Analysis of Genetic counseling among pancreatic cancer patients

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3/28/2022

Introduction

The main purpose of this project is to evaluate the genetic counseling and germline genetic testing process within the pancreatic adenocarcinoma patient population at Roswell Park Comprehensive Cancer Center. We are mainly interested in investigating the reasons that patients opt out of genetic testing and genetic counseling and the trend of referral rate after the guideline came out. The report can be divided into five parts. The first part will analyze the reasons in each step why people drop out. We will uncover the relationship between referral rate and other factors including disease stage and ECOG score. The third part will focus on the overall trend of the referral rate for 30 months. The fourth part will compare the referral rate before and after the genetic center offered telehealth and help to answer the question of whether people prefer telehealth to in-person meetings. The last part is the additional analysis of people with second opinions as well as an exploration of the dominant reasons for dropping-out individuals.

Data Processing

The dataset includes 220 pancreatic patients' medical records for 30 months. The dataset contains personal information of patients, medical records as well as genetic counseling records. There are many missing values in the data. We fill in some missing values based on our understanding of context. For example, the entry will be missing for the later part of genetic counseling if the patient does not have a referral placed. In further analysis, we also divide some specific reasons into groups. The detailed encoding information will be shown in the Appendix. Also, except for the analysis of second opinion patients, we only include 155 patients who do not have second opinions in either somatic testing or the reason no referral column in the report.

Summary of Analysis

I.Referral rate and its analysis

The overall referral rate is 35.5%. There were 55 patients who ordered the germline genetic test among 155 patients. We will divide the referral process into four steps and analyze the reasons for dropping off during each step in later analysis.

Part.I Genetic referrals placed

The first acceptance ratio refers to the number of patients whose genetic referrals were placed by doctors over the total amount of patients.

Options	Number of patients	Ratio
Yes - Acceptance	111	0.716
No	44	0.284
Total	155	-

Part II. Genetic meeting scheduled

The second acceptance ratio is calculated based on the previous step, which implies the proportion of patients who scheduled the testing by the patients who accepted the first step.

Options	Number of patients	Ratio
Yes - Acceptance	81	0.730
No	30	0.270
Total	111	-

Part III. Genetic meeting attended

The calculation of the third ratio is the same as the second one, which represents the number of patients attending a genetic meeting over the number of the acceptance group in the second step.

Options	Number of patients	Ratio
Yes - Acceptance	59	0.728
No	22	0.272
Total	81	-

Part IV. Genetic counseling ordered

In the table below, we calculate the proportion of patients who ordered testing given the third acceptance group.

Options	Number of patients	Ratio
Yes - Acceptance	55	0.932
No	4	0.068
Total	59	-

Part V. Proportions of individuals who proceed through each step of the process

The following Sankey plot illustrates how many individuals succeed (currently labeled "Accept") at each step of the genetic counseling process.

