Methodology on Clinical Evaluation of Urinary Stents

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1 Introduction

In the framework of COST CA16217 "European Network of multidisciplinary research to improve the Urinary Stents (ENIUS)", WG3 group worked on the validation of protocols for new stent designs. In this chapter, we address a methodology on clinical evaluation of urinary stents as well as the importance of clinical data and patients' feedback regarding urinary stents.

This methodology is meant to provide guidance on clinical aspects of urinary stent development, thus assisting all stakeholders in innovation and improvement of new stents designs during clinical investigation in both, pre- and post-market evaluation.

In addition, as part of the methodology for urinary stents development, we were also focused to effective determination of any undesirable side effects that can appear in stented patients. That is the reason we performed analysis of all tools developed in order to obtain and deliver such information from the patients who underwent urinary stent placement and suggest a newer approach in obtaining this feedback through The Urinary Stent Related Health (UriSteRH) questionnaire (Table 1).

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Table 1 The Urinary Stent Related Health (UriSteRH) questionnaire

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Urinary Stent Related Health (UriSteRH)

*** 1. Age**

☐ <20 ☐ 20-29 ☐ 30-39 ☐ 40-49 ☐ 50-59 ☐ > 60

☐ Other (please specify)

*** 2. Gender**

☐ Male ☐ Female

*** 3. Type of urinary stent**

☐ J-J polymer

☐ J-J silicone

☐ Metallic ureter stent

☐ Folley catheter - latex

☐ Folley catheter - silicone

☐ Thieman catheter - latex

☐ Thieman catheter - silicone

☐ Metallic prostate stent

☐ Other (please specify)

***4. Time after stent implantation**

☐ 24 hours ☐ 1 week ☐ 1 month ☐ 3 months ☐ Other (please specify)____

***5. Rate pain (suprapubic or flank) after stent placement.**

No pain, excellent	Mild, bothersome	Moderate, tolerable	Severe, bad	Extreme, intolerable
1	**2**	**3**	**4**	**5**

Table 1 (continued)

***6. Rate pain during voiding after stent placement**

No pain, excellent	Mild, bothersome	Moderate, tolerable	Severe, bad	Extreme, intolerable
1	**2**	**3**	**4**	**5**

***7. Rate your Social life (cinema,theatre,shopping etc) after stent placement**

Excellent	Good	Tolerable	Bad	Unsatisfactory
1	**2**	**3**	**4**	**5**

***8. Rate mood and sleep disturbances (depression, anxiety, insomnia)**

No disturbances, Excellent	Mild, bothersome	Moderate, tolerable	Severe, bad	Extreme, intolerable
1	**2**	**3**	**4**	**5**

***9. Rate your sexual activity after stent placement (if any)**

Excellent	Good	Satisfactory	Not Satisfactory	Disabled	N/A
1	**2**	**3**	**4**	**5**	☐

***10. Rate your physical activity (walking, running, biking, driving etc.) after stent placement**

Excellent	Good	Satisfactory	Not Satisfactory	Disabled	N/A
1	**2**	**3**	**4**	**5**	☐

***11. Rate your Quality of life after stent placement (subjective perception)**

Excellent	Good	Tolerable	Bad	Unsatisfactory
1	**2**	**3**	**4**	**5**

2 Background

Urinary stents are used to alleviate obstruction along the urinary tract and prevent its complications, either as a temporary or a definitive treatment. There are stents for the upper urinary tract (ureteric stents) and for the lower urinary tract (urethral stents and catheters).

There are mandatory and relative indications for urinary stent placement. Mandatory relief of obstruction is indicated in obstructed pyelonephritis, bilateral ureteral obstruction with anuria, obstruction of a solitary functioning kidney, ureteric injuries, and post-operatively in some cases for the upper urinary tract, and for acute urinary retention for the lower urinary tract. Relative indications include the relief of pain associated with ureteral obstruction, relief of renal colic during pregnancy, significant ureteral edema after ureteroscopy, or anticipated ureteral obstruction from stone fragments during shockwave lithotripsy [1, 2].

Urinary stents have numerous side-effects affecting the patient both, physically and psychologically. Ideal or near ideal stent designs and models should aim to minimize these side effects and be as much tolerable, safe, and efficacious as possible [3, 4].

