Analysis of Genetic counseling among pancreatic cancer patients

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Introduction

The main purpose of this project is evaluating 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 three parts. The first part will analyze the reason in each step on why people drop out. The second part will focus on the overall trend of the referral rate for 30 months. The third part will compare the referral rate before and after the genetic center offered telehealth and help to answer the question whether people prefer telehealth to in-person meeting.

Data Processing

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

Summary of Analysis

I.Referral rate and its analysis

The overall referral rate is 0.355. There are 55 patients ordered the germline genetic test among 155 patients. We will divide the referral process into four steps and analyze the reasons of dropping of during each step.

Part.I Genetic referrals placed

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

Part II. Genetic meeting scheduled

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

Part III. Genetic meeting attended

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

Part IV. Genetic counseling ordered

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.

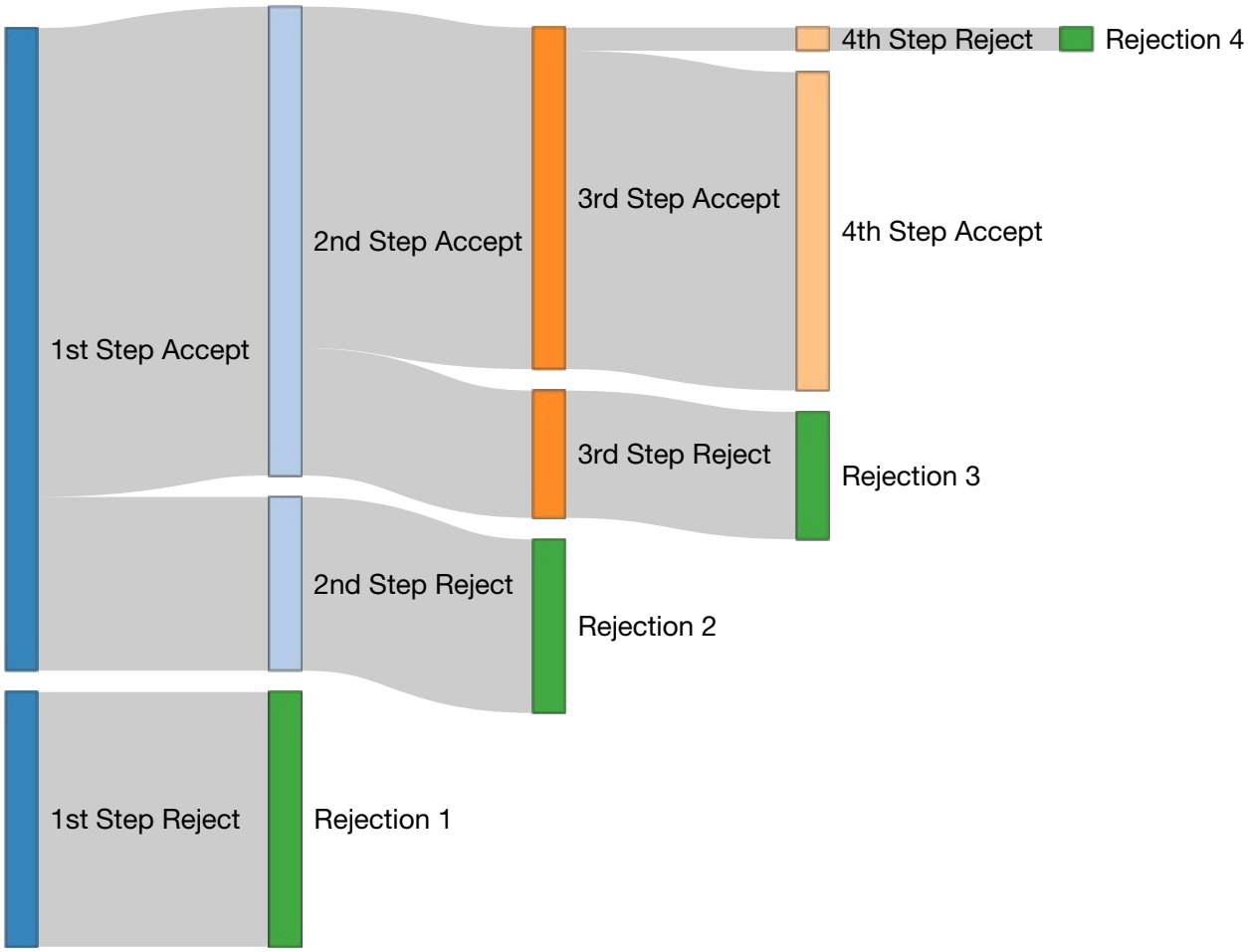

Figure 1: Proportions of patients in each step

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 variation in referral rate. The following stacked bar plot serves as visualization to 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 ordered genetic counseling, so the percentage is supposed to be $\frac{41}{121} = 33.88\%$.