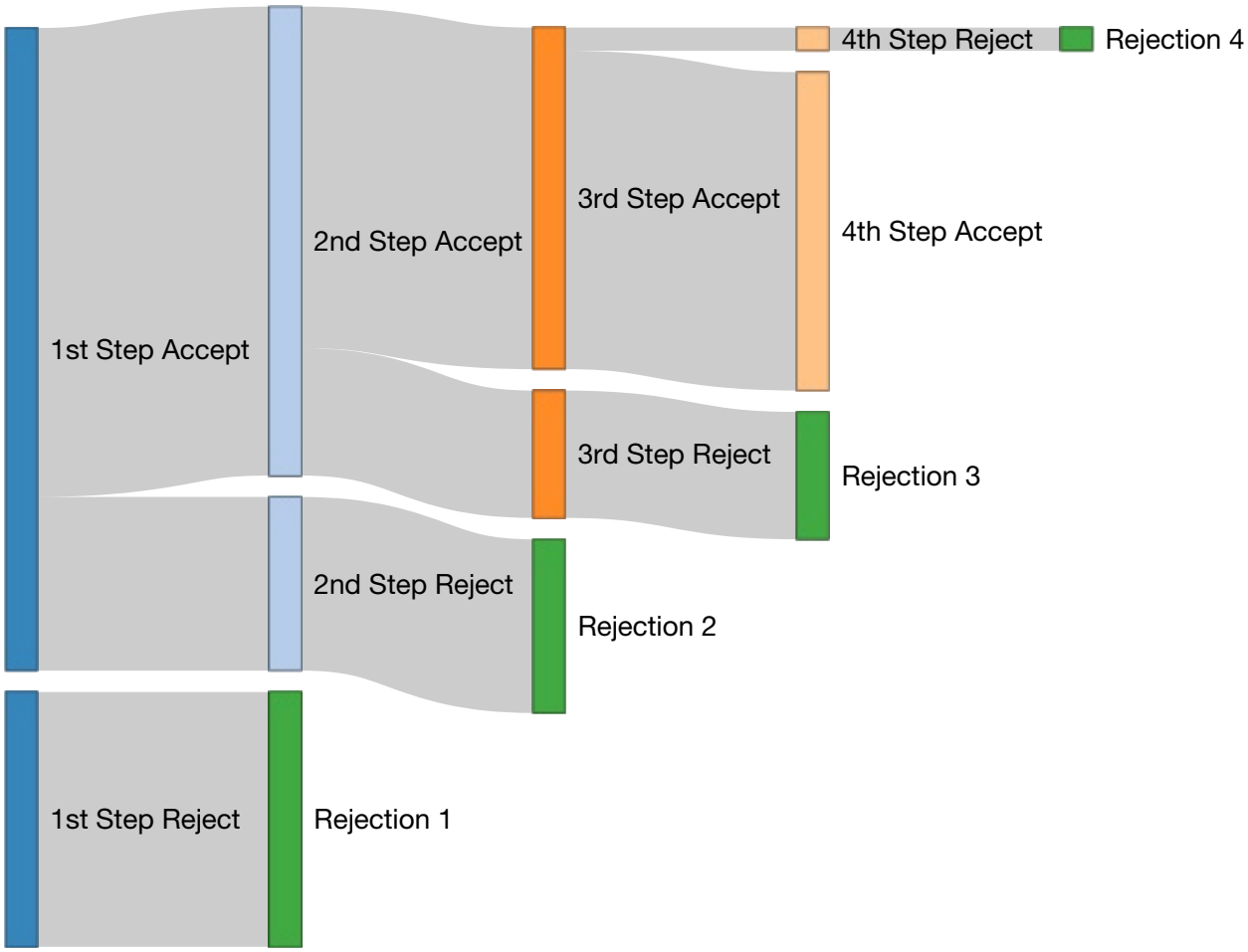

Figure 1: Proportions of patients in each step

II. Analysis of referral rate with other factors

Part I.Cancer Stage and Genetic Counseling Referral Rate

We think that the stage of cancer might explain some of the variations in referral rate. The following stacked bar plot serves as a visualization of the proportions of individuals who ordered testing given that they were diagnosed with certain stages of cancer. We only selected the patients who finally ordered genetic counseling and labeled the numbers and percentages on each bar.The percentage can be calculated by:

$$percentage = \frac{number\ of\ patients\ ordered\ testing}{number\ of\ patients\ in\ each\ stage}$$

For instance, the total number of patients in fourth stage is 121, and 41 of them have ordered genetic counseling, so the percentage is supposed to be $\frac{41}{121} = 33.88\%$.