3 Clinical Evaluation in Urinary Stents Improvement

After evaluating the available evidence, we concluded that in order to assess whether a device is fit for purpose(s) and suitable for the patient population(s) it is intended for, there are two crucial steps needed for a clinical investigation:

to verify whether the stent in accordance with clinical guidelines for stent implantation and the manufacturer's instructions is fit for purpose, and

to determine any side effects following clinical guidelines for stent implantation and the manufacturer's instructions of use, and assess the risk—benefit balance for the stent under its intended use.

4 Design of Clinical Investigation(s)

The design of any clinical investigation must be based on the claims made by the manufacturer and, as part of the demonstration of compliance, with the essential requirements of the medical device directive (MDD) [5, 6]. Undoubtedly, controlled randomized studies are best suited to confirm or deny claims made by the manufacturer. Randomized-comparative studies are required to demonstrate the risk-benefit profile of the stents. Studies must include enough patients to allow assessment of the primary performance and safety end-points specified in the clinical investigation

plan, with a 95% confidence interval [7]. Several criteria need to be met to conduct reliable studies with clear and valuable end-points:

Criteria for population selection in clinical investigations.
Criteria for duration of the clinical investigation.
Criteria for analysis of Quality of Life (QoL).
Criteria for post market clinical follow-up.

5 Population Selection in Clinical Investigations

It is important for the study population selection that there are well-defined eligibility criteria, considering the safety and performance claims and any other future marketing claims. Criteria such as site, length and type of the obstruction, ureteral or urethral diameter, and risk factors including but not limited to infection, previous instrumentation, and other defined conditions must be applied. All patients should be on well-defined medically recommended prophylaxis and/or therapy unless otherwise justified.

The number of patients to be enrolled should not only be based on a sound scientific rationale, but also on statistical calculations to support the hypotheses.

6 Duration of the Clinical Investigation

Timelines for an acceptable evaluation of the performance and safety will depend upon the characteristics of a urinary stent as well as the urinary pathologies and/or medical conditions for which it is intended. Timelines must always be justified. Appropriate endpoints must also take into consideration the time-frame around possible complications. Moreover, a long-term follow-up should be performed, and a post market clinical follow-up should be considered unless there are good reasons not to.

7 Analysis of Quality of Life (QoL)

It is of utmost importance to achieve an acceptable QoL in patients that undergo urinary stent placement. Side-effects need to be quantified to evaluate their impact on QoL. Efforts have been made by Joshi et al. to develop a validated tool in the form of a questionnaire called USSQ that assesses patient comfort after stent placement [8]. It is endorsed in different languages and has been used in many

comparative studies. Some authors concluded that USSQ is more relevant in long-term trials [9]. Along this whole process, a thorough literature review is necessary. The scientific literature in this area is highly focused and specific. Before setting up any such study protocol, it would be expected that a critical evaluation of available evidence is performed by a suitably qualified person [10].

Stents need to be re-designed to improve patient tolerance and minimize side-effects. Obtaining adequate feedback from the end-users, namely stented patients, is therefore very important. For that reason, we support the creation of specific questionnaires for the evaluation of QoL in patients with urinary stents.

However, existing questionnaires are ambiguous and cumbersome. We suggest such questionnaires should be composed of a maximum of 10 questions addressing discomfort, abdominal pain, pain during voiding (in upper urinary stents), mood disturbances, sleep disturbances, sexual life, social life, physical activities and subjective perception of QoL.

All these questions should be evaluated at certain well-defined time points depending on the type of stent.

8 Development of Urinary Stent Related Health (UriSteRH) Questionnaire

In order to achieve information about the tools and questionnaires used so far, we made a literature search in Google Scholar database. The search phrase used was "Quality of life questionnaire", period of publishing was set "all to 2020" and it disposed 4,250,000 articles. After introducing advanced search i.e., exact phrase "urinary stent symptoms", only 71 articles were disposed. Of them only 14 articles were related to the questionnaires that were analyzing urinary stents related symptoms and the data from the patients were obtained through SF-36, USSQ and IPSS questionnaire (Fig. 1).

Questionnaire for quality of life SF-36 (original or modified) can be used as an assessment form for quality of life of the patients in both types of urinary stents regarding the part of urinary tract they are introduced in. The results obtained by these questionnaires deliver information about the patients' satisfaction after stent or catheter introduction [11, 12]. However, this information cannot provide specific knowledge of urinary stents and catheters efficacy, safety and tolerance. A psychometrically valid measure to evaluate symptoms and impact on quality of life of ureteral stents was developed in the form of the ureteral stent symptom questionnaire (USSQ) [8].

The original English language Ureteral Stent Symptom Questionnaire (USSQ) has been validated in various languages worldwide. Still this questionnaire is related only to upper urinary tract stents and has its own advantages and disadvantages. Some authors concluded that USSQ is more relevant in long-term trials [9]. Both SF-36 and USSQ are paper-based questionnaires that have their own advantages and disadvantages. As the first one quantifies the patient's life on general basis, the

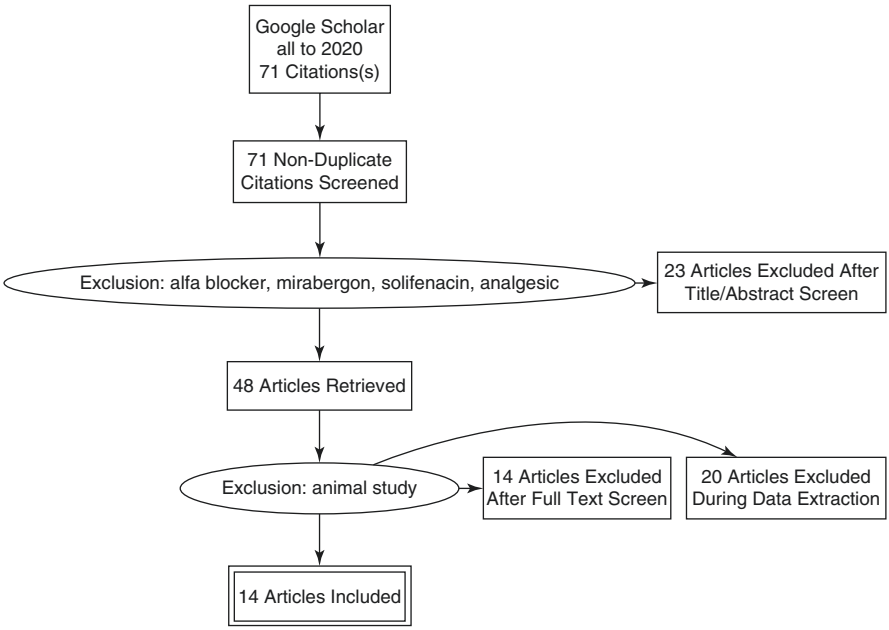

Fig. 1 PRISMA diagram of performed search of Google scholar database

second one is more specific and orients on patients with urinary stents. According to some experts in surveys and questionnaires development, it is best for a questionnaire to be as short as possible A long questionnaire leads to a long interview and this is open to the dangers of boredom on the part of the respondent (and poorly considered, hurried answers), interruptions by third parties and greater costs in terms of interviewing time and resources [13, 14].

The more reliable example of short and effective questionnaire is "The Satisfaction with Life Scale" (SWLS), developed to access an individual's cognitive judgment of their satisfaction with their life in general. The scale is a very simple, short questionnaire made up of only five statements [15].

It was our starting point to create a more specific variant of the questionnaire regarding patients with inserted urinary stents and catheters. In congruence with the World Health Organisation's definition of health, health-related quality of life refers to the overall conditions of the quality of life of ill or healthy individuals in accordance with the following eight domains: (1) limitations in physical activities because of health problems, (2) limitations in social activities because of physical or emotional problems, (3) limitations in role activities because of physical health problems, (4) bodily pain, (5) general mental health, (6) limitations in role activities because of emotional problems, (7) vitality, and (8) general health perceptions of an individual or a group measured in terms of feelings of satisfaction or dissatisfaction [16, 17].

9 Methodology for Creating New Urinary Stent Related Health (UriSteRH) Questionnaire

The step forward was our intention to build a tool that can be accessible both as paper and e-based questionnaire. In this intention we used "Survey Monkey" online application and created a short but specific questionnaire for evaluation the quality of health in patients with introduced urinary devices.

The Urinary Stent Related Health (UriSteRH) questionnaire consists of 11 questions, 4 of which are not validated and deliver information about patient's age, gender, type of stent/catheter and duration of stent introduction. These questions are important to because they deliver information about the patient him/herself.

First question refers to patient's age and grading is made younger than 20, divided in decades 20–29, 30–39, 40–49, 50–59 and over 60 years.

The second is patient's gender that is important to be included in the questionnaire, because of different anatomy, physiology, psychology, perception and other factors in male and female.

The third qualitative question is regarding the type of stent/catheter, so it is very important because it gives feed-back on certain type of stents regarding their design, material, and pattern.

The fourth question is not validated but is important because it obtain feed-back on the duration of stent/catheter introduction. Namely, the symptoms are not the same immediately after insertion and they tend to change in some manner after some time. We propose measurement of patients' stent related health after 24 h, 1 week, 1 month and 3 months.

Other seven questions in UriSteRH questionnaire are validated according Likert scale that in this case is a five-point scale which is used to allow the patient to make a numerical value which would be used to measure the attitude under investigation.

First two of these questions reveal to both suprapubic/flank and pain during voiding. Answers are graded such as 1 is no pain and 5 is extreme, intolerable pain.

The next question is related to patient's social life i.e. affection of urinary stent symptoms on social events (cinema, theatre, family matter events etc.) in patient's life. It is graded 1 for excellent social life a 5 for unsatisfactory social life.

Question number 8 quantifies patients' mood and sleep disturbances related to urinary stent symptoms. It is a very important question since patients with expressed symptoms become depressive, anxious and have sleep disturbances due to pain, frequency, and urgency.

Sexual activity has the important role in quality of life in stented patients and is evaluated in the questionnaire under number 9. The ratings include 1 for excellent activity to 5 for disabled. In the se we gave a N/A option for the patients that are not interested in answering.

As a question number 10 we introduced physical activity of stented patients regarding their everyday movement activities and hobbies, and we graded 1 for

excellent activities and 5 for disabled. We also gave a N/A option for those patients that are not physically active (paraplegia, paresis etc.)

The last question (11) refer patient's subjective perception of the quality of life after stent placemen and it is graded 1 for excellent and 5 for extremely bad.

Total score classifies patients in three groups: score 5–13 = Good tolerance, satisfied patient, scores 14–24 = disturbing but tolerable, partially satisfied patient and score 25–35 = Bad tolerance, unsatisfied patient.

Regarding the total score and each question points, a correlation between the type of the stent, duration of its insertion and health repercussion can be obtained. These information are of great importance using as a patient feedback to inserted urinary stent or catheter.

10 Validation of UriSteRH Questionnaire

The questionnaire was evaluated by 15 urologists from North Macedonia in the network of Macedonian Urological Association of which 11 were male (73.3%) and 4 were female (26.7%), by nationality they were: 9 Macedonians (60%), 5 Albanians (33.3%) and one Turk (6.7%).

The questionnaire was translated from Macedonian and Bosnian to English language for the purposes of this report and language validation was done. Approval from the Ethical committee of Macedonian Urological Association was obtained in according to declaration from Helsinki in 1975, revised in Seoul 2008.

The questionnaire was evaluated by four domains

1. Relevance—does the questionnaire refer to the topic for which it is intended.
2. Availability—is the questionnaire easily available to the patients it is intended for.
3. Clarity—are the questions clearly defined without prejudicing the answer.
4. Design—does the questionnaire meet the needs of the examination after the initial examination, without quantification of the same.

For scoring a scale from 1 to 5 was used, 1 being the most negative and 5 the most positive characteristics score. The questionnaire received a perfect score of 5.0 by all 15 urologists regarding clarity, relevance, and design, where as a score of 4.67 ± 0.49 regarding availability, receiving a score of 4 by 5 urologists and score of 5 by 10. There were no significant differences in the scoring by gender and nationality of the evaluators. A correlation matrix and linear regression analysis could not be calculated due to 3 of 4 scoring characteristics being constants.

The validation of questionnaire was evaluated by 27 urologists from Bosnia and Herzegovina in the network of Urological Association of Federation of Bosnia and Herzegovina of which 25 were male and two were female.

Approval from the Ethical committee of Urologic Association of Federation of Bosnia and Herzegovina was obtained in according to declaration from Helsinki in 1975, revised in Seoul 2008.

Results of validation of questionnaire in Bosnia and Herzegovina was as the questionnaire received a perfect score of 5.0 by all 27 urologists regarding clarity and relevance, where as a score 4.73 ± 0.27 regarding availability and for design as 4.74 ± 0.26.

The statistical analysis was performed using IBM SPSS Statistics 20.0, Armonk, NY, U.S.

11 Post-Market Follow Up

A post market clinical follow-up is important for urinary implants to evaluate their long-term safety. Such a program must be planned and can take the form of a clinical investigation and/or registry where data obtained from the patients' feed-back are collected.

12 Discussion and Elaboration

The UriSteRH questionnaire is an easily accessible questionnaire related to patients with introduced urinary stents that can be distributed both as paper and e-based questionnaire. It is made according the World Health Organization's definition of health-related quality of life that refers to the overall conditions of the quality of life of ill or healthy individuals in accordance with the domains regarding bodily pain, limitations in physical activities because of health problems, limitations in social activities, general mental health, vitality (expressed throughout sexual life) and general health perceptions of an individual or a group measured in terms of feelings of satisfaction or dissatisfaction. These questions comply with the methodological guideline for closed-ended questions [17–19].

A short overview of each of the seven health-related quality of life dimensions assessed by the questionnaire is in accordance with WHO definitions.

1. Bodily pain (flank and/or abdominal): The scores on this dimension indicate to what extent the respondents' experience of bodily pain hinders their performance of daily activities, including work-related duties in the public domain and tasks within the home environment.
2. Related pain to voiding: The scores on this dimension indicate to what extent the respondents' experience the micturition pain that affects their satisfaction and disturb their daily activities and overnight rest.
3. Physical functioning and physical roles limitation: The scores on the physical functioning domain scale indicate the extent to which the respondents' perceptions of their quality of life are influenced by their physical condition. In the first place, physical functioning refers to the extent to which the respondents

can perform vigorous activities such as running, lifting heavy objects, participating in strenuous sports, climbing several flights of stairs and walking more than a kilometer. In the second place, it entails the performance of moderate activities such as bending, kneeling, or stooping, bathing, and dressing themselves. This dimension also refers to the extent to which respondents' performance of their roles in daily activities is impeded by their physical state of health. For example, their ability to perform vigorous activities such lifting heavy objects or to perform moderate activities such as moving a table or pushing a vacuum cleaner.

4. Social functioning refers to social activities and interaction with significant others such as family members, friends, neighbors, and other social relations.
5. The mental health dimension and psychology alterations of the respondent is measured in terms of the extent to which he/she is inter alia feeling full of pep, is happy, is feeling calm and peaceful, is very nervous, or is feeling worn out and tired.
6. The vitality dimension relates to the respondent's experience of feeling energetic and sexually active.
7. The perception of an individuals' general health is measured in terms of concepts such as excellent, very good, good, fair or poor, getting ill easier than other people, and just as healthy as anyone he/she knows.

Prior to the assessment of an individual's health-related quality of life, he/she must be informed about and assured of several things. This information and assurance can be verbally given by the fieldworker and includes the following:

- It must be clearly stated that, by completing the questionnaire, the respondent will be participating in research.
- The purpose of the research must be explained.
- An outline of the procedures of the research must be given.
- The respondent must be assured that the completion of the questionnaire is voluntary.
- It must be stated that the privacy of the respondents is preserved through anonymity and that no-one would be able to relate a given response to a given respondent.
- The respondent must be assured that the use of the data will be strictly confidential.
- It must be stated that the results will be reported accurately and that all shortcomings in the research, such as errors and limitations, will be disclosed [20].

13 Conclusion

As final part of the methodology on clinical evaluation of urinary stents, we suggest definition of stent-related and procedure-related success endpoints. Such stent-related endpoints should include but are not limited to successful delivery of the stent bypassing the obstruction site, appropriate cuff expansion (in lower urinary tract stents), appropriate stent deployment, successful removal of any delivery

system (if applicable) after correct stent placement and safe removal of the device in case of deployment failure.

Procedure related endpoints may include the above with additional criteria related to the clinical outcome of the procedure with the use of both, stents that are used only for diagnostic (short-term) and therapeutic purposes (longer indwelling time). We recommend choosing and defining well all necessary endpoints which may vary depending on the type of stent and the procedure it was used in.

In order to obtain feedback from patients with urinary stents, we need specific and good tools in the form of questionnaires who can quantify both, patients' safety and satisfaction with urinary stents/catheters. Any such data gathered from clinical practice should be used to establish clinical safety and fed back into the device labelling performance by manufacturers. The value of measuring patients' experiences of their health-related quality after introduction of urinary stent/catheter by making use of the UriSteRH questionnaire, is comprehensive.

The final goal of the clinical methodology is to identify specific problems, stent-health-related quality of life indicator. Based on these findings, interventions in stent design can then be done in order to improve individuals' quality of life. In that manner, the accessibility of the UriSteRH questionnaire allows more patients to be followed up and fourthly very quick presentation of results in electronic based distribution is enabled.

References

1. Sali GM, Joshi HB. Ureteric stents: overview of current clinical applications and economic implications. Int J Urol. 2020;27(1):7–15.
2. Oliver R, Wells H, Traxer O, Knoll T, Aboumarzouk O, Biyani CS, Somani BK, YAU Group. Ureteric stents on extraction strings: a systematic review of literature. Urolithiasis. 2018;46(2):129–36.
3. Al-Aown A, Kyriazis I, Kallidonis P, Kraniotis P, Rigopoulos C, Karnabatidis D, Petsas T, Liatsikos E. Ureteral stents: new ideas, new designs. Ther Adv Urol. 2010;2(2):85–92.
4. Tolley D. Ureteric stents, far from ideal. Lancet. 2000;356(9233):872–3.
5. Markiewicz K, van Til JA, IJzerman, M.J. Medical devices early assessment methods: systematic literature review. Int J Technol Assess Health Care. 2014;30(2):137–46.
6. Byrne RA, Serruys PW, Baumbach A, Escaned J, Fajadet J, James S, et al. Report of a European Society of Cardiology-European Association of Percutaneous Cardiovascular Interventions task force on the evaluation of coronary stents in Europe: executive summary. Eur Heart J. 2015;36:2608–20.
7. Nguyen T, Dave V, Jia S, Fang C, Wang L, Zhang C, Nguyen J, Fearnot N, Saito S. Practical clinical evaluation of stents. J Interv Cardiol. 1998;11:101–10.
8. Joshi HB, Newns N, Stainthorpe A, MacDonagh RP, Keeley FX Jr, Timoney AG. Ureteral stent symptom questionnaire: development and validation of a multidimensional quality of life measure. J Urol. 2003;169(3):1060–4.
9. Lingeman JE, Preminger GM, Goldfischer ER, Krambeck AE. Assessing the impact of ureteral stent design on patient comfort. J Urol. 2009;181:2581–7.
10. Park J, Kim E, Shin K. Developing an evaluation framework for selecting optimal medical devices. J Open Innov Technol Mark Complexity. 2019;5:64.
11. Jenkinson C, Coulter A, Wright L. Short form 36 (SF36) health survey questionnaire: normative data for adults of working age. BMJ. 1993;306:1437–40.

12. Ware J, Sherbourne C. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. Med Care. 1992;30:473–83.
13. Babbie E. The basics of social research. Belmont: Wadsworth; 2002.
14. Berg BL. Qualitative research methods for the social sciences. Boston: Allyn & Bacon; 1998.
15. Diener E, Emmons R, Larsen R, Griffin S. The satisfaction with life scale. J Pers Assess. 1985;49(1):71–5.
16. Preamble to the Constitution of the World Health Organization as adopted by the International Health Conference, New York, 19–22 June, 1946; signed on 22 July 1946 by the representatives of 61 States (Official Records of the World Health Organization, no 2, p. 100) and entered into force on 7 April 1948.
17. The WHOQOL Group. The World Health Organization Quality of Life Assessment (WHOQOL). Development and psychometric properties. Soc Sci Med. 1998;46:1569–85.
18. Frisch MB. Quality of life therapy and assessment in health care. Clin Psychol Sci Pract. 1998;5:19–40.
19. Baker F, Intagliata J. Quality of life in the evaluation of community support systems. Eval Program Plann. 1982;5:6–79.
20. Andersen ML, Taylor HF. Sociology: the essentials. Belmont: Wadsworth; 2002.