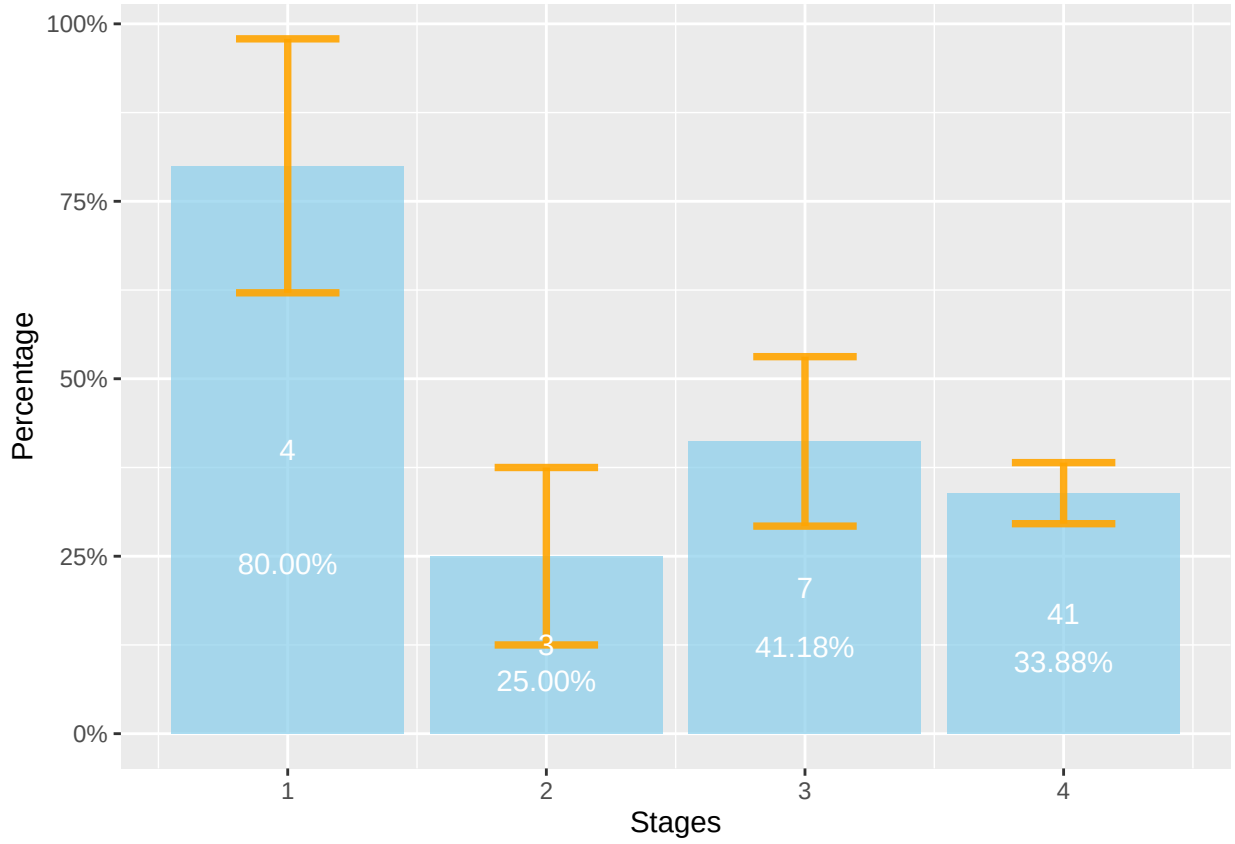

Figure 2: Proportion of patients who order test in each cancer stage

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 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).