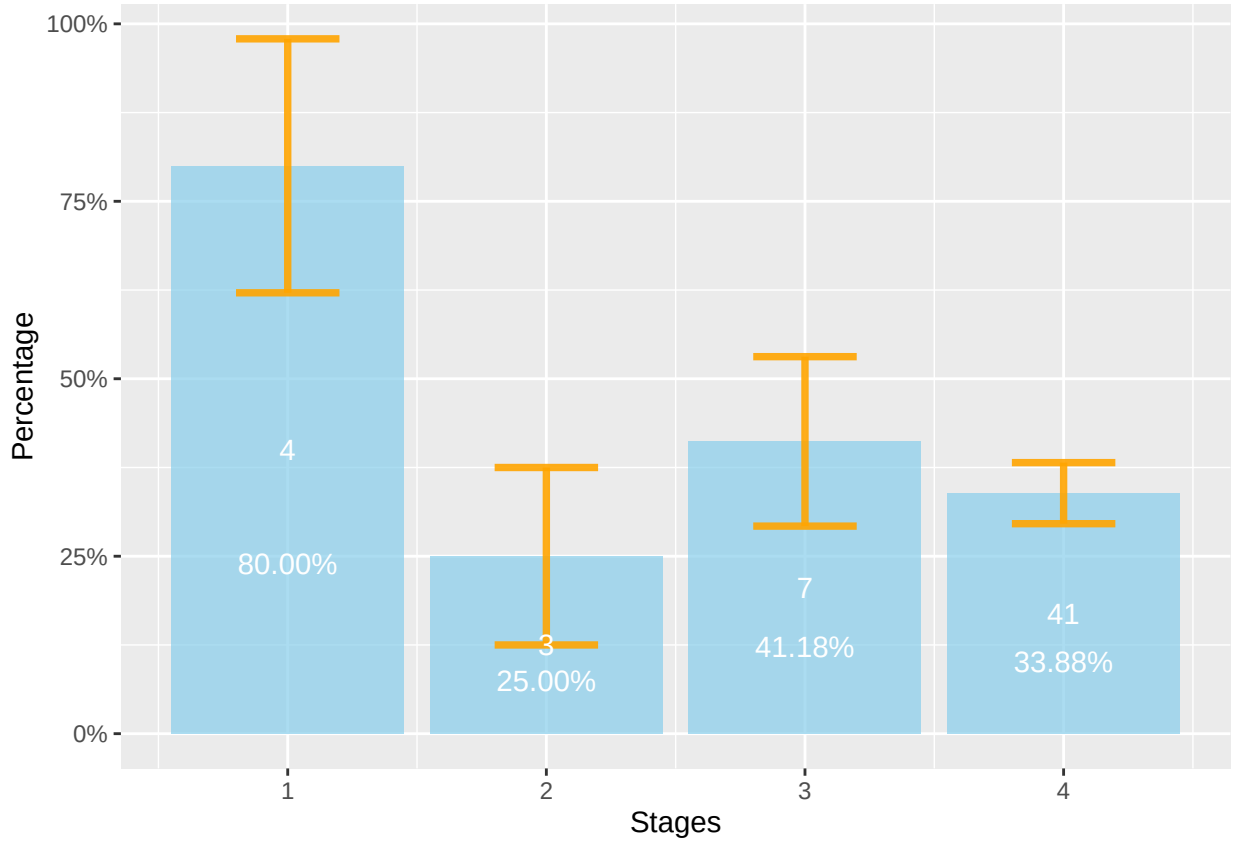

Figure 2: Proportion of patients who order test in each cancer stage

Part II. ECOG and Referral Rate

ECOG is an indicator of the wellness level of the patients. In the following section, we want to investigate the relationship between the ECOG of patients and the referral rate. As a result, we use the same method as the previous analysis. The stacked bar plot presents the proportions of individuals who ordered testing based on the patient's level of functioning in terms of their ability to care for themselves (ECOG Status).

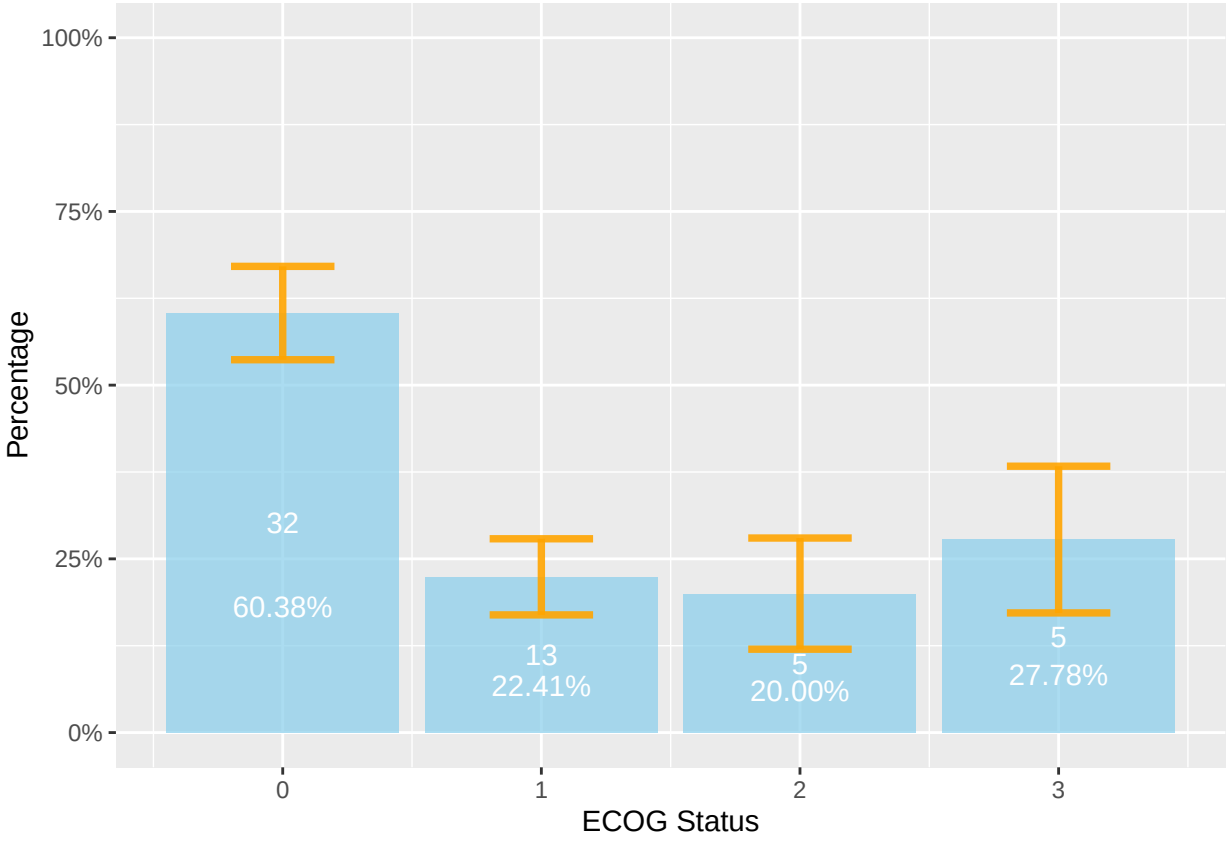

Figure 3: Proportions of patients who order test in each ECOG level

III. Change of referral rate

In this section, we visualize the trends of referral rates using both three months and six months as a period. We can learn whether the referral rate is increasing or not through time from the figures.

