. However, since observational studies are prone to selection bias and residual confounding[24,25], a multi-stage, mixed methods randomized controlled trial (RCT) is recommended to validate these results. An updated systematic review and meta-analysis on chiropractic use and opioid receipt among patients with spinal pain is also needed.[14] As of this writing, PCE has registered a pilot cluster RCT on the effect of chiropractic care on opioid use for chronic spinal pain.[26] This study will incorporate a convergent, mixed methods experimental design[27] and will be funded by the Canadian Institutes of Health Research, the Michael G. DeGroote Institute for Pain Research and Care, and the Canadian Chiropractic Research Foundation. In addition, an updated systematic review and meta-analysis on the impact of chiropractic care on prescription opioid use for non-cancer spine pain has been registered and is underway.[28]

Methodological contributions

Our work has helped to address knowledge gaps in the literature and made methodological contributions to the mixed methods research field. For instance, our methodological reviews[5,6] were the first to examine reporting quality and risk of bias among published chiropractic mixed methods studies. Previous reviews of RCTs on stroke[29], organ transplantation[30], and orthopedic surgery[31] research have examined the relationship between reporting quality and risk of bias according to the Consolidated Standards of Reporting Trials (CONSORT) statement and Jadad[30,31] or other scales.[29] Our review on reporting quality[6] was the first to explore correlation between reporting quality and risk of bias (i.e., the GRAMMS and MMAT instruments) in the mixed methods literature. The mixed methods study by Stuber *et al*.[7,9] was also the first to evaluate patient-centredness in chiropractic care for patients with chronic health conditions, in accordance with the Chronic Care Model and assessed using the PACIC questionnaire. The two mixed methods studies by Emary *et al*.[10,11] were among the first to examine the relationship between chiropractic integration and opioid use among vulnerable patients with non-cancer spinal pain in a CHC setting, and the first to do so using a mixed methods approach. In addition, the second mixed methods study[11] was one of the first to investigate whether the receipt of chiropractic services is associated with reduced opioid use in patients already prescribed opioid therapy for chronic non-cancer pain.

From a methodological standpoint, the sequential explanatory mixed methods study conducted by Stuber *et al*.[7,9] utilized initial survey findings along with both patient and clinician interviews, as well as focus groups, to triangulate patients' and clinicians' perceptions and experiences of patient-centred care in chiropractic practice. They also collected data from a variety of different chiropractic clinical settings across Canada to strengthen the generalizability of their results.[7] The two sequential explanatory mixed methods analyses by Emary *et al*.[10,11] were the first in Canada to include comparison groups in answering the aforementioned research questions. In doing so, these investigations produced a higher level of evidence (i.e., level 2b versus levels 4 and 5)[32] , and were therefore a substantial improvement over previous research of chiropractic integration within Canadian primary care centres.[13-18] Unlike other comparative studies from the United States[19-23], Emary *et al*.[8,10,11] also controlled for calendar year in their analyses to account for policy changes in opioid prescribing.[33] This helped to more clearly delineate between a reduction in opioid use associated with access to chiropractic services versus confounding by policy change. Lastly, in using a mixed methods approach, the qualitative findings in the first study by Stuber *et al*.[9] corroborated (or validated) the initial survey findings, and the qualitative data in the two studies by Emary *et al*.[10,11] provided a richer understanding of the barriers and facilitators to opioid use and how chiropractic services may have been used by patients and GPs to reduce reliance on opioid prescribing for non-cancer spinal pain. Previously published studies on the topic of chiropractic care and opioid prescribing had lacked in-depth, contextual understanding because they were exclusively quantitative in nature.[13-23]