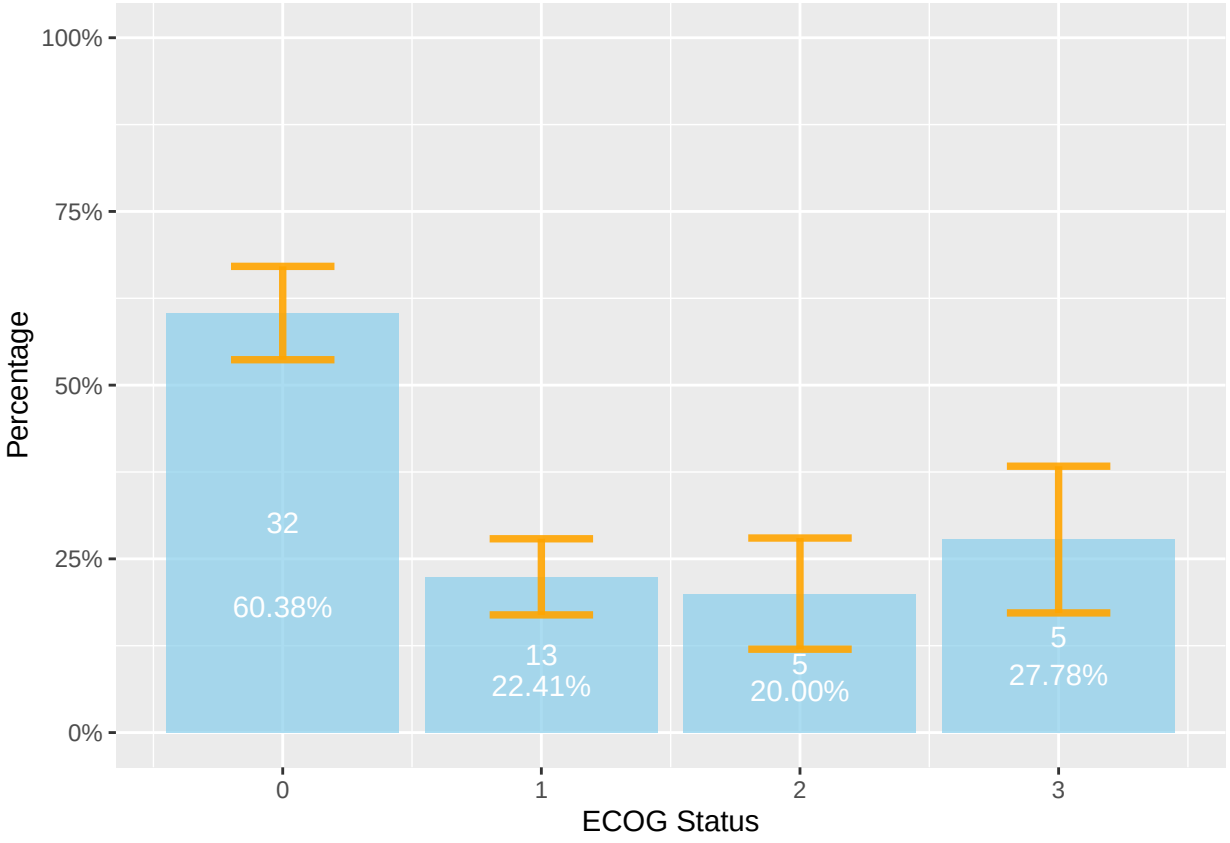

Figure 3: Proportions of patients who order test in each ECOG level

III. Change of referral rate

In this section, we visualize the trends of referral rate using both 3 months and 6 months as a period. We can learn whether the referral rate is increasing or not through the time.