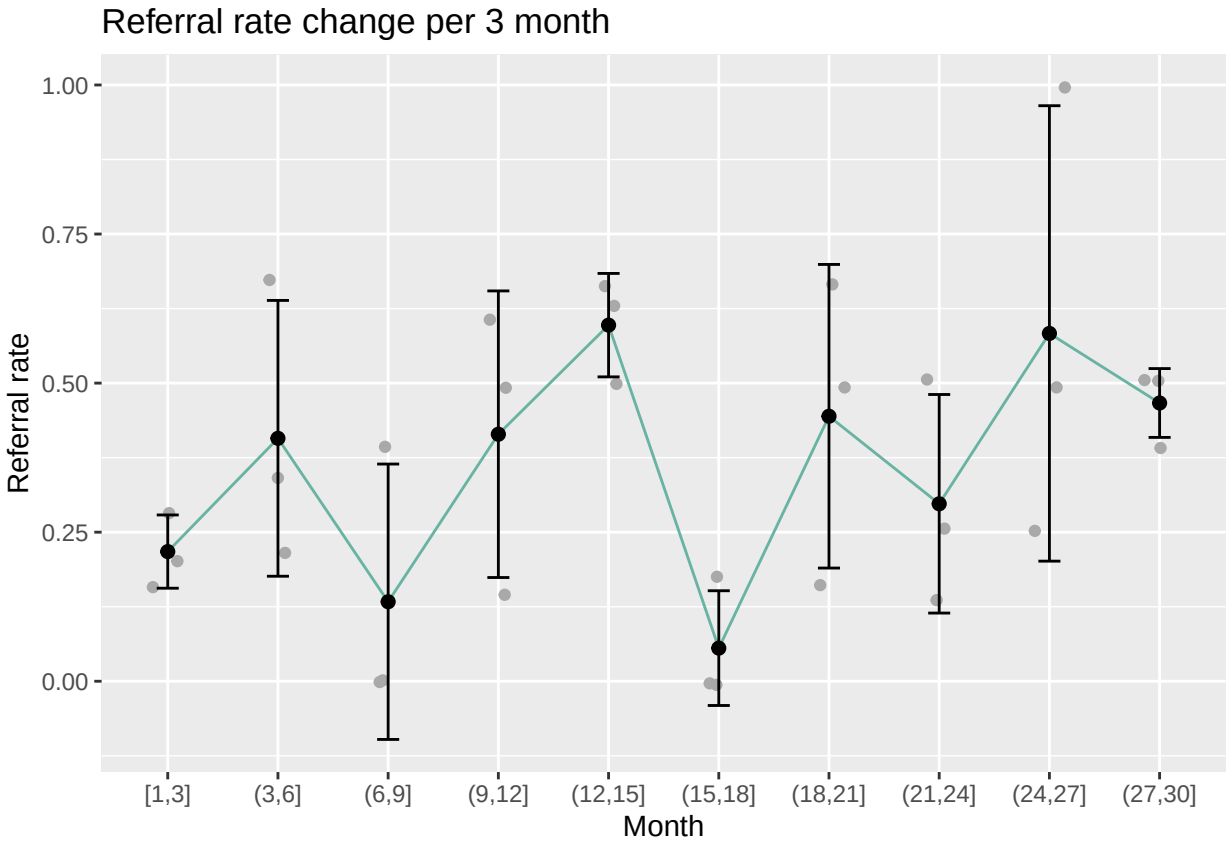

Figure 4: Referral rate change per 3 month

The figure above shows us the trend of referral rate using three months as a period. We jitter the points to avoid overlaps. The plot above does not indicate there is any increasing or decreasing trend.