Integration in mixed methods research

In mixed methods research, the integration of quantitative and qualitative methods can be achieved at three levels: (1) the study design, (2) methods, and (3) interpretation and reporting.[34] In our primary chiropractic mixed methods studies[9-11], quantitative and qualitative methods were integrated at the *study design* level by using a sequential explanatory mixed methods design (i.e., quantitative

data were first collected and analyzed and used to inform follow-up qualitative data collection and analysis[34]). The quantitative and qualitative methods were integrated (or 'connected'[34]) at the *methods* level through our studies' qualitative sampling (i.e., we each selected a subsample of participants from our larger cohorts to participate in follow-up interviews). The interview guides for our studies were also developed (or 'built') from the initial quantitative findings.[34] At the *interpretation and reporting* level, integration was achieved by presenting the quantitative and qualitative results contiguously[9-11] (i.e., in different sections of the results or discussion within a single report[34]), in joint displays[10,11] (i.e., together in a figure, table, matrix, or graph[34]), and through narrative weaving[9-11] (i.e., written together on a theme-by-theme or concept-by-concept basis[34]). We also adhered to the GRAMMS guideline and MMAT criteria in the reporting and conduct of these studies. For a more complete review on achieving integration in mixed methods research, we refer readers to the paper by Fetters *et al*.[34]

Recommendations and future research

Our findings suggest there are opportunities for improvement in the methodological quality of mixed methods studies involving chiropractic research. In particular, we found that authors of chiropractic mixed methods studies often failed to adequately describe the mixed methods study design (42.5 of 55 studies; 77%), as well as the limitations of combining qualitative and quantitative methods (46 of 55 studies; 84%).[6] In addition, considerations of reflexivity (i.e., the impact of research setting, or of the researchers themselves, on the qualitative methods and/or findings) were often poorly addressed (36 of 55 studies; 65%, and 41.5 of 55 studies; 75%, respectively).[5] Methodological issues in reporting quality and risk of bias have also been found in reviews of mixed methods research involving other health care professions.[1,35-39] For example, O'Cathain *et al*.[1] found that authors of mixed methods studies in health services research typically did not describe or justify the need for a mixed methods design, or integrate data and findings from the individual quantitative and qualitative components. A 2013 review by Bishop and Holmes[35] found that the majority of mixed methods studies in complementary and alternative medicine (excluding studies on chiropractic) did not contain adequate details on qualitative analysis, or quantitative and qualitative sampling and recruitment procedures. We have summarized the methodological areas most in need of improvement among published chiropractic mixed methods studies in Table 1. Additional examples of well-reported[40-43] and well-conducted[40,41b] mixed methods studies from other chiropractic authors are presented and summarized in Table 2.

To improve the methodological quality of future chiropractic mixed methods studies, we recommend that chiropractors conducting these studies either first undertake graduate-level training in mixed methods research or, at a minimum, collaborate with researchers possessing mixed methodological expertise. In our two methodological reviews of the chiropractic mixed methods literature[5,6], less than half of studies (46%; 25 of 55) clearly reported the inclusion of a methodologist amongst the author team (i.e., a contributing author with training in one or more health research methodology subdisciplines, including qualitative and/or mixed methods research, public health, epidemiology, health technology assessment, health services research, knowledge translation, or biostatistics), and only one study clearly reported the inclusion of a mixed methodologist (i.e., someone with graduate-level training or expertise explicitly in mixed methods research). Not surprisingly, we found no association between inclusion of a methodologist and quality of reporting (OR = 0.86; 95% CI, 0.46 to 1.62) or risk of bias (OR = 0.79; 95% CI, 0.48 to 1.31) among chiropractic mixed methods studies.[5,6]

We further recommend that editors of journals within the chiropractic profession endorse the use of, and require adherence to, mixed methods article reporting and quality of conduct guidelines, such as the GRAMMS and MMAT criteria. Many chiropractic journal editors already advocate for quantitative and qualitative reporting guidelines. For instance, 56% (5 of 9) of the chiropractic journals in our reviews[5,6] currently endorse reporting guidelines for other types of study designs (e.g., PRISMA for systematic reviews, MOOSE for meta-analyses of observational studies, STARD for diagnostic accuracy studies, STROBE for observational studies in epidemiology, COREQ for qualitative research, etc.). However, none of the journals advocate

[b] These two studies addressed all MMAT criteria in our risk of bias analysis.[5]

Table 1.
Methodological areas most in need of improvement in chiropractic mixed methods research