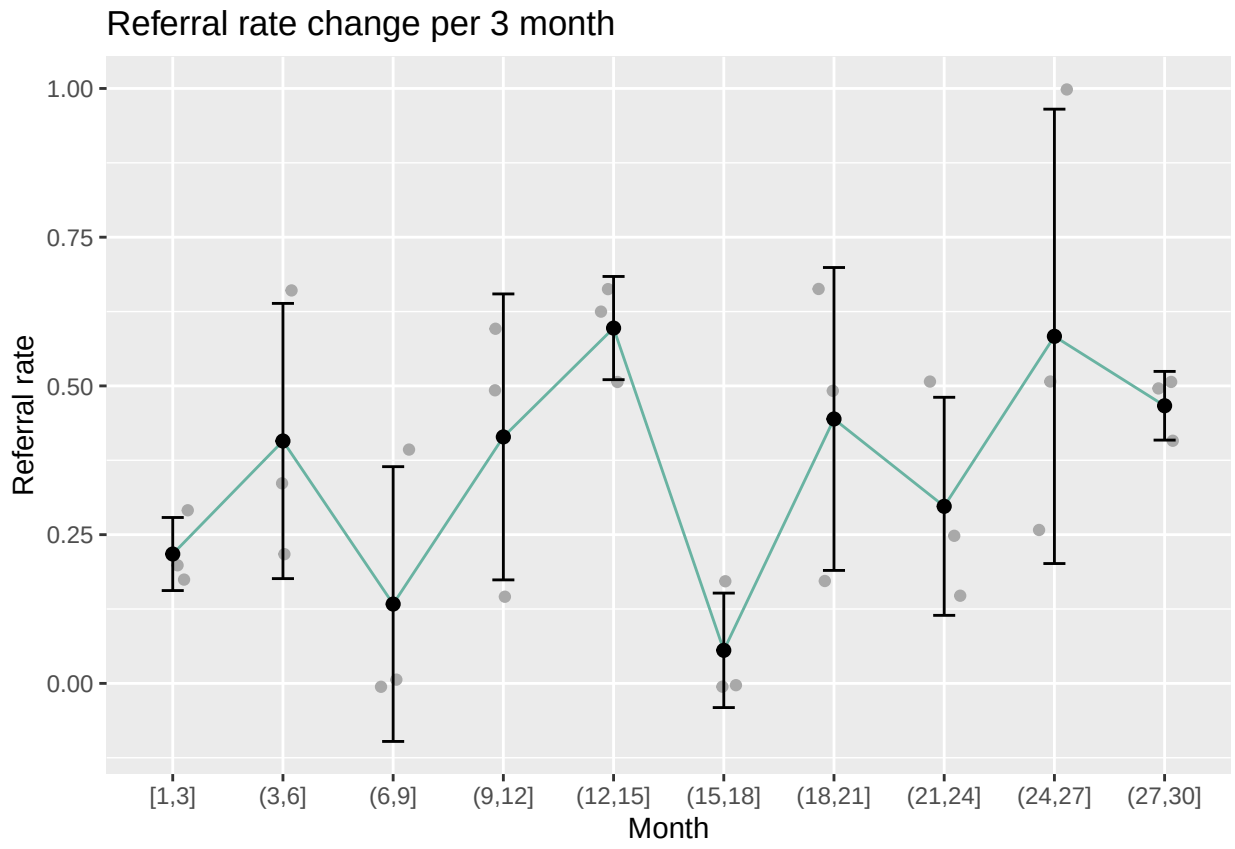

Figure 4: Referral rate change per 3 month

The figure above shows us the trend of referral rate using 3 month as a period. We jitter the points to avoid overlaps. The plot above does not indicate there is any increasing or decreasing trend.

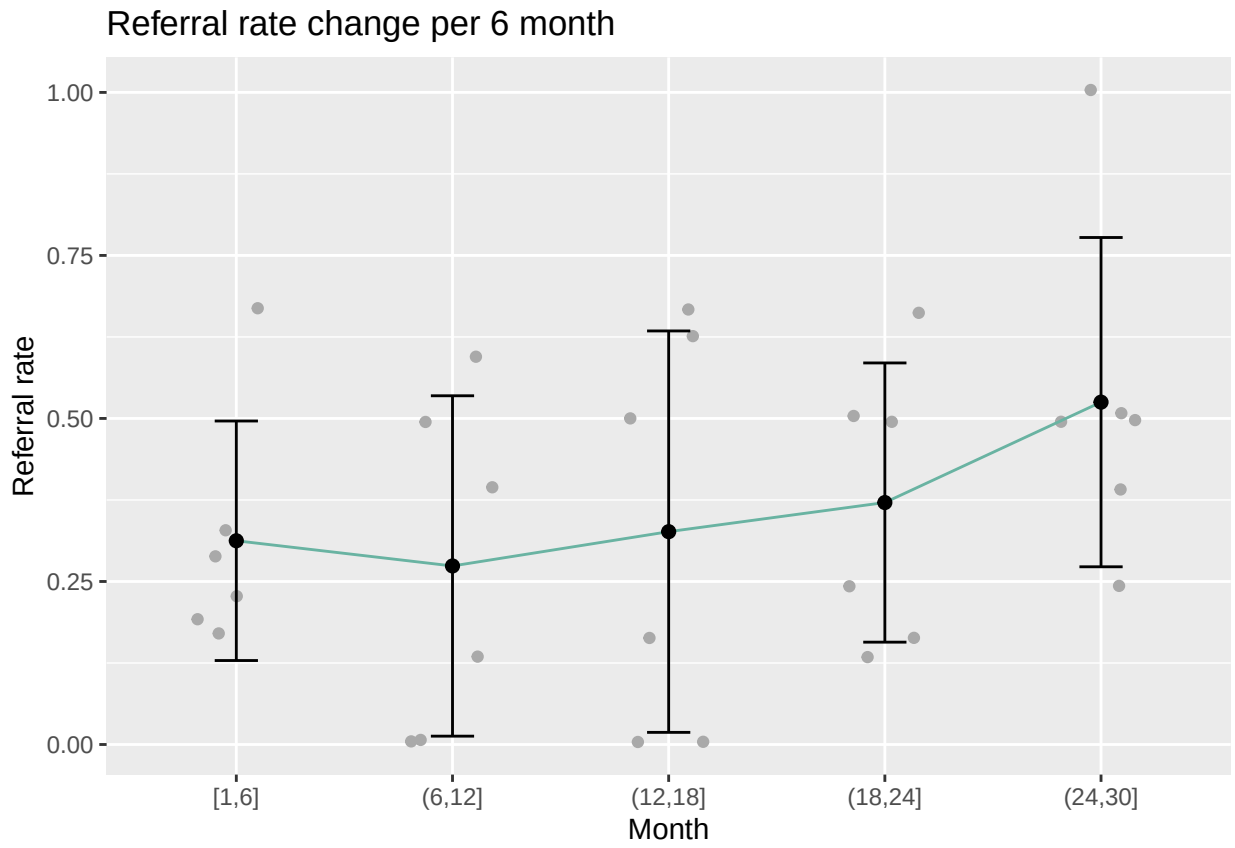

Figure 5: Referral rate change per 6 month

The visualization above tells us the change of the referral rate per 6 month. Since there are a lot of variations of 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 of the referral rate before and after telehealth is provided as an preference options for the patients. After two options are referred, which corresponding to the 'After' row, the referral rate is 48.6%. The number of patients who preferred telehealth vs who preferred who preferred in-person meeting are the entry in the row 'Telehealth' and 'In-pseron'.

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 testing. 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 failure

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 study the reasons for the subset that patients don't have a 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 fail to place the referrals caused by 'confirm dx', 'palliative', and 'testing' (around 10%).

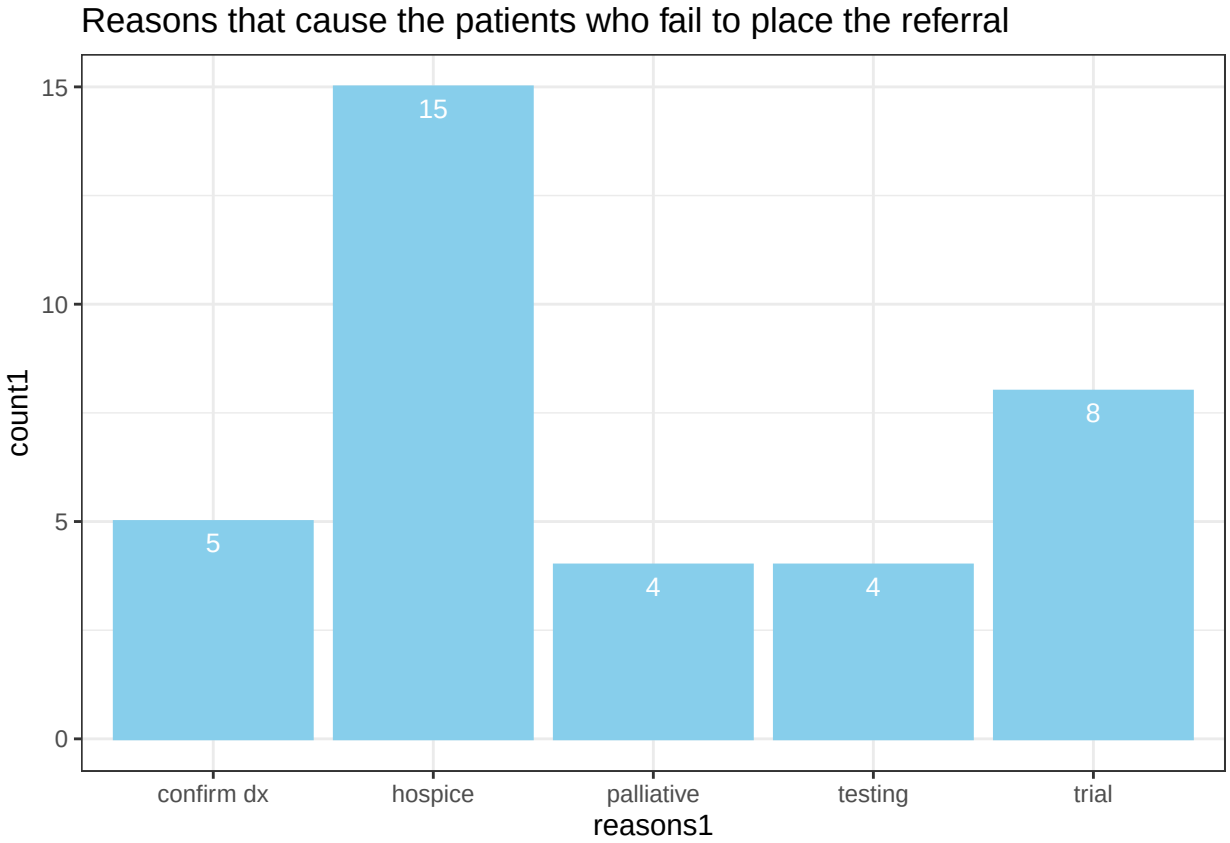

Figure 6: Reasons that cause the patients who fail to place the referral

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

We next explore the reason that causes the patients to fail to schedule genetic meetings and the bar plot shown below. The graph shows that the main reason is 'no response by call/mail' that about 9 patients (27%) fail due to this reason. The resting patients fail to schedule genetic meetings caused by 'never contacted' (9%), 'never schd' (9%), 'not addressed' (15%), 'passed' (15%'), and 'pt declined' (18%).

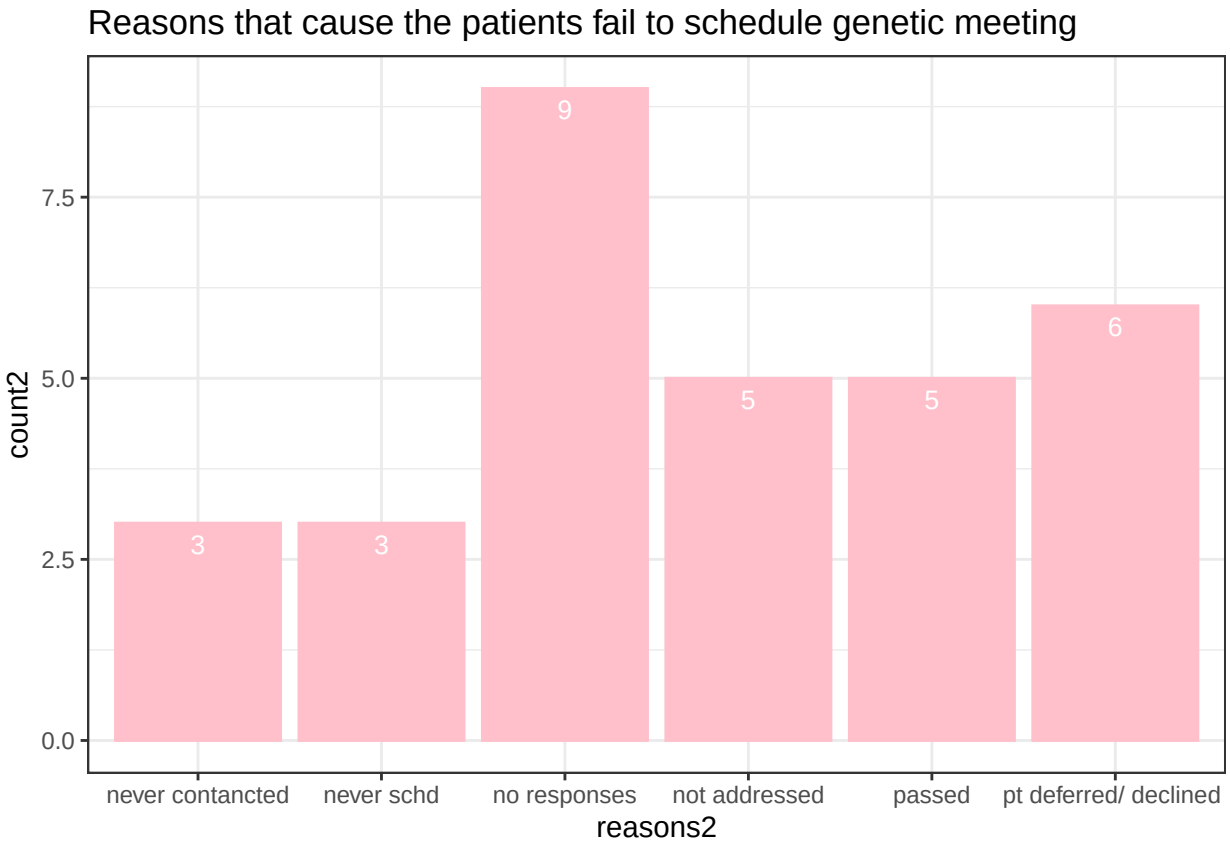

Figure 7: Reasons that cause the patients who fail to schedule genetic meeting

Appendix

In the appendix part, we include the code about how we calculate the ratio above. And here are the encoding method for the plots aboves.

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

The bar plots below 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 the bar plots below presents the relationship among patients in diversity of ECOG status and the referral rates in acceptance and rejection groups.

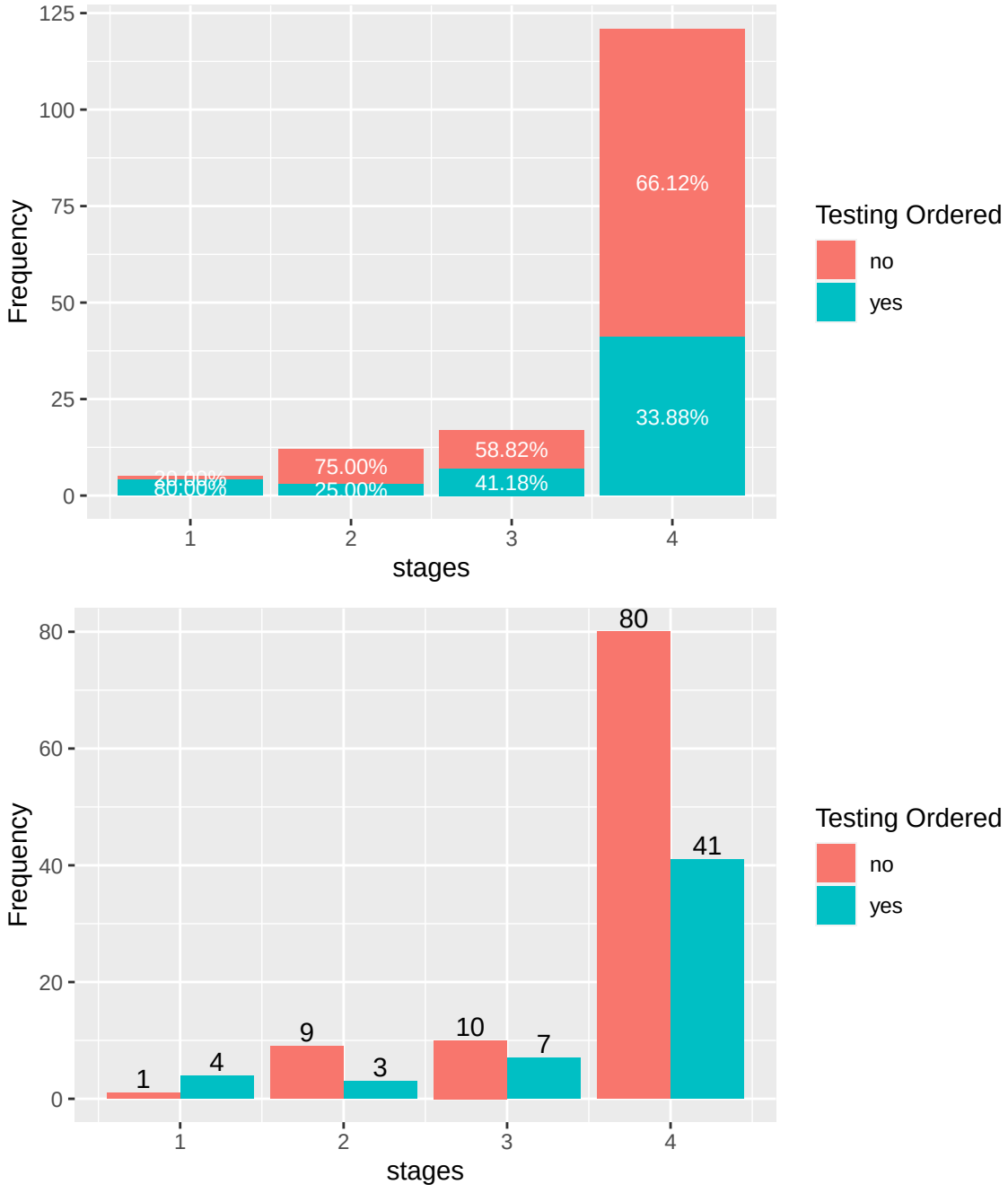

Figure 8: Proportion of patients who order test in each cancer stage

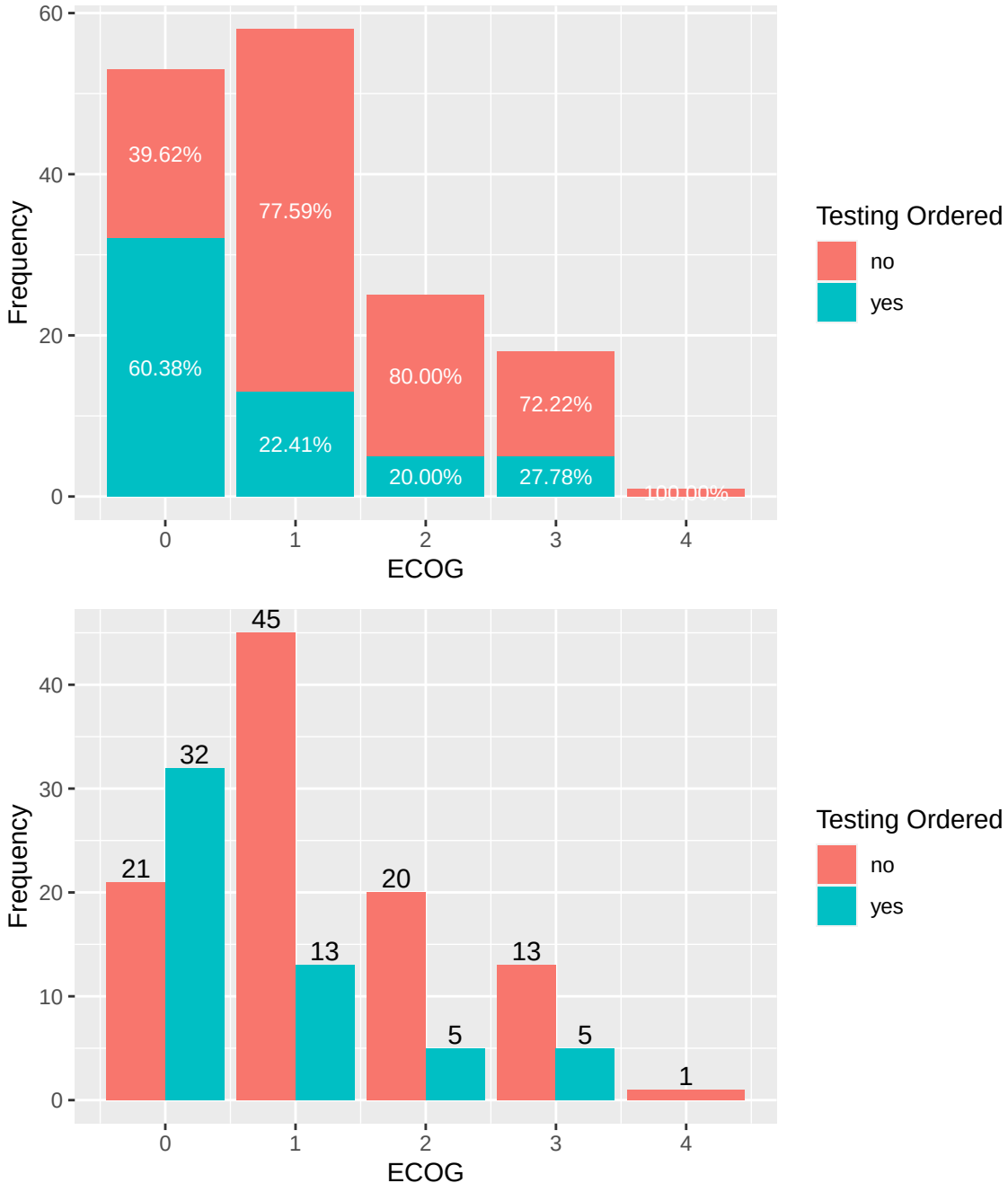

Figure 9: Proportions of patients who order test in each ECOG level