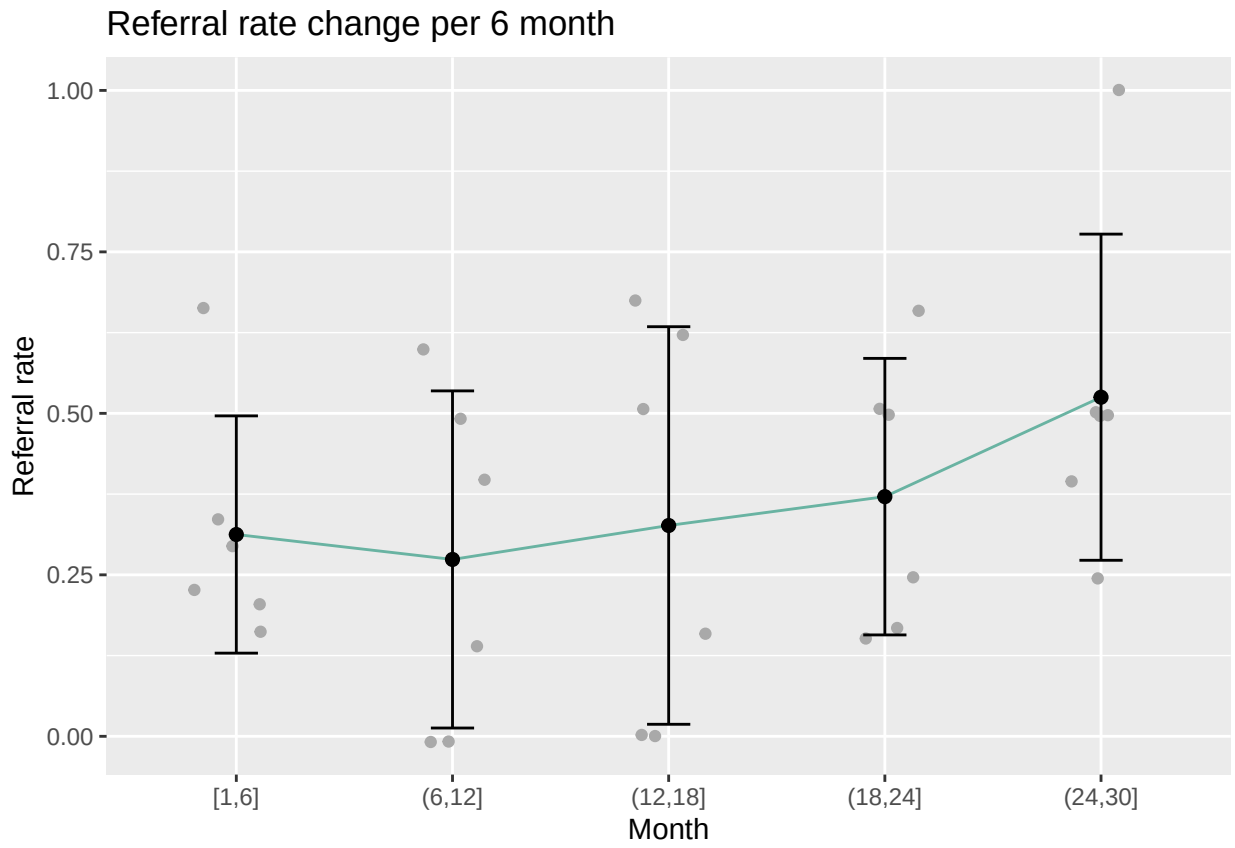

Figure 5: Referral rate change per 6 month

The visualization above tells us the change in the referral rate per 6 months. Since there are a lot of variations in the referral rate in each time interval, we can not conclude that there is an obvious increasing relationship between time and referral rate.

IV.Virtual/Teleheath Impact

In this part, we want to investigate if there is any difference in the referral rate before and after telehealth is provided as a preferred option for the patients. After two options are offered, which corresponds to the 'After' row, the referral rate is 48.6%. The number of patients who preferred telehealth versus those who preferred in-person meetings is the entry in the row 'Telehealth' and 'In-person.

Period	Total number of patients	Number of patients who placed a referral	Number of Patients who scheduled a meeting	Number of patients who attended the meeting	Number of Patients who ordered the test	Referral rate
Before	120	82	55	40	37	0.308
After	35	29	26	18	17	0.486
Telehealth	-	-	17	14	13	-
In-person	-	-	5	4	4	-
NA	-	-	4	0	0	-
Total	155	111	81	58	54	0.348

V. Further analysis

Part I.Analysis on second opinion patients

Among 65 patients who had 'second opinion' in the data, 3 of them still ordered the germline genetic testings. And the referral rate among these patients is 4.62%.

Period	Total number of patients	Number of patients who placed a referral	Number of Patients who scheduled a meeting	Number of patients who attended the meeting	Number of Patients who ordered the test	Referral rate
Before	65	11	8	6	3	0.0462

Part II.Reasons for failures

1.Reasons that cause the patients with no second opinion fail to place the referral

The following bar plots provide simple counts of the number of individuals who listed certain reasons for failing to schedule genetic meetings or place the referral. We firstly separate the patients who fail to place the referrals into two subsets based on whether the failure reason is caused by the second opinion. As result has shown, the number of patients that have a second opinion is 53 and the resting is 48. Then we further explore the reasons for the subset where patients do not contain 'second opinion'. The bar plot below illustrates the reason that causes patients with no second opinion to fail to place the referral. The main reason is 'hospice' (31%). And there are about 8 patients (17%) who fail because of 'screen trials/phase III trials'. The resting patients who failed to place the referrals are caused by 'confirm dx', 'palliative', and 'testing' (around 10%).

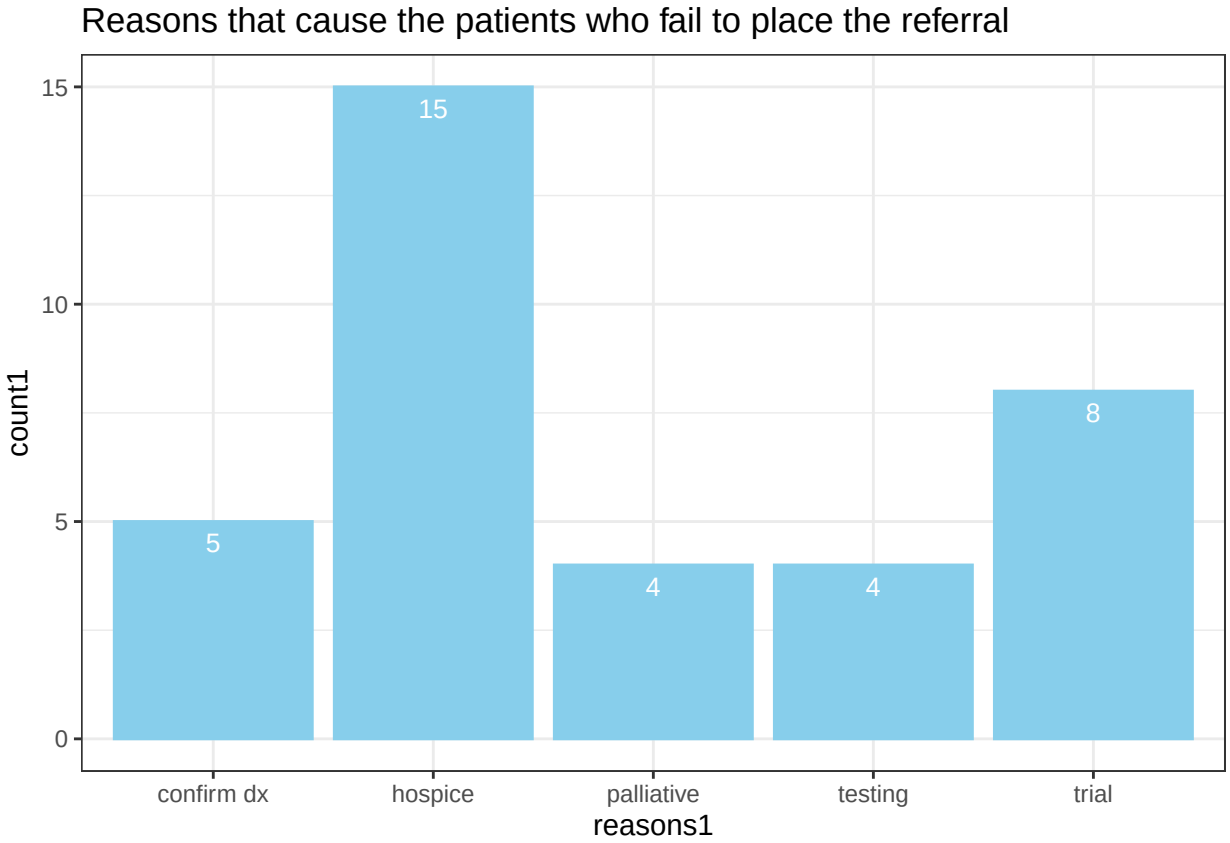

Figure 6: Reasons that cause the patients who fail to place the referral

2.Reasons that cause the patients fail to schedule genetic meeting

We next look into the reasons that lead the patients to not to schedule genetic meetings. In the bar plot shown below, the main reason that cause patients to drop out is 'no response by call/mail'. There are 9 patients (about 27%) who did not schedule the meetings due to this reason. The rest patients who fail to schedule genetic meetings are mainly caused by 'not addressed' (15%), 'passed' (15%'), and 'pt declined' (18%).

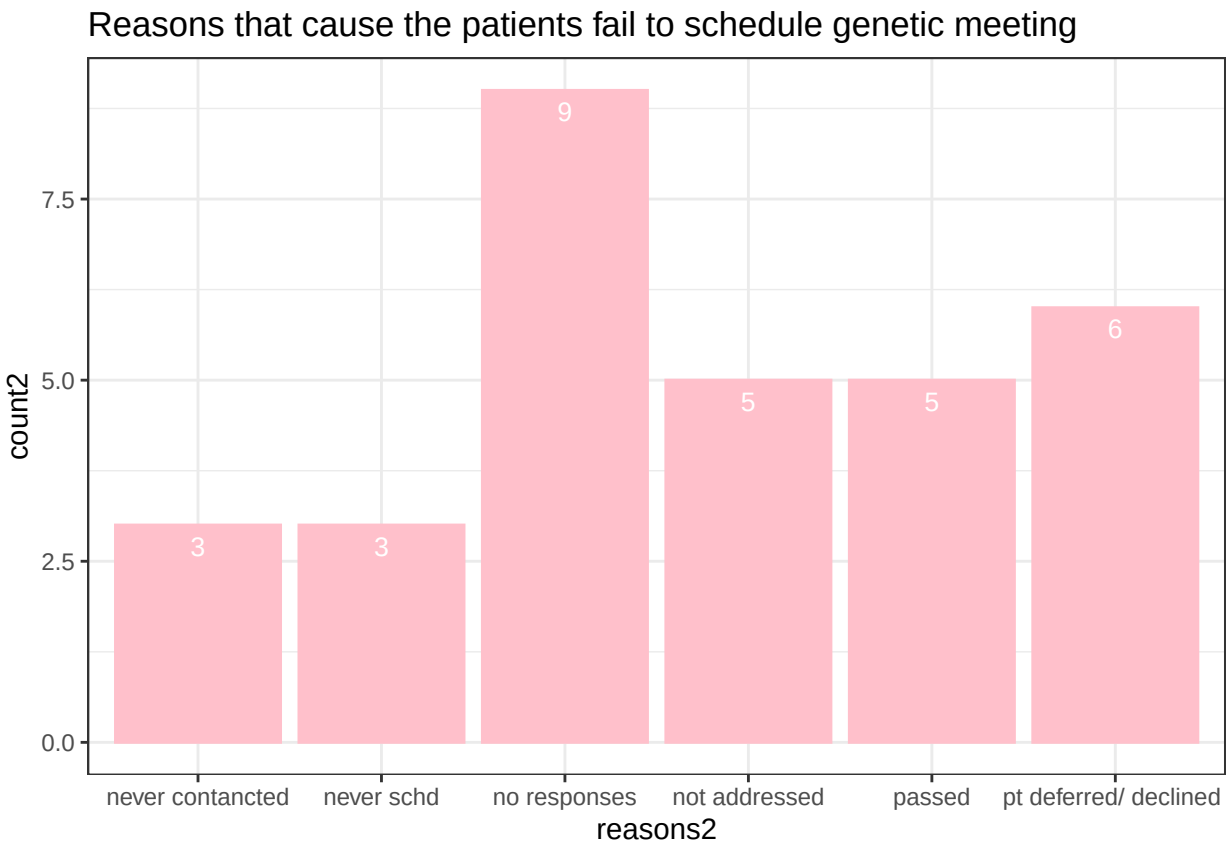

Figure 7: Reasons that cause the patients who fail to schedule genetic meeting

Appendix

In the appendix part, we include the code about how we calculate the ratio above. And we also include the encoding method for Figure 6 and Figure 7. The additional stacked bar plots are also attached in this part.

1. Encoding method for Figure 6

Encoding: confirm: confirm dx then chose care at ECMC, workup/confirm dx;

trial: phase III trial, trial screen;

palliative: palliative/ supportive, recommended supportive/ palliative care, other - palliative/ supportive;

testing: other - prior testing completed at Roswell (2017), other - prior testing previously completed outside;

hospice: hospice, then inpatient then enrolled in hospice, other - hospice

2. Encoding method for Figure 7

Encoding: pt declined: pt deferred/not interested, pt deferred/ declined, other - pt declined x2;

No response/mail: other - no response to calls/VM or mailed letter, other - no call back, inpatient to inpatient hospice;

Never schd: no never schd, never seen;

Not addressed: referral not addressed - active;

Never contacted: never contacted - d/c via pt discharge;

passed: pt passed before referral reviewed, pt passed before appt offered, never contacted - d/c via pt discharge;

3. More stacked bar plots

Figure.8 contains both of acceptance and rejection groups of patients who ordered testing diagnosed with different stages of cancer. The numbers and percentages on bars are same with the previous corresponded bar plots. And Figure.9 presents the relationship among patients in diversity of ECOG status and the referral rates in acceptance and rejection groups.

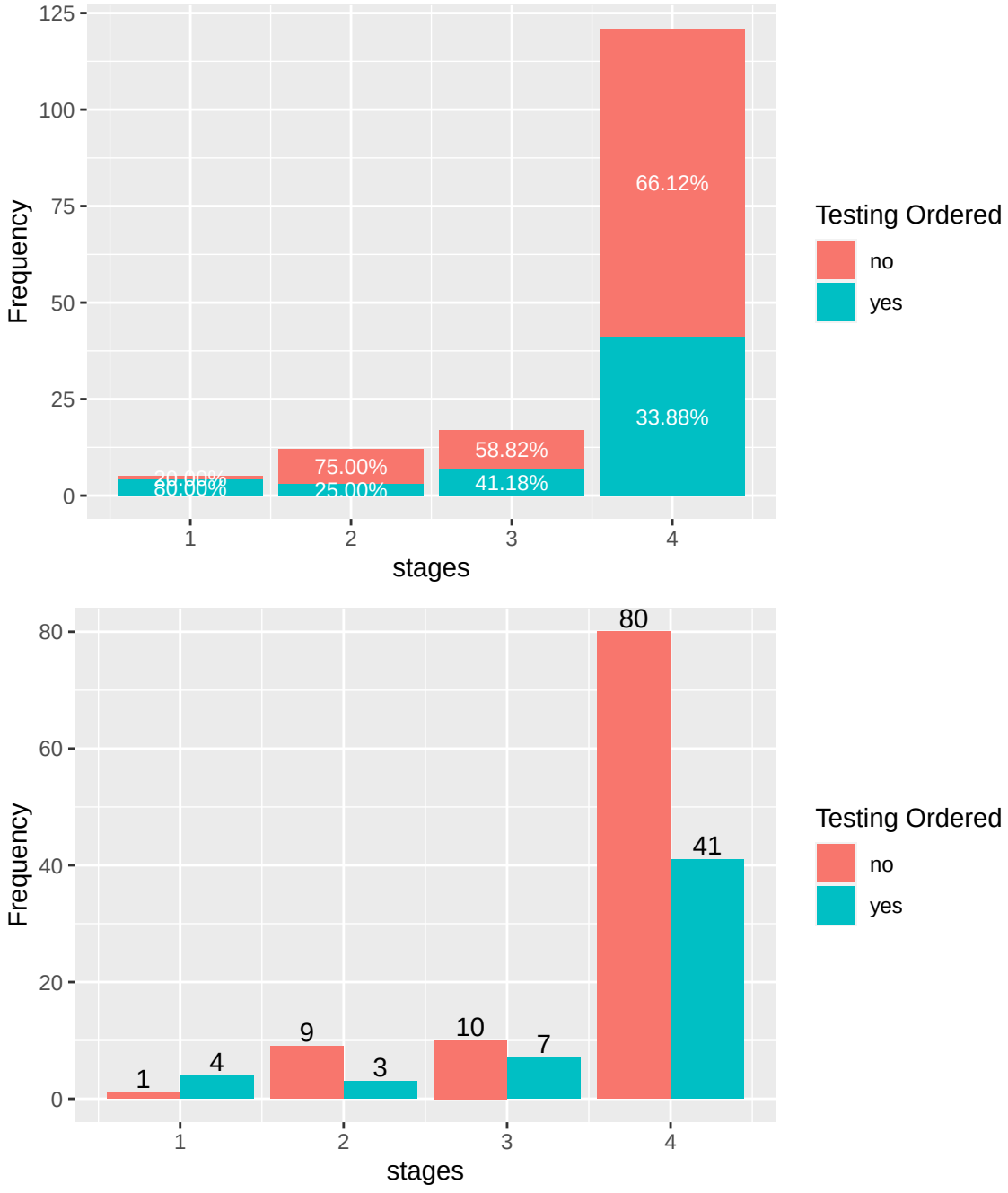

Figure 8: Proportion of patients who order test in each cancer stage

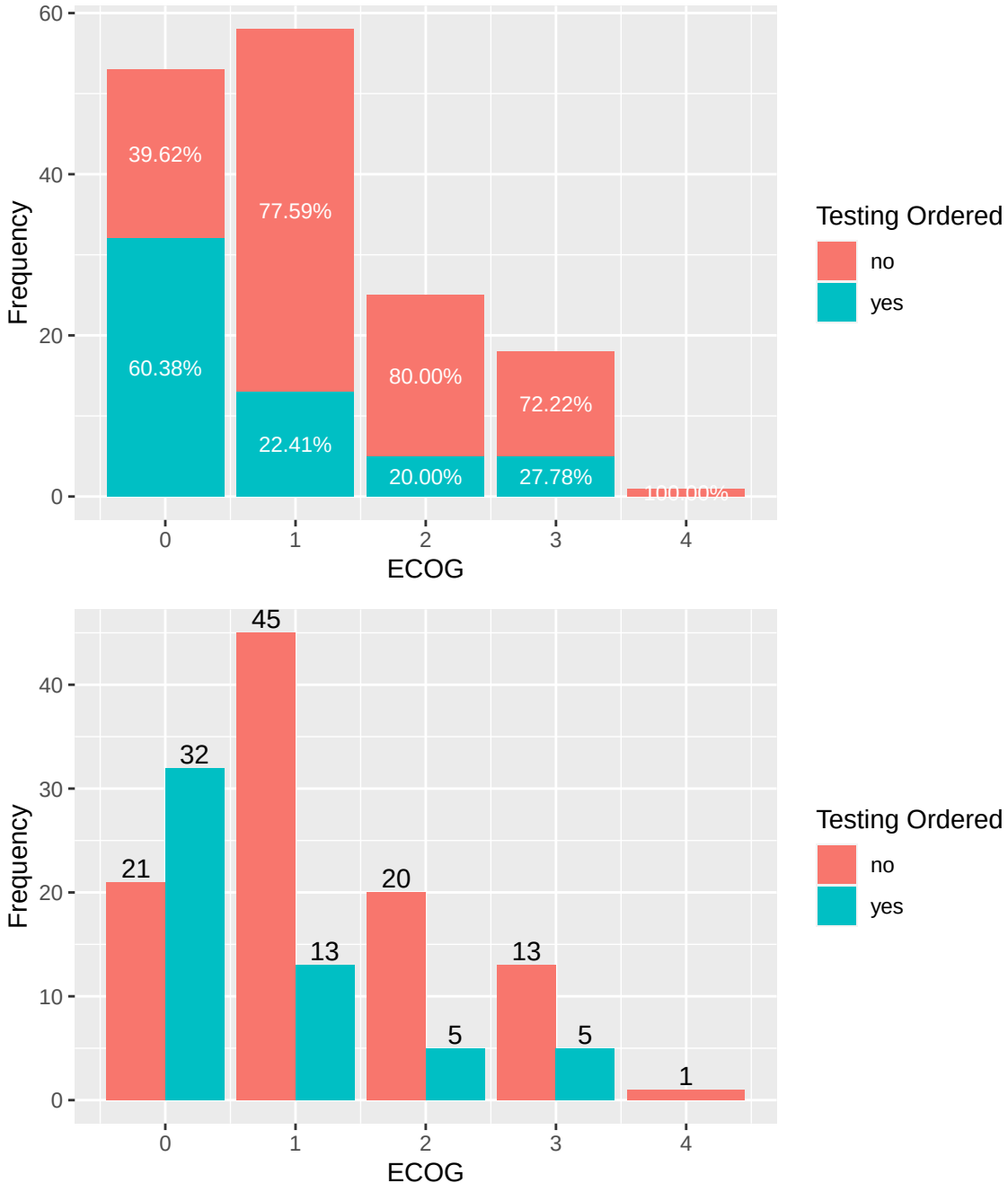

Figure 9: Proportions of patients who order test in each ECOG level