

1 **Consent for the discontinuation of life-prolonging treatment in cancer patients: a retrospective**
2 **comparative analysis before and after the enforcement of the Life Extension Medical Decision**
3 **law**

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41

42 **Abstract**43 **Background**

44 The Life Extension Medical Decision law enacted on February 4, 2018 in South Korea was the first to
45 consider the suspension of nonsensical life-prolonging treatment, and its enactment raised big
46 controversy in Korean society. However, there is no study on whether the actual life-prolonging
47 treatment for patients has decreased after enforcing the law. This study aimed to compare the
48 provision of patient consent before and after the enforcement of the law among cancer patients who

49 visited a tertiary university hospital's emergency room to understand the effects of the law on cancer
50 patients' clinical care.

51 **Methods**

52 This retrospective single cohort study included advanced cancer patients over 19 years of age who
53 visited the emergency room at a tertiary university hospital. The two study periods were as follows:
54 from February 2017 to January 2018 (before) and from May 2018 to April 2019 (after). The primary
55 outcome was the average length of hospital stay. The consent rate for cardiopulmonary resuscitation
56 (CPR), intubation, continuous renal replacement therapy (CRRT), and intensive care unit (ICU)
57 admission were the secondary outcomes.

58 **Results**

59 The average length of hospital stay decreased after the law was enforced, from 4 days to 2 days ($p=$
60 0.001). The rates of direct transfers to secondary and nursing hospitals increased from 8.2% to 21.2%
61 ($p=0.001$) and from 1.0% to 9.7%, respectively ($p<0.001$). The rate of provision of consent for
62 admission to the ICU decreased from 6.7% to 2.3% ($p=0.032$). For CPR and CRRT, the rate of
63 provision of consent decreased from 1.0% to 0.0% and from 13.9% to 8.8%, respectively, but the
64 differences were not significant ($p=0.226$ and $p=0.109$, respectively).

65 **Conclusion**

66 According to previous research, for patients wishing only conservative treatment, the reduction in
67 hospital stays at tertiary hospitals ultimately reduces the physical, emotional, financial burdens and
68 also improves the quality of end-of-life at home or in a hospice facility. In this context, this research
69 ultimately show that the purpose of the LEMD law has been achieved. Further research in several
70 hospitals including those patients who completed the consent after hospitalization is needed to
71 generalize the clinical implication of the LEMD law.

72 **Keywords:** Life Extension Medical Decision law, length of hospital stay, cardiopulmonary

73 resuscitation, intubation, continuous renal replacement therapy, intensive care unit

74

75 **Background**

76 Cancer is one of the three leading causes of death in South Korea, with more than 210,000 newly
77 diagnosed cases every year (1,2). In 2007, 79 million people died from cancer worldwide, and this
78 number is expected to increase by about 45%, with 115 million deaths in 2030 (3). The death burden
79 due to cancer is heavy despite early diagnosis and aggressive treatment approaches (4). Cancer
80 patients receive rigorous chemotherapy and thus, incur high treatments costs with longer than average
81 hospital stays compared to patients with other illnesses (5). Therefore, it is important for cancer
82 patients to decide their own direction of treatment, considering an improved quality of life and how
83 they wish to spend the rest of it. That is, patients have the right to refuse nonsensical life-prolonging
84 treatments, and such decisions should be made after thorough discussions between the patient, their
85 family, and the medical professionals involved. In addition, the suspension of life-prolonging
86 treatment must be guaranteed by an unbiased social system in consideration of the relevant ethical
87 aspects.

88 However, in practice, it is rare that patients themselves decide to refuse life-sustaining treatment in
89 the Korea's medical field, as in most cases, only the patient's family and medical professionals make
90 this decision without sufficient discussion (6). Furthermore, in South Korea, the legal system
91 concerning life-prolonging medical care has been incompetent in respecting the decision-making
92 rights of patients.

93 Consequently, the Life Extension Medical Decision (LEMD) law, regarding the decisions on hospice
94 care, palliative care, and life-prolonging medical care for patients close to death, was enforced on
95 February 4, 2018, as an institutional measure to respect the dignity and rights of patients in South
96 Korea (7). It provides legal provisions describing the criteria, conditions, and methods for
97 discontinuing nonsensical life-prolonging care. The enforcement of this law resulted in a big
98 controversy in the Korean society as this law respects the patient's right to self-determination, and
99 allows all patients to end their lives comfortably while maintaining human dignity.

100 Since the value of a patient's life is influenced by social consensus, which differs by culture,
101 regulations related to life-prolonging medical care differ from country to country. A similar law was
102 passed in the United States. In 1976, The Natural Death Act was passed in California, United States,
103 and it was the first law to legally consider a patient's letter of intent to discontinue medical care (8). In
104 addition, the Patient Self-Determination Act was passed in 1990, respecting patients' decisions and
105 allowing them the independence to refuse treatment. According to a survey from 10 states in the
106 United States, after the enactment of the self-determination law, the number of do-not-resuscitate
107 (DNR) cases increased from 4.2% in 1990 to 13.3% in 1992, and the proportion of DNR orders
108 increased from 31.1% to 51.5% (9).

109 Therefore, even in South Korea, with advent of the LEMD law, changes such as a decrease in life-
110 prolonging aggressive treatments and an increase in DNR documentations are expected. It is essential
111 to comparatively analyze the type of changes observed in response to the enactment of this law in
112 clinical practice. For instance, previous studies have shown that terminal cancer patients account for
113 the highest proportion of patients receiving life-prolonging medical care (33.2%); therefore, analyzing
114 the influence of the enactment of the LEMD law on the use of life-prolonging treatments in advanced
115 cancer patients would have significant implications in the clinical setting (10).

116 However, no study has been conducted on whether LEMD has practical effectiveness than the DNR.
117 Therefore, in this study, we aimed to compare the relevant parameters such as the average length of
118 hospital stay, consent rate of cardiopulmonary resuscitation (CPR), intubation, continuous renal
119 replacement therapy (CRRT), and intensive care unit (ICU) admission, the rate of survival to
120 discharge before and after the enforcement of the LEMD law in advanced cancer patients who visited
121 the emergency room (ER) of a tertiary university hospital to implicate the effect of the law on cancer
122 patients.

123 **Methods**

124 *Study design*

125 This retrospective single cohort study was conducted at a tertiary university hospital. To compare the
126 effects of the LEMD law, the periods of 1 year before and after enforcement were set as the target
127 research periods, and the period of 3 months immediately after the enforcement of the law was
128 considered as the adaptation period and thus, excluded from the study. Therefore, the two final study
129 periods were as follows: from February 2017 to January 2018 and from May 2018 to April 2019.

130 Primary comparisons were made between these two study periods. The patients in each period were
131 divided into two groups: one group included patients with a signed DNR or a life-sustaining treatment
132 plan before their visit to the ER and the other included patients who prepared their DNR or life-
133 sustaining treatment plan during their ER visit.

134 The study data were collected using the Severance Clinical Research Analysis Portal, the clinical
135 data search system used by the hospital, and approved by the Institutional Review Board of Yonsei
136 University Health System (approval number 4-2020-0630). This study was conducted in compliance
137 with the Declaration of Helsinki, and the need for informed consent was waived due to the study's
138 retrospective design.

139 *Participants*

140 Advanced cancer patients of over 19 years of age with stage IV or metastatic cancer who visited the
141 ER of Severance Hospital during the study periods were included in this study.

142 Overall, the analyzed subjects included the following: (1) patients who visited the ER between
143 February 2017 and January 2018, before the enforcement of the law, with a signed DNR obtained
144 prior to the ER visit or those who prepared their DNR letters during their ER visit and (2) patients
145 who visited the ER between May 2018 and April 2019, after the enforcement of the law, with advance
146 directives prepared beforehand or those who prepared their life-sustaining treatment plans during the

147 ER visit. If a contract was created but lacked the specific classification and accurate information, the
148 corresponding patients were excluded from the study.

149 *Outcomes*

150 We investigated the length of hospital stay as the primary outcome.. In addition, CPR, intubation,
151 CRRT, and ICU admissions were considered as secondary outcomes, to confirm whether the rate of
152 aggressive treatments actually reduced with the enactment of the law. Furthermore, variables such as
153 the time taken from reception to the completion of DNR orders or a life-sustaining treatment plan,
154 time spent in the ER, transfer to nursing hospitals, ER mortality rate, and medical expenses were also
155 analyzed.

156 1. Provision of do-not-resuscitate orders before the enforcement of the Life Extension Medical 157 Decision law

158 DNR orders enforce the abandoning of resuscitation attempts in patients with no prospect of
159 resuscitation especially in patients with predicted cardiac arrest (11). This document has an arbitrary
160 format used widely by medical institutions in clinical practice; however, the subject and format are
161 not universal.

162 2. Provision of advance directives after the enforcement of the Life Extension Medical Decision 163 law

164 Any adult 19 years of age or above can document his or her intention for life-sustaining treatment
165 and hospice directly in preparation for the case where the person becomes a patient at the end stage of
166 life in the future. The document prepared for this purpose is called the advance directive on life-
167 sustaining treatment, and should be created after receiving sufficient explanation through the Registry
168 Agencies for Advance Directives designated by the Ministry of Health and Welfare. The legal validity
169 of the created and registered advance directives can be recognized only when they are kept in the
170 database of life-sustaining treatment information processing system (7).

171 3. Provision of a life-sustaining treatment plan after the enforcement of the Life Extension
172 Medical Decision law

173 According to the decision of the terminally ill patient, the doctor-in-charge plans and documents the
174 decisions related to the patient's life-sustaining medical treatment and hospice care (7), and the
175 procedure involved in this process is shown in Fig. 1 (12).

176 *Statistical analysis*

177 The collected data were analyzed using the SAS software (version 9.4, SAS Inc., Cary, NC, USA).
178 All continuous variables did not satisfy the normality assumption; thus, the variables were analyzed
179 using the Wilcoxon rank-sum test and results were presented as medians (Q1, Q3). Categorical
180 variables were analyzed using the chi-square test (Fisher's exact test) and presented as counts (%).
181 The Monte Carlo estimation method was used to accurately determine the location of the primary
182 cancer. A p-value < 0.05 was considered significant.

183

184 **Results**

185 During the study period, a total of 1,443 patients with stage IV advanced cancer or metastatic cancer
186 were admitted to the hospital's ER. Overall, 433 and 1,010 patients visited the hospital before
187 (February 2017-January 2018) and after (May 2018-April 2019) the enforcement of the LEMD law,
188 respectively. Prior to the enforcement, 197 patients had written consent letters in advance or planned
189 their treatment plans in the ER, while after the enforcement of the law, 220 people had advance
190 directives beforehand or planned their treatment plans in the ER. Of these, five patients (two before
191 and three after the enforcement) were excluded from the study due to incomplete information on the
192 forms. Finally, 195 patients presenting before and 217 patients presenting after the enforcement were
193 included as subjects of this study. Among these, 20 patients had obtained DNR orders in advance
194 before the enforcement, and 78 patients had advance directives after the enforcement of the law. The

195 number of patients who filled out their DNR consent form in the ER was 175, and 139 patients wrote
196 their life-sustaining plan in the ER (Fig. 2).

197 After the LEMD law was enforced, the average time taken to prepare a patient consent letter was
198 reduced to 232 minutes from 273 minutes ($p=0.031$); conversely, the time spent in the ER increased
199 from 817 minutes to 1,195 minutes ($p=0.006$). The length of stay in the hospital decreased from 4
200 days to 2 days ($p=0.001$), along with a decrease in average medical expenses ($p=0.008$). Furthermore,
201 the rate of direct transfers to secondary hospitals from the ER increased from 8.2% to 21.2%
202 ($p=0.001$), and that of transfers to nursing hospitals increased from 1.0% to 9.7% ($p<0.001$).

203 In addition, the rate of provision of consent for admission to the ICU decreased from 6.7% before the
204 enforcement to 2.3% after the enforcement ($p= 0.032$). In the case of CPR and CRRT, the rates of
205 provision of consent decreased from 1.0% to 0.0% and from 13.9% to 8.8%, respectively, but the
206 difference was not significant ($p=0.226$ and $p=0.109$, respectively). After the enforcement of the law,
207 a larger number of patients were found to survive until discharge ($p= 0.001$) (Table 1).

208 On comparing only those patients who created the DNR order or life-sustaining treatment plan in the
209 ER, it was found that the average time taken from reception to creating the consent letter was 296
210 minutes before the enforcement, while the same task took significantly longer (466 minutes) after the
211 enforcement ($p<0.001$). However, consistent with the results of the overall comparison, the average
212 time spent in the ER increased from 864 minutes before the enforcement to 1,391 minutes after the
213 enforcement ($p= 0.003$), and the length of hospital stay decreased from 4 days to 2 days ($p=0.001$).
214 The rates of direct transfers to secondary and tertiary hospitals, and nursing hospitals from the ER also
215 increased in the period after the enforcement from 9.1% to 20.1%, and from 1.1% to 10.1%,
216 respectively ($p= 0.005$, $p= 0.001$, respectively). The proportion of patient deaths in the ER decreased
217 from 88.6% to 80.6% after the law was implemented ($p=0.049$).

218 The percentage of aggressive treatments or procedures specified in the DNR order or life-sustaining
219 plan decreased after the enforcement of the law. The rates of CPR, intubation, and CRRT decreased

220 from 1.1% to 0.0%, from 5.1% to 4.4%, and from 1.1% to 0.0%, respectively, but the decreases were
221 not significant ($p=0.506$, $p=0.755$, and $p=0.506$, respectively). However, there was a significant
222 reduction in the percentage of ICU admissions from 6.9% to 1.5% ($p= 0.026$). When consent was
223 obtained in the ER, there was no significant difference between the DNR and life-prolonging groups
224 with respect to the rate of survival to discharge from the hospital ($p= 0.505$) (Table 2).

225 The following two groups were compared: previously completed DNR and previously completed
226 life-sustaining medical intention form. We established that the time spent in the ER increased from
227 510.5 minutes before the enforcement to 970.5 minutes after the enforcement ($p=0.042$).
228 Contrastingly, the average length of hospital stay decreased from 5.5 days to 2 days ($p=0.061$), along
229 with an insignificant reduction in the overall average medical cost ($p=0.133$). The rate of transfers
230 from the ER to other hospitals increased from 0.0% to 23.1% ($p=0.020$). Lastly, the rate of survival to
231 discharge showed a significant increase after the enforcement of the law ($p= 0.001$) (Table 3). Since
232 the patients in this comparative analysis had prepared their consent forms in advance, the time taken
233 to complete the consent forms was not evaluated in this sub-analysis.

234 **Discussion**

235 On February 4, 2018, the “Act on Hospice, Palliative Care, and Life-sustaining Health Care
236 Decisions for Patients on End of Life (Life Extension Medical Decision Law)” came into force in
237 South Korea (7). This was the first law to consider the suspension of nonsensical life-prolonging
238 medical care, which raised a big issue both in the medical field and in the social community.

239 We demonstrated that before the law was enforced, the time taken to obtain consent for preparing a
240 life-sustaining treatment plan was longer than the time taken from ER admission to finalization of the
241 DNR order. Additionally, the time spent in the ER was longer after the enforcement of the law. In
242 contrast, the percentage of transfers to other hospitals increased and the length of hospital stay
243 decreased after the law was enforced. There were no significant differences in the rates of most of the
244 classified aggressive procedures before and after enforcement; however, the provision of consent for

245 admission to the ICU decreased after enforcement. The rate of survival to discharge was particularly
246 high in the group of patients who had completed a consent form before the ER visit.

247 The time from ER registration to signing the consent form was longer after the enforcement of the
248 law, and this can be attributed to the peculiarity of the legal system. As shown in Fig. 1, if a patient
249 who has not indicated an intention to discontinue life-prolonging treatment in advance is unconscious
250 and cannot confirm their intention, a decision can be made only after all of the family members come
251 to a unanimous agreement. In the period following the enforcement, not many patients had prepared
252 such documents in advance, and many severely ill patients were unconscious at presentation; thus, it
253 took a long time for all family members to come to a unanimous decision. However, after a certain
254 period of time, even in the absence of an official life-sustaining treatment plan, the patient's attending
255 physician usually documents medical records about their will indicating an intention to discontinue
256 life-prolonging medical treatment. Thus, it was possible to discontinue life-prolonging treatment at a
257 relatively early stage with a decision statement from only two family members. If the time to finalize
258 consent is prolonged, the length of ER stay also increases, which may cause overcrowding in the
259 emergency care center. This clearly indicates the need for a simplified procedure for preparing a life-
260 sustaining care scheme.

261 In this study, the increase in the length of ER stay can be understood in relation to the increase in the
262 rate of direct transfer from the ER to other hospitals. Before the LEMD law was implemented, the rate
263 of transfer to other hospitals was only 8.2% and that of transfer to a nursing hospital was 1.0%, but
264 the corresponding rates increased to 21.2% and 9.7%, respectively, after implementation (Table 1).
265 Considering that the length of ER stay has been extended in the same way in the patient group who
266 wrote the life-sustaining treatment plan in advance, the longer stay in the ER is a separate issue from
267 the time it takes to complete the consent form. It is most likely because the number of direct transfers
268 to other hospitals, especially nursing hospitals has increased. In South Korea, transfer to nursing
269 hospitals is mostly possible only during regular consultation sessions, and patients have to wait until
270 regular hours; therefore, selecting a nursing hospital utilizes an inordinate amount of time. Even

271 though direct transfer from the ER to a nursing hospital is beneficial for conservative management,
272 the resulting increase in the length of hospital stay causes simultaneous overcrowding in the ER. This
273 can lead to a reduction in the ER's capacity to accommodate patients, disruption of medical practice
274 for those in urgent need of treatments, and an increase in the mortality rate (13). An earlier study
275 suggested the use of alternative care facilities as one of the ways to resolve ER overcrowding. This
276 has been shown to not only reduce waiting times and medical expenses but also improve patient
277 outcomes and satisfaction with the medical staff (13). In other words, rather than staying in the ER
278 while waiting for hospitalization or transfer to other hospitals, admission to the hospice ward could be
279 a good option for patients who have already written a life-sustaining treatment plan; their transfer to
280 palliative care hospitals can be considered later. However, in Severance Hospital, we have no choice
281 but to keep patients waiting in the ER due to the absence of a hospice ward; this area has scope for
282 further improvement.

283 Contrary to the time spent in the ER, the number of patients discharged to nursing hospitals for
284 conservative treatment or home care will increase and the total length of hospital stay will be
285 shortened if the number of patients who prepare life-sustaining plans increase. This was consistent
286 with the results from our study. As the disease progresses, the hospitalization rate of patients increases
287 exponentially, which leads to spending more time in the hospital during the last six months of life; this
288 is especially true for cancer patients (14). In the case of cancer patients, nutrition support or pain
289 control is often the most common reason for hospital admission, in addition to chemotherapy.
290 However, these types of symptom control treatments can be adequately provided in secondary and
291 nursing hospitals. From a medical professional's point of view, hospital beds must be used for patients
292 who absolutely need treatment in tertiary hospitals, but this is not the case in real-world practice as
293 patients and their families demand hospitalization at a tertiary university hospital even for receiving
294 chemotherapy or supportive care. Of course, such requests are rational considering the psychological
295 reassurance received by patients and their families on admission to a hospital equipped with doctors
296 and facilities competent enough to cope with emergencies; however, admission to a tertiary university

297 hospital solely for receiving supportive care will deprive other cancer patients who require more
298 aggressive and urgent treatment. The problem is even more concerning in hospitals that do not have a
299 hospice ward. A study showed that receiving specialized treatment in the ambulatory care sector is
300 associated with reduced bed utilization and a reduced need for hospitalization, especially in advanced
301 cancer patients (14). Therefore, if patients who have a life-sustaining treatment plan prepared in
302 advance utilize a nursing hospital or a primary medical institution, the frequency of unplanned
303 hospitalizations to a higher-level hospital can be reduced, and other patients can avail treatment
304 opportunities. Furthermore, from the patient's point of view, receiving treatment at a specialized
305 facility with caregivers who can provide focused hospice care can reduce emotional and mental stress.
306 As mentioned above, this could potentially be of great help in improving the patient's quality of life.
307 Therefore, it can be inferred that the reduction in length of hospital stay is an important consequence
308 of the enactment of the LEMD law and fulfills the purpose of the enforcement of this law.

309 When the patient fills out the life-sustaining plan document, the patient may refuse all ultimate
310 treatments, but with the patient's will, some aggressive treatment may be sought later. In this study, as
311 the LEMD law was implemented, a difference was expected in the provision of consent for each
312 aggressive treatment before and after implementation. However, this study showed that there was no
313 difference in the provision of consent for CPR, intubation, and CRRT, although the provision of
314 consent for admission to the ICU showed differences. The results of previous international studies
315 have revealed that even if a life-sustaining treatment plan is prepared, the treatment goals widely vary,
316 subjectively reflecting each patient's will. For example, patients receiving conservative treatment only
317 and patients receiving some restrictive treatment may not be revived but may receive all aggressive
318 treatments (15,16); however, the procedures described in the domestic life-sustaining treatment plan
319 include CPR, intubation, CRRT, and ICU admission, and each of them is interconnected and related to
320 resuscitation. Furthermore, in critical situations, it is not easy to choose only one or two of these
321 aggressive treatment approaches. Besides, there are differences in the scope of treatment that patients
322 want to receive depending on the timing of preparation of the life-sustaining care plan (17). For

323 instance, if a patient visits the ER and prepares a life-sustaining plan, there will not be enough time to
324 think about how aggressive treatment to continue. Moreover, considering the situation in which a life-
325 sustaining care plan is being prepared, it is conceivable that a plan prepared in the ER is intended for a
326 patient who is no longer likely to be resuscitated or is dying. In such situations, it is virtually difficult
327 to explain the aggressive treatments related to the patient's resuscitation to the patient's guardians in
328 despair and select some of them. Additionally, even if the caregiver selects only some of the listed
329 procedures, it may not make sense for the medical professionals to perform only some of those
330 treatments for the aforementioned reasons. Therefore, it might be difficult to explain to the patients or
331 caregivers that partially consenting to vigorous treatments might not be fruitful. Consequently, there
332 seems to be no difference in the rate of aggressive procedures before and after the LEMD law was
333 implemented.

334 The rate of survival to discharge were significantly higher in patients who had advance directives
335 before visiting the ER than in patients who wrote life sustaining treatment plan in the ER. This is
336 proof that the patients who wrote the letter of intent for life-sustaining treatment in advance had time
337 to ponder about the quality of their remaining life thoroughly. The preparation of a life-sustaining care
338 plan enables patients to be discharged or transferred after recovering from their condition without the
339 continuation of unwanted treatment, even if the patients are hospitalized unexpectedly. Earlier studies
340 have also revealed that the preparation of a letter of intent for life-sustaining treatment in advance is
341 associated with decreased hospital mortality and an increase in hospice use (18), which is equivalent
342 to an increase in the rate of survival to discharge. Besides, one study found that patients receiving
343 only limited treatment have shorter hospital stays, which increases the rate of discharge to hospice
344 hospitals for conservative treatment (19). This study confirmed that the rate of survival to discharge
345 significantly increased after the LEMD law was enforced, and patients were discharged to home,
346 hospice, or long-term care facilities. The families of patients receiving hospice services were
347 generally highly satisfied with the quality of care (20,21), and the fact that patients can spend the end
348 of their lives with their families significantly helps in improving the quality of end-of-life. In this

349 study, it was demonstrated that patients who had written a letter of intent for life-sustaining treatment
350 in advance wanted an improved quality of life at home or in a hospice facility rather than life-
351 prolonging treatment at a university hospital. Although the number of patients in this group was small
352 and not significant, the reduction in the length of hospital stay by more than half can be considered a
353 supporting result. Since the enactment of the LEMD law, more and more patients are writing their
354 intentions and plans regarding life-sustaining treatment in advance; thus, it is necessary to improve the
355 quality of medical services for patients receiving conservative treatment by activating domestic
356 hospice programs in the future.

357 Previously, there was no legal system for the suspension of life-prolonging treatment, and thus,
358 treatment for life extension continued regardless of the patient's will. Alternatively, in many cases in
359 which the patient was on the verge of dying, their guardians fill out the DNR consent form, and the
360 patients can die without receiving even non-aggressive treatment. Near the end-of-life, intensive care
361 for patients who do not want active treatment imposes physical, emotional, and financial burdens
362 (22,23), which lead to a poor quality of life. Therefore, to improve the quality of life of patients with a
363 short life expectancy, it is necessary to respect the freedom and will of patients who have prepared a
364 life-sustaining treatment plan. This approach will also reduce unnecessary admissions to university
365 hospitals, enabling the provision of high-quality treatment to patients who need aggressive treatments.

366 Although the number of patients who write their life-sustaining treatment plans in advance is
367 increasing, there are still no studies comparing the effects of this law and DNR orders, a similar
368 document used before the implementation of this law. Therefore, this study has a significant
369 advantage in that it is the first to investigate the differences in the provision of consent for DNR
370 orders before and after the enforcement of the LEMD law.

371 There are several limitations to this study. First, this study was conducted at one university hospital
372 in South Korea, and thus, the results cannot be generalized to the entire country. In subsequent
373 research, continuing the study in several other university hospitals will increase the reliability of the
374 results and contribute to generalization. Second, as we only included those who prepared the life-

375 sustaining treatment plan before ER presentation (outpatient/other institutions) and in the ER, patients
376 who completed the document in the ward after admission through the ER were not included. In the
377 follow-up study, it would be interesting to include those patients who completed the consent form in
378 the ward after hospitalization. Thirdly, since the DNR consent format and the life-sustaining treatment
379 plan format are different, some detailed procedures, even with slight differences, were excluded from
380 the study.

381 **Conclusion**

382 This study aimed to compare the relevant parameters before and after the enforcement of the LEMD
383 law to determine its clinical implications in South Korea. After the law was implemented, the average
384 length of stay in the tertiary university hospital decreased for patients who prepared life-sustaining
385 treatment plans in advance. Moreover, according to the law's purpose, the provision of consent for
386 ICU admission for aggressive treatments decreased. For patients wishing only conservative treatment,
387 the reduction in hospital stays at university hospitals ultimately reduces the physical, emotional,
388 financial burdens and also improves the quality of end-of-life at home or in a hospice facility. The
389 rates of provision of consent for CPR, intubation, and CRRT were not significantly different before
390 and after enforcement. Because this study is conducted in the ER of one university hospital in South
391 Korea, further research in several other hospitals including those patients who completed the consent
392 form in the ward after hospitalization is needed to generalize the clinical implication of the LEMD
393 law.

394

395 **List of abbreviations**

396	CPR	Cardiopulmonary resuscitation
397	CRRT	Continuous renal replacement therapy
398	DNR	Do-not-resuscitate

399	ER	Emergency room
400	ICU	Intensive care unit
401	LEMD	Life Extension Medical Decision

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405 Declarations**406 *Ethics approval and consent to participate***

407 The study data were collected using the Severance Clinical Research Analysis Portal, the clinical
408 data search system used by the hospital, and approved by the Institutional Review Board of Yonsei
409 University Health System (approval number 4-2020-0630). This study was conducted in compliance
410 with the Declaration of Helsinki, and the need for informed consent was waived due to the study's
411 retrospective design.

412 *Consent for publication*

413 Not applicable

414 *Availability of data materials*

415 The datasets used and/or analysed during the current study are available from the corresponding
416 author on reasonable request

417 *Competing interests*

418 The authors declare that they have no competing interests

419 *Funding*

420 Not applicable

421 *Authors' contributions*

422 All the authors contributed to the conceptualisation of this work. YJC, JHB designed the study. JEL
423 collected the data. YJC and JHB developed the data analysis strategy. YJC and JEL prepared the first
424 draft of the manuscript. JHB commented. Revisions were made by YJC and all the other authors (YJC,
425 JHB, JEL) read and approved the final manuscript. ICP and JHC supervised the overall work.

426 *Acknowledgments*

427 Not applicable

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513 Table 1. Comparison of parameters before and after the enforcement of the law

Variable	Group		p-value
	Before (n=195)	After (n= 217)	
Time taken from reception to obtaining written consent (mins)	273 (117,501)	232 (0,683)	0.031
Time spent in the ER (mins)	817 (447,1705)	1,195 (594,2151)	0.006
Length of admission (days)	4 (1,10)	2 (0,8)	0.001
Medical expenses (won)	3,718,989 (1,776,908, 6,629,026)	2,691,195 (1,356,584, 5,347,890)	0.008
Type of visit			0.860
Direct visit to the ER	144 (73.9)	155 (71.4)	
Transfer from another hospital	46 (23.6)	56 (25.8)	
Transfer from the OPD	5 (2.6)	6 (2.8)	
Transfer from the ER			0.001
Yes	16 (8.2)	46 (21.2)	
No	179 (91.8)	171 (78.8)	
Transfer from the ER to a nursing hospital			<0.001
Yes	2 (1.0)	21 (9.7)	
No	193 (99.0)	195 (90.3)	
Death in the ER			0.363
Yes	173 (88.7)	186 (85.7)	
No	22 (11.3)	31 (14.3)	
Primary cancer			0.599
Pancreatic cancer	15 (7.69)	18 (8.3)	
Gastric cancer	24 (12.31)	16 (7.4)	
Head, neck, and oral cancer	6 (3.08)	8 (3.7)	
Liver and intrahepatic bile duct cancer	25 (12.8)	37 (17.1)	
Lung, tracheal, and bronchial cancer	47 (24.1)	46 (21.2)	
Hematologic cancer	1 (0.5)	1 (0.5)	
Esophageal cancer	2 (1.0)	3 (1.4)	
Colorectal cancer	21 (10.8)	36 (16.6)	
Breast cancer	19 (9.7)	14 (6.5)	
Prostatic cancer	3 (1.5)	5 (2.3)	
Uterus, ovarian, and cervical cancer	8 (4.1)	12 (5.5)	

Kidney cancer	5 (2.6)	3 (1.4)	
Bladder cancer	3 (1.5)	3 (1.4)	
Skin cancer	3 (1.5)	6 (2.8)	
Others	13 (6.7)	9 (4.2)	
CPR			0.226
Yes	2 (1.0)	0 (0.00)	
No	193 (99.0)	215 (100.00)	
Intubation			0.995
Yes	10 (5.1)	11 (5.1)	
No	185 (94.9)	204 (94.9)	
CRRT			0.109
Yes	27 (13.9)	19 (8.8)	
No	168 (86.2)	196 (91.2)	
ICU admission			0.032
Yes	13 (6.7)	5 (2.3)	
No	182 (93.3)	210 (97.7)	
Survival at discharge			0.001
Yes	56 (28.7)	96 (44.2)	
No	139 (71.3)	121 (55.8)	

DNR; do-not-resuscitate, CPR; cardiopulmonary resuscitation, CRRT; continuous renal replacement therapy, ICU; intensive care unit, ER; emergency room, OPD; outpatient department

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530 Table 2. Comparison of parameters when life-sustaining treatment plan or DNR consent form was
 531 obtained in the ER

Variable	Group		p-value
	Before (n=175)	After (n=139)	
Time taken from reception to obtaining written consent (mins)	296 (155,532)	466 (245,963)	<0.001
Time spent in the ER (mins)	864 (479, 1750)	1,391 (642, 2,467)	0.003
Length of admission (days)	4 (1,9)	2 (0,6)	0.001
Medical expenses (won)	3,782,083 (1,732,649, 6,638,183)	2,755,304 (1,615,569, 4,823,854)	0.076
Type of visit			0.208
Direct visit to the ER	134 (76.6)	94 (67.6)	
Transfer from another hospital	36 (20.6)	40 (28.8)	
Transfer from the OPD	5 (2.9)	5 (3.6)	
Transfer from the ER			0.005
Yes	16 (9.1)	28 (20.1)	
No	159 (90.9)	111 (79.9)	
Transfer from the ER to a nursing hospital			0.001
Yes	2 (1.1)	14 (10.1)	
No	173 (98.9)	125 (89.9)	
Death in the ER			0.049
Yes	155 (88.6)	112 (80.6)	
No	20 (11.4)	27 (19.4)	
Primary cancer			0.712
Pancreatic cancer	13 (7.4)	12 (8.6)	
Gastric cancer	22 (12.6)	10 (7.2)	
Head, neck, and oral cancer	5 (2.9)	4 (2.9)	
Liver and intrahepatic bile duct cancer	19 (10.9)	21 (15.1)	
Lung, tracheal, and bronchial cancer	45 (25.7)	34 (24.5)	
Hematologic cancer	1 (0.6)	1 (0.7)	
Esophageal cancer	1 (0.6)	3 (2.2)	
Colorectal cancer	20 (11.4)	22 (15.8)	
Breast cancer	16 (9.1)	10 (7.2)	
Prostatic cancer	3 (1.7)	2 (1.4)	

Uterus, ovarian, and cervical cancer	8 (4.6)	8 (5.8)	
Kidney cancer	5 (2.9)	3 (2.2)	
Bladder cancer	3 (1.7)	2 (1.4)	
Skin cancer	3 (1.7)	4 (2.9)	
Others	11 (6.3)	3 (2.2)	
CPR			0.506
Yes	2 (1.1)	0 (0.0)	
No	173 (98.9)	137 (100.0)	
Intubation			0.755
Yes	9 (5.1)	6 (4.4)	
No	166 (94.9)	131 (95.6)	
CRRT			0.506
Yes	2 (1.1)	0 (0.0)	
No	173 (98.9)	137 (100.0)	
ICU admission			0.026
Yes	12 (6.9)	2 (1.5)	
No	163 (93.1)	135 (98.5)	
Survival at discharge			0.505
Yes	53 (30.3)	47 (33.8)	
No	122 (69.7)	92 (66.2)	

DNR; do-not-resuscitate, CPR; cardiopulmonary resuscitation, CRRT; continuous renal replacement therapy, ICU; intensive care unit, ER; emergency room, OPD; outpatient department

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547 Table 3. Comparison of parameters when the life-sustaining treatment plan or DNR consent form was
 548 completed before visiting the ER

Variable	Group		p-value
	Before (n=20)	After (n=78)	
Time spent in the ER (mins)	510.5 (349.5, 1085)	970.5 (462, 1615)	0.042
Length of admission (days)	5.5 (3,10)	2 (0,10)	0.061
Medical expenses (won)	3,593,733.5 (2,439,355.5, 4,899,793.5)	2,167,290.5 (961,601, 6,025,705)	0.133
Type of visit			0.025
Direct visit to the ER	10 (50.0)	61 (78.2)	
Transfer from another hospital	10 (50.0)	16 (20.5)	
Transfer from the OPD	0 (0.0)	1 (1.3)	
Transfer from the ER			0.020
Yes	0 (0.0)	18 (23.1)	
No	20 (100.0)	60 (76.9)	
Transfer from the ER to a nursing hospital			0.339
Yes	0 (0.0)	7 (9.1)	
No	20 (100.0)	70 (90.9)	
Death in the ER			0.599
Yes	18 (90.0)	74 (94.9)	
No	2 (10.0)	4 (5.1)	
Primary cancer			0.571
Pancreatic cancer	2 (10.0)	6 (7.7)	
Gastric cancer	2 (10.0)	6 (7.7)	
Head, neck, and oral cancer	1 (5.0)	4 (5.1)	
Liver and intrahepatic bile duct cancer	6 (30.0)	16 (20.5)	
Lung, tracheal, and bronchial cancer	2 (10.0)	12 (15.4)	
Hematologic cancer	0 (0.0)	0 (0.0)	
Esophageal cancer	1 (5.0)	0 (0.0)	
Colorectal cancer	1 (5.0)	14 (18.0)	
Breast cancer	3 (15.0)	4 (5.1)	
Prostatic cancer	0 (0.0)	3 (3.9)	
Uterus, ovarian, and cervical cancer	0 (0.0)	4 (5.1)	
Kidney cancer	0 (0.0)	0 (0.0)	

	Bladder cancer	0 (0.0)	1 (1.3)	
	Skin cancer	0 (0.0)	2 (2.6)	
	Others	2 (10.0)	6 (7.7)	
CPR				
	Yes	0 (0.0)	0 (0.0)	
	No	20 (100.0)	78 (100.0)	
Intubation				>0.999
	Yes	1 (5.0)	5 (6.4)	
	No	19 (95.0)	73 (93.6)	
CRRT				0.579
	Yes	0 (0.0)	4 (5.1)	
	No	20 (100.0)	74 (94.9)	
ICU admission				>0.999
	Yes	1 (5.0)	3 (3.9)	
	No	19 (95.0)	75 (96.2)	
Survival at discharge				
	Yes	3 (15.0)	49 (62.8)	0.001
	No	17 (85.0)	29 (37.2)	

DNR; do-not-resuscitate, CPR; cardiopulmonary resuscitation, CRRT; continuous renal replacement therapy, ICU; intensive care unit, ER; emergency room, OPD; outpatient department

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565 **Figure legends**

566 Fig. 1. Procedure of decision-making to discontinue life-prolonging care

567 Fig. 2. Flow diagram of patient eligibility

568 DNR; do-not-resuscitate, ER; emergency room, OPD; outpatient department

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