	Reporting Quality [a]		**Risk of Bias** [b]
1.	Description of the mixed methods design in terms of the purpose, priority, and sequence of methods.	1.	Considerations of reflexivity (i.e., impact of the research setting, or of the researchers themselves, on the qualitative methods and/or findings).
2.	Description of any limitation(s) of one method in association with the presence of the other method.	2.	Consideration of the limitations with combining qualitative and quantitative methods.
3.	Description of the justification for using a mixed methods approach to the research question.	3.	Details of allocation concealment, instrument validation, or assessment of selection bias (for randomized, non-randomized, or descriptive study components, respectively).
4.	Description of the integration of qualitative and quantitative components.	4.	Details regarding the mixing or integration of quantitative and qualitative methods.
5.	Description of any insights gained from mixing or integrating methods.	5.	Adequacy of follow-up or response rates (for all study types) and use of standardized outcome measures (for non-randomized or descriptive study components).

[a] Assessed using the Good Reporting of A Mixed Methods Study (GRAMMS) guideline.
[b] Measured with the Mixed Methods Appraisal Tool (MMAT), version 2011.

for mixed methods reporting guidelines. Chiropractic journals could highlight the GRAMMS and MMAT guidelines in their online submission instructions, and request that authors submit a completed reporting checklist highlighting where in their manuscript each item has been reported. The International Committee of Medical Journal Editors (ICMJEs) has encouraged journals to request reporting standards from authors[44], and when journals request authors to submit a completed reporting checklist, this has been shown to improve the quality of reporting.[45,46] In order for readers (and peer reviewers) to determine if a mixed methods study has been well-conducted (i.e., at low risk of bias and therefore trustworthy), we recommend use of the MMAT checklist as a critical appraisal tool. Two versions of the MMAT are currently available (i.e., versions 2011 and 2018), along with free user guidelines with examples and explanations (available at: http://mixedmethodsappraisaltoolpublic.pbworks.com). We have provided author and peer review checklists of the GRAMMS and MMAT criteria, respectively, as supplemental material in our published methodological review protocol[4] and 2022 methodological (risk of bias) review.[5] Our key recommendations for improving future chiropractic mixed methods studies are summarized and provided in the current commentary in Table 3.

Conclusion

Through the dissemination of our primary and secondary research findings summarized and presented in part 2 of this three-part commentary, we aim to create awareness amongst the chiropractic community of published mixed methods reporting and quality of conduct standards (i.e., the GRAMMS and MMAT criteria), and to provide reference to some exemplar mixed methods studies for prospective chiropractic mixed methods authors. Further, we have made specific recommendations to authors and journals to improve the reporting and conduct of future chiropractic mixed methods research. In part 1 of this series, we provided an overview of mixed methods research to highlight the value, and challenges, of using this unique methodology. Further dissemination of our findings and recommendations will occur via online webinars and conference presentations.

In our third and final paper of this series, we will discuss integrating qualitative research with RCTs and how

Table 2.

Additional published examples of well-reported and well-conducted mixed methods studies in chiropractic research (adapted from Emary et al.[6])

First Author, Year	Objective of Study	Rationale for Using Mixed Methods [a]	Mixed Methods Design	Quantitative and Qualitative Data Sources	Integration of Quantitative and Qualitative Components [b]	Insights Gained from Using Mixed Methods
Evans[40], 2014	To understand Global Perceived Effect (GPE) in chronic neck pain patients	Complementarity	Complex / Multistage	Patient self-report outcomes (including GPE) measured at baseline, 4, 12, 26, and 52 weeks post-randomization; Interviews with trial participants at conclusion of intervention phase (week 12).	Merging, by data transformation (i.e., quantifying qualitative data), and by comparing the quantitative and qualitative findings through joint display tables and narrative discussion.	The qualitative findings provided a deeper understanding of GPE in chronic neck pain patients and allowed for better interpretation of the results from the parent clinical trial.
Maiers[41], 2014	To explore perceptions of spinal manipulative therapy and exercise among seniors with chronic neck pain	Complementarity	Complex / Multistage	Patient self-report outcomes (pain, disability, general health, satisfaction, medication use) measured at baseline, 4, 12, 26, and 52 weeks post-randomization; Interviews with trial participants at conclusion of intervention phase (week 12).	Merging, by data transformation (i.e., quantifying qualitative data), and by comparing the quantitative and qualitative findings through narrative discussion of the results.	The qualitative findings helped to identify facets of the clinical encounter that contributed to a positive therapeutic experience in the parent clinical trial (i.e., patients prioritized relationships and interactions with health care team members more so than change in neck pain symptoms).
Connell[42], 2020	To explore chiropractors' understanding of building trust with patients	Complementarity / Development to inform data collection	Exploratory sequential	Interviews with chiropractors in British Columbia (BC) on perceived patient trust, and questionnaire distributed to all members of the provincial chiropractic association.	Building, by using the qualitative findings to create a questionnaire; Merging, by comparing the qualitative and quantitative findings through narrative discussion.	The qualitative findings ensured that survey questions reflected the perspectives of BC chiropractors; The quantitative findings were used to confirm themes related to chiropractors' perceptions of trust.
Pohlman[43], 2020	To evaluate patient safety attitudes among chiropractic teaching clinic stakeholders	Complementarity / Triangulation	Convergent	Online survey (closed- and open-ended questions) with students, faculty, and staff of five international chiropractic educational programs on attitudes toward patient safety.	Merging, by comparing the quantitative and qualitative findings through joint display figures and narrative discussion.	The qualitative findings provided in-depth insight into the survey results and helped identify areas for improvement in patient safety education within chiropractic teaching programs.

[a] *Complementarity* seeks elaboration, enhancement, illustration, clarification of the results from one method with the results from the other method. *Development* seeks to use the results from one method to help develop or inform the other method, where development is broadly construed to include sampling and implementation, as well as measurement decisions. *Triangulation* seeks convergence, corroboration, correspondence of results from the different methods. (Source: Greene JC, Caracelli VJ, Graham WF. Toward a conceptual framework for mixed-method evaluation designs. Educ Eval Policy Anal. 1989;11(3):255-74.)

[b] Integration through *building* occurs when results from one data collection procedure informs the data collection approach of the other procedure. Integration through *merging* of data occurs when researchers bring the two databases together for analysis and for comparison. (Source: Fetters MD, Curry LA, Creswell JW. Achieving integration in mixed methods designs – principles and practices. Health Serv Res. 2013;48(6 Pt 2):2134-56.)

Table 3.
Key recommendations for improving the methodological quality of future chiropractic mixed methods studies

Recommendations for Authors
⇒ Chiropractors conducting mixed methods studies should undertake graduate-level training in mixed methods research or, at a minimum, collaborate with researchers possessing mixed methodological expertise.
⇒ Details on the inclusion of mixed methodologists should be made explicit in future publications.
⇒ Authors of chiropractic mixed methods studies should adhere to published mixed methods reporting (e.g., GRAMMS) and quality of conduct (e.g., MMAT) standards.
Recommendations for Journals
⇒ Editors of journals within the chiropractic profession should endorse the use of, and require adherence to, mixed methods article reporting and quality of conduct guidelines, such as the GRAMMS and MMAT criteria.
⇒ Editorial review boards of chiropractic journals should incorporate mixed methods appraisal tools, such as the MMAT checklist, into the peer review process.
⇒ Chiropractic journals should cite well-reported and well-conducted mixed methods studies involving chiropractic research to serve as exemplars of good methodological quality for prospective chiropractic mixed methods authors.
⇒ Chiropractic journals should ensure they have at least one mixed methodologist on their editorial board.

GRAMMS = Good Reporting of A Mixed Methods Study, *MMAT* = Mixed Methods Appraisal Tool.

this mixed methods study design can be applied to research within the chiropractic profession. Together, we hope the work presented in these three papers will lead to important changes in the quality of evidence generated from chiropractic mixed methods studies, with consequent implications for chiropractic policy, research, editorial, and clinical practice